In Search of the Present State of Nuclear-energy-use, Cost comparison, and the Developing Country Context with some Highlights on Bangladesh*

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Summary

Nuclear power was first commercially generated in 1954 in Russia using a small 5 MW plant. It is projected to increase to 17% share of the world's electricity production by 2020. Skyrocketing prices of fossil fuel has turned the balance of competitiveness between fuel bas power and nuclear power against the former. The world now is to witness an upcoming renaissance in nuclear power generation with participation in the race by most of the countries. Those who still, oppose use of nuclear power form but a thin minority.

At present there are 439 nuclear power reactors on earth scattered over 31 countries; the number is projected to rise by 200 to 400 more plants during the next quarter century. Presently dependence on nuclear energy for power varies from zero to eighty percent. France, has proved to be the smartest among the world community by being successful at achieving power security through the nuclear route; after meeting 80 percent of domestic power needs she exports some amount of nuclear power to other European countries. The saying that a stitch in time saves nine has been amply justified in the case of France, which recognised its economy's vulnerability to oil price shocks saying, "We have no coal, no oil, no gas, we have no choice." By all indications France will come out almost unhurt of the ongoing oil price crisis.

Nuclear fuel, uranium-235, is derived from uranium ore. The latter is about abundant in supply worldwide, uranium-235 forms only 0.7% of the raw ore and has to be derived through sophisticated scientific methods. Uranium is cheap, and unlike fossil fuel has no alternative use.

Of late many developing countries have joined the nuclear community, which in the past used to be the developed countries's profligacy not unlike most other advanced scientific initiatives. Among the developing countries, India, China,

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Pakistan, Indonesia, Vietnam have made remarkable progress at the nuclear energy front. Bangladesh, which took the "stich" even earlier than "in time" has handled matters badly to end up being bankrupt. Since its leadership historically has tendencies to manage matters somehow upto election, and since power plants deliver benefits only in the long run, Bangladesh has now to so reap the fruit as it sowed, i.e., suffer. Immediate recourse to nuclear route might to some extent relieve the woes in the medium run and significantly in the long run. The current decade is said to be witnessing an upcoming renaissance of nuclear energy

Given the state of development of alternative energy technologies and skyrocketing fossil fuel prices, countries like Bangladesh probably hardly can afford to ignore the nuclear route.

"Nuclear energy policy is a national and international policy concerning some or all aspects of nuclear energy, such as, mining for nuclear fuel, extraction and processing of nuclear fuel from the ore, generating electricity by nuclear power, enriching and storing spent nuclear fuel and nuclear fuel reprocessing".

The first nuclear power plant in the world with an output capacity of only 5 MW, aimed to generate power for commercial use was commissioned in Russia in 1954. On 1 April 2008 the world's nuclear plants numbered 439, scattered over 31 countries with a total installed electric net capacity of about 372 GW. Table-1 shows distribution of nuclear plants along with installed capacity of power generation worldwide. http://www.pur.com/pubs/4198.cfm)[1]

According to IAEA, nuclear power is projected to increase to 17% share of the world's electricity production by 2020. The spectacular progress in the nuclear power sector, however, has not been smooth over time. Rather there has been ups and downs in the number of nuclear power plants as well as generating capacity since the very early days of inception of the technology, with particular troughs being associated with the years in late 1970s and early 1980s.

Growth of nuclear power slowed down in the 1980s due to the following factors:

(1) Chernobyl disaster and the Three Mile Island accident, (2) environmentalist opposition, (3) fall in fossil fuel price in the early 1980s.

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1 Nuclear- power- generation during the recent years has enormously increased. For example, in the U.S. it has been an all-time high for the fifth year in a row in 2002. Also, nuclear power plant capacity expansion rate (90 percent in 2002) is higher than any other form of energy generation capacity (US).

Interest in nuclear energy revived globally as the world is increasingly being faced with dwindling oil reserves and rising concern about global warming. Also nuclear plants now can be built on time and budget thus allowing for a reliable source of energy at stable price. Nuclear energy production emit little greenhouse gas.

According to the World Nuclear Association (WNA), in most industrialized countries today new nuclear power plants offer the most economical way to generate base-load electricity.[2] WNA also observes that governments now are increasingly turning to nuclear power to achieve: (1) national goals of price stability and energy security; and (2) global goals of environmental preservation through reduced carbon emissions.

Opponents of Nuclear Energy

Until now however there remains significant opposition to nuclear energy. Countries generally opposed to it include Australia and NewZealand and there prevail large number of anti nuclear lobbies in almost every country on earth. The opponents, still are highly concerned about accident-risks[3] associated with nuclear plants and strongly disapprove suitability of nuclear energy[4] and argue that with appropriate program of energy research it is possible to reduce energy use per unit of economic output to as low as one-tenth present levels within a few decades[5].

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2 Base-load is the minimum level of demand on an electrical supply system over 24 hours: the load that exists 24 hours a day. These plants run at all times through the year except in case of repair or scheduled maintenance. For typical power stations the rule of thumb is that the base load power is usually 35-40% of the maximum load during the year..

3 **Accident Risks:** Proponents of nuclear energy however advance the following kind of argument about accident risks. Per amount of electricity produced, hydropower causes 110 fold, coal, 45 fold and natural gas 10 fold more deaths than nuclear power. Failure of the Teton dam on a tributary of the Snake River near Idaho Falls in 1976 killed 14 people. The Machu Dam In India killed 2500 people when it ruptured in 1979. Third generation reactors reduce possibility of core meltdown accident from a likelihood of 1 in 20,000 to 1 in 800,000 per reactor year. (Donald W. Miller, Jr. MD). Technological progress also has made possible non-repeat of any Chernobil type accident.

4 The West knows the costs of uranium fuel well. This is especially so in the Colorado Plateau, which is dotted with about two hundred million tons of radioactive mill tailings and possibly a comparable amount of uranium mine waste. These wastes have injured health, polluted precious water supplies, and resulted in billions of dollars in clean-up costs. And the liabilities will extend into the future for tens of thousands of years.

5 For instance, hundreds of millions of poor people still use candles and kerosene wick lamps for lighting because they have no electricity. The amount of light output that they can avail themselves of can be increased a hundred-fold or more without any change in energy input by going to efficient electric lighting.

Table 1 : Worldwide distribution of Nuclear Energy plant and generation Capacity

Country	In Operation		Under Construction	
	Number	Electr. net output MW	Number	Electr. net output MW
Argentina	2	935	1	692
Armenia	1	376	-	-
Belgium	7	5824	-	-
Brazil	2	1795	-	-
Bulgaria	2	1906	2	1906
Canada	18	12589	-	-
China	11	8572	6	5220
Czech Republic	6	3523	-	-
Finland	4	2696	1	1600
France	59	63260	1	1600
Germany	17	20470	-	-
Hungary	4	1829	-	-
India	17	3779	6	2910
Iran	-	-	1	915
Japan	55	47587	1	866
Korea, Republic	20	17373	3	2880
Lithuania	1	1185	-	-
Mexico	2	1360	-	-
Netherlands	1	482	-	-
Pakistan	2	425	1	300
Romania	2	1310	-	-
RussianFederation	31	21743	7	4789
SlovakianRepublc	5	2034	-	-
Slovenia	1	666	-	-
South Africa	2	1800	-	-
Spain	8	7450	-	-
Sweden	10	8974	-	-
Switzerland	5	3220	-	-
Taiwan	6	4921	2	2600
Ukraine	15	13107	2	1900
United Kingdom	19	10222	-	-
USA	104	100356	1	1165
Total	**439**	**371855**	**35**	**29343**

Source: http://www.euronuclear.org/info/npp-ww.htm

Global Energy Consumption

Global energy consumption is growing rapidly and according to estimates, will double by 2030. There will thus arise need for creating some 4700 GWs of new generating capacity during the next two decades. Starting from current global nuclear capacity of 367 GWe, according to WNA world nuclear capacity will expand to a range between 524 and 740 GWe in the next 25 years. These scenarios represent construction of 200 to 400 new reactors worldwide some for replacement and most for generating new capacities. Operating costs of nuclear plants have fallen steadily over the last quarter century as the capacity factor can increase squeezing more and more output from the same generating capacity. Low marginal cost and high degree of price stability and predictability have also provided investors with adequate incentives to consider bulky investment in the sector.

The key development in the "new economics" of nuclear power is that, both costs (construction and operation and maintenance) considered, nuclear power has now become less expensive than fossil and any other form of electricity generation[6]. Calculations demonstrate that nuclear power does not, over the long-term, require subsidy. Governmental measures to stimulate nuclear investment may be extremely well justified in serving geopolitical and environmental aims, but are not required by the fundamentals of long-term nuclear economics.

According to the New York Times, *Today, with oil approaching $150 a barrel, most European countries, which generally have no oil and gas resources, have been forced by finances to consider new forms of energy – and fast* (NYT May 23, 2008).

Countries Reentering Nuclear Energy Club

The recently observed renaissance of nuclear energy may be attributable to the reentrance of some countries into the nuclear paradigm and also reinforcement of nuclear energy policy by most other countries that had not formally abandoned nuclear energy generation but slowed down investment in the sector.

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6 Limitations of Wind and Solar Technologies: Wind energy is cheaper but is limited to small generator size, need many towers, need expensive energy storage equipments, and vulnerable to stormy weather. Solar requires special materials for mirrors/panels that can affect environment. Large amount of land is required for solar panels. Also, the New York Times comments, *New green technologies, like solar power, wind and bio-fuel, cannot yet form the backbone of a country's energy strategy, and it is not clear that they will ever achieve that level. (New York Times, May 23, 2008)*

Italy announced recently that within five years it would resume building nuclear power plants, two decades after a public referendum banned nuclear power generation and deactivated all nuclear power plants. Cosiderations that induced Italy change her mind include, skyrocketing fossil fuel price, energy security, and warming effects of carbon emission from fossil fuel.

Enel, the Italian Power giant has been researching so-called fourth-generation nuclear reactors, which are intended to be safer and to minimize waste and the use of natural resources

The United Kingdom recently gave okayed a new wave of nuclear power stations. Most of the country's 19 reactors — which provide nearly 20 percent of the United Kingdom's electricity — **are set to close by 2023**. By approving the new power stations, London is supporting nuclear energy as a clean source of power and a means of reducing greenhouse gas emissions (http://www.stratfor.com/analysis/global_market_brief). However, rising oil and gas prices have put pressure on UK consumers, and over the longer term with decline in the UK's North Sea oil reserves the country might be compelled to embolden further nuclear energy policy. Already she is importing from France electricity generated by nuclear power plants.

The United States passed an Energy Policy Act in 2005 that empowers the Secretary of Energy to provide loan guarantees for up to 80 percent of the costs of innovative technologies that avoid reduce or sequester air pollutants or anthropogenic emissions of greenhouse gases. According to the the president of the Nuclear Energy Institute, "The administration correctly anticipates a new era of plant construction, as part of a diverse electricity production mix that meets the need for clean affordable and reliable energy."

Countries the Depend Heavily on Nuclear Energy

Available data shows that some countries are very significantly dependent upon Nuclear energy. France, Lithuania, Belgium, Slovakia, Sweden, Ukraine, Korea and the USA are a few examples.

As table-2 indicates, France, which has 59 reactors, depends on nuclear energy for 80 percent of total energy used by her. Moreover France also exports to the UK a significant amount of nuclear electricity. In the words of the French, "We have no coal, we have no oil, we have no gas, we have no choice."Most of the countries included in the table depend for fifty percent or more of their energy needs on nuclear energy. US's overall dependence is 20 percent, although the state

Table 2 : Countries Heavily Dependent on Nuclear Energy

Country	Year	% Dependence	Data Source
France	2007	80	www.msnbc.msn.com/id/16554514/
Lithuania	2004	80	http://www.martinfrost.ws/htmlfiles/chernobyl_disaster
Vermont (USA)	2006	75	http://www.american.com/archive/2008/january-february-magazine-contents/power-surge
Belgium	2007	58	http://www.pahrumpvalleytimes.com/2007/Nov-09-Fri-2007/news/17798696.html
Slovakia	2003	57	http://www.eoearth.org/article/Energy_profile_of_North-Central_Europe
Sweden	2006	50	http://www.nytimes.com/2006/08/05/world/europe/05sweden.html
Ukraine	2006	50	http://www.american.com/archive/2008/january-february-magazine-contents/power-surge
USA	2007	20	http://www.whitehouse.gov/news/releases/2007/06/20070621.html
Korea	2008	39	http://www.stratfor.com/analysis/global_market_brief

of Vermont meets 75 percent of its energy needs with nuclear energy. Besides, US is the world's largest owner nuclear capacity estimated at 28 percent. France holds the distant second position sharing 18 percent of the total. In Asia, the heaviest dependent is Korea with about 40 percent of total power needs.

Relative Costs of Nuclear Energy

Costs of generating electricity from coal, gas and nuclear plants vary considerably depending on location. Coal is, and will probably remain, economically attractive in countries where the resource is abundant. China, the USA and Australia are such countries. But coal involves costly carbon emissions. Gas is also competitive for base-load power in many places, particularly using combined-cycle plants. But gas prices have been rising fast world -wide.

Cost Comparison

Costs of nuclear energy production consists of internal and external costs. Nuclear energy is the only kind of prevailing energy that internalises most of the costs

associated with it. These costs include cost of waste management—preservation and disposal—and decommissioning the plant at expiry of lifespan[7]. Thus nuclear energy cost includes all the costs of building a plant, which involves cost of the sophisticated building materials, costs of land and relocation, labor and technician compensation, costs of fund, etc., and fuel costs, and operation and maintenance costs, which, also involves, unlike in cases of most other forms of energy generation, cost of waste management, and finally, the cost of decomissioning the plant.

External costs are the ones that are related to health, environment, and security. Thus the direct radioactive emission from the nuclear plant, its impact on global warming and climate change, likely accidental damages, and likely weapons proliferation by terrorists etc. fall in this category. To arrive at total cost the amount due to the latter has to be added to the above subtotal. As we will see there have been attempts recently to quantify costs attributable to these heads.

Nuclear Fuel

Nuclear fuel is extracted from Uranium. Uranium-235 or Uranium-238, is derived from uranium ore through a sophisticated mechanism of uranium enrichment. Uranium is found in the Earth's crust at an abundance of 2-3 parts per million.[8] Its supply is about 600 times greater than gold and about the same as tin. Uranium-235 forms only 0.7 percent of naturally occurring uranium.

Table 3 : Average US Nuclear production costs, 1981-2003, 2003 cents per kWh

	1981	1985	1990	1995	2000	2003
O&M costs	1.41	1.93	2.07	1.73	1.37	1.28
Fuel costs	1.06	1.28	1.01	0.69	0.52	0.44
Total	**2.47**	**3.21**	**3.08**	**2.42**	**1.89**	**1.72**

Source: FERC4/EUCG5

7 While the costs of waste management are external to other power supply technologies, they are internal to nuclear power generation costs.

8 Price of uranium in early 2008 was around $165/kg, after peaking at over $300/kg in 2007. The world's present availability of uranium is about 600 times greater than gold and about the same as tin. At current level of consumption the known reserves amount to 85 years supply with an expected further 500 years supply in additional or speculative reserves. There exists around 4000 million tons of uranium in sea- water, which can now be extracted at a cost of $900/kg. This cost may fall to $127/kg with improvements in technology. Also uranium-238, which fuels breeder reactors to produce plutonium, are so abundantly available on earth that it can meet world demand for nuclear fuel thousands of years (Cohen :The Nuclear Energy Option, chap. 13).

Unlike fossil fuel, uranium has no other alternative use[9]. A significant aspect of nuclear fuel is that about fifty percent of the fuel costs until now is attributable to enrichment the ore. Also costs arise due to the need for preservation and final disposal of the radioactive spent fuel.

The fuel's contribution to the overall cost of the electricity produced is relatively small; so even a large fuel price escalation will have relatively little effect on energy price. **One kilogram of natural uranium will yield about 20,000 times as much energy as the same amount of coal.[10] Another issue of specific significance** regarding nuclear energy generation is the heavy cost of plant installation. Compared to costs of building of coal, oil, or gas fired plants, nuclear plant costs several times higher[11] due to the necessity in case of the latter to use special materials and incorporate sophisticated safety features and back up control equipments. Also the construction period for nuclear plants are relatively longer, which accordingly increases total fund costs[12].

Nuclear's Rising Efficiency

Nuclear power generation worldwide has seen significant increase in efficiency. Table (—) shows in US both fuel and maintenance and operating costs have declined during years since early 1980s. Between 1981 and 2003, overall production cost per kWh declined by over 30 percent and fuel costs by nearly 60 percent. Spectacular efficiency gains have been achieved by Spain where electricity cost fell by 29 percent the five years since 1995. External costs of nuclear energy are by far lower than that of fossil fuel.[13]

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9 Coal , oil, and gas are the principal inputs of plastic and organic chemicals, such as fertilizers. Their supply thus is crucial for the expanding civilization.

10 Transport cost is another area in which nuclear energy cane realise economy. According to an estimate a 1000 mw nuclear plant can run 1.5 years with such a load of nuclear fuel as can be carried by seven 16-tons trucks in a single trip. Operation of a coal plant capable in turn of generating the same output would require a train of 89-100 tons coal cars each run every day. www.nucleartourist.com/basics/why.htm \

11 **Capital costs contributed 60% to nuclear's power price but only 20% to gas's.**

12 In Asia construction times have tended to be shorter, for instance the new-generation 1300 MWe Japanese reactors which began operating in 1996 and 1997 were built in a little over four years, and 48 to 54 months is typical projection for plants today.

13 Total amount of co2 emitted by a nuclear plant per kw-hr is 3.3 grams. In contrast co2 output from natural gas and coal per kw-hr electricity are respectively 400 and 700 grams. **nuclear**info.net/**Nuclearpower**/TheBenefitsof**NuclearPower**. One estimate of external costs (http://www.world-nuclear.org/info/inf02.htm) which considers emissions, dispersion and ultimate impact including the risk of accidents and radiological impacts shows nuclear energy cost on average 0.4 euro cents/kWh, coal and gas cost respectively in the ranges of 4.1-7.3 and 1.3-2.3 cents. Only wind energy is cheaper than nuclear and hydro costs the same under the estimate.

Table 4 : OECD Electricity Generating Cost Projections for the Year 2010 0n - 5% Discount Rate

	Nuclear	coal	Gas
Finland	2.76	3.64	-
France	2.54	3.33	3.92
Germany	2.86	3.52	4.90
Switzerland	2.88	-	4.36
Netherlands	3.58	-	6.40
Czech Rep	2.30	2.94	4.97
Slovakia	3.13	4.78	5.59
Romania	3.06	4.55	-
Japan	4.80	4.95	5.21
Korea	2.34	2.16	4.65
USA	3.01	2.71	4.67
Canada	2.60	3.11	4.00

US 2003 cents/kwh, Discount rate 5%, 40 year lifetime, 85% load Factor.

Source: OECD/IEA NEA 2005

When these costs are taken into account, the EU price of electricity from coal would double and that from gas would increase 30%. And the cost of global warming has not been included in these accounting. http://www.world-nuclear.org/info/inf02.html

Cost Projections

At 5% discount rate nuclear, coal and gas costs are as shown above and wind is around 8 cents. Nuclear costs were highest by far in Japan. Nuclear is comfortably cheaper than coal in eight of ten countries, and cheaper than gas in all.

A Finnish study in 2000 also quantified fuel price sensitivity to electricity costs:

It shows that a doubling of fuel prices would result in the electricity cost for nuclear rising about 9%, for coal rising 31% and for gas 66%.

See also the December 2005 World Nuclear Association report (pdf 310 kB) The New Economics of Nuclear Power.

The **French Energy Secretariat in 2003** published updated figures for new generating plant. The advanced European PWR (EPR) would cost EUR 1650-1700 per kilowatt to build, compared with EUR 500-550 for a gas combined cycle

plant and 1200-1400 for a coal plant. The EPR would generate power at 2.74 cents/kWh, competitively with gas, which would be very dependent on fuel price. Capital costs contributed 60% to nuclear's power price but only 20% to gas's.

4. Nuclear Power in the Developing Countries in Asia

It is now the new Asian Age

In Asia nuclear power is growing significantly.

In East and South Asia there are over 109 nuclear power reactors in operation, 18 under construction and plans to build about a further 110.

Table 5 : Nuclear Power in Asia, and Involvement with Nuclear Fuel Cycle

Country	Power Reactors in Operation	Power Reactors Under Construction	Power Reactors Planned or Proposed	Research Reactors	Others Stages of the Fuel Cycle
Australia				1	UM
Bangladesh				1	
China	10	5	63	13	UM, C, E, FE,
India	16	7	19	5	UM, FE, R, WM
Indonesia			4	3	FF
Japan	55	2	12	17+1	C, E, FF, R, WM
S. Korea	20	1	7	2	C, FF
N. Korea			1	1	C?, FF,
Malaysia				1	
Pakistan	2	1	4	1	UM, E, FF
Philippines				1	
Thailand				1+1	
Vietnam			2	1	
** Total	109	18	112	56*	

**54 operable, 2 under construction*

*** The total includes 6 reactors in operation, plus two under construction, on Taiwan. It also has four research reactors. Taiwan has mo other stages of the fuel cycle.*

Key: UM uranium Mining, C Conversion, E Enrichment, FF Fuel Fabrication, R Reprocessing, WM Waste Management facilities for spent fuel away from reactors.

Source: Asia's Nuclear Energy Growth & World Nuclear Association Feb. -2007.

Table-5 describes the Asian countries' nuclear status. Aside from Korea and Japan all the other countries are developing ones. The greatest growth in nuclear generation in the up coming years is expected in China, Japan, South Korea and India.

Japan generates 29% of its electricity from nuclear power. Its long term plans are to double nuclear capacity (to 90 GWe) and nuclear share by 2050.

South Korea meets 45% (39% according to another source) of its electricity needs from nuclear power, and her dependence on the source is increasing.

The national plan is to expand to 28 nuclear power reactors, including advanced reactor designs, and achieve 60% nuclear supply by 2035.

China's National plans call for 40 GWe by 2020, requiring an average of 2000 MWe per year to be added. A longer-term goal is 240 GWe by 2050. (World Nuclear Association : Asia's Nuclear Energy Growth, Feb, 2007) http://www.world-nuclear.org/info/inf47.html)

India generates 2.8 Gwe in its 15 reactors. It has as of 2005, 8 plants under construction and 24 planned for. It also has five research reactors. Nuclear power currently supplies less than 4% of electricity in India.

Pakistan generates almost 3% of its electricity by nuclear reactors. The government plans 0.9 GWe of new nuclear capacity by 2015, and a further 7.5 GWe by 2030.

Indonesia has three research reactors. In 2005 the government confirmed in principle approval of four 1000 MWe units with a view to commissioning in 2016.

Interest by Thailand in nuclear power was revived by a forecast growth in electricity demand of 7 per cent per year for the next twenty years. There is one research reactor and another is being built.

In Vietnam, there is one research reactor.

In February 2006 the government announced that a 2000 MWe nuclear power plant would be on line by 2020.

More than half of its power comes from hydro, a quarter from gas

The Philippines has one research reactor. Besides, it has one power reactor completed but left abandoned due to political tension related to its establishment. Recently the government is planning to turn the abandoned plant operational.

Bangladesh has one research reactor. It has plans to build a 600 MWe reactor and in 2005 signed a nuclear cooperation agreement with China.

For the developing countries now the question is not whether or not to go for nuclear energy generation but to resolve how fast and to what extent they will go nuclear. Keeping one's own door closed will make no sense in this regard.

Bangladesh Context

The World Bank in July 2006 estimated that Bangladesh needed 10 billion dollars in investment for its electricity supply in the next decade.

But for the country's leaders the priority was to somehow manage the situation till the next elections were held.

Recently, Dhaka also succeeded in getting the green signal from the International Atomic Energy Agency (IAEA) for the construction of a nuclear power plant in Pabna. The country plans to set up a 600-1000 MW nuclear power plant by 2015, which is estimated to cost between US $1 and 1.5 billion

A vivid account of the woes of Bangladesh's power crisis can be found in an October 2, 2006 report of the Wake Up Singaporeans (http://simontay78.wordpress.com/2006/10/02/bangladesh-deepening-power-crisis/).

To quote, *The country has a daily demand for over **5,000MW electricity** while the production **deficit is more than 1,500-2200MW**. As 19 power generation units remain shut down, the country is reeling under perennial power cuts with daily power supply shortfall exceeding 2200 megawatts (MW) — the highest power shortage in the country ever. ...*

The government failed to install any new power project in the last five years except for the 80 MW Tongi power plant which remains shutdown most of the times due to its sub-standard quality. In contrast the government in the last five years has doubled the number of power consumers — mostly in the rural areas. The Executive Committee of National Economic Council (ECNEC) approved different power distribution projects worth Tk 20.00 billions recently — but none related to power generation. One of these projects specifically target at increasing power consumers by another 1.0 million. ...

The country currently has about 8.5 million power connections covering around 50 million consumers. Five years ago, this number was around 5.0 million connections. In 2002, the country generated 3100 MW power and stayed even

with the demand of 3100 MW. Now in 2006, the country generates 3300 MW of power even though its number of consumers has nearly doubled. ...

Rooppur Nuclear Power Project conceived in 1961. Land for the plant (105.30 ha) and the residential colony (12.15 ha) was acquired and the people affected were compensated and rehabilitated. Reactor suppliers from USA, Canada, Sweden, USSR and Belgium submitted proposals for the supply of reactors. A Canadian nuclear plant, originally proposed for Rooppur, was in 1965 implemented in Karachi.

For the nearly half a century since then Bangladesh's approach to nuclear energy production can be likened to such backward and forward movements as nullify each other. The country is yet to find a single megawatt of electricity from the said source.

This long period has been taken by the following kind of jobs. Conducting feasibility study, evaluation of the same and recommendation, to be followed by cancellation, going for new feasibility, appointing consultants, inviting project proposal, proposal evaluation, seeking endorsement of IAEA, searching for credit, obtaining credit approval to be refused finally, etc. Most of the years have been marked by governmental performances aimed to set up Ruppur Nuclear plant. But fruitlessly.

The era of globalisation and privatisation arrived in this process. Such modes of production as BOO, BOOT etc. began to become more and more familiar. http://banglapedia.search.com.bd/HT/R_0218.htm

In this type of mode, no investment on the part of the government will be necessary, although a contract is required to be signed to ensure the sale of electricity at a price according to the terms and conditions to be agreed upon between the government and the owner of the plant. In 1997 the government decided to build the Rooppur Plant on this ***unwise*** concept. After about a decade a nuclear cooperation agreement with China was signed in 2005. Then in 2008 we are told that China has shown interest to build Rooppur nuclear power plant.

Cost Comparison: A 1000 mw nuclear reactor now costs $1.5 billion (http://en.wikipedia.org/wiki/Metsamor_Nuclear_Power_Plant). Assuming a life span of 60 years which latest technology allows for, annual fixed cost on simple arithmatic basis comes about $25 million. On the basis of construction cost of $1 billion, Westinghouse-claimed price for its AP The proposed Haripur 360 Mw Combined Cycle Power Plant for example is supposed to cost Taka 29205 million (BPDB, 2007). At this rate a thousand mega watts would cost $1.16 billion. Add

to it cost of gas and consideration of life span.[14] Under this scenario nuclear is readily cheaper. Think about the prospect of gas becoming prohibitively expensive and new innovations being concentrated, as now, on nuclear sector alone. Also the resource base of nuclear energy, uranium and thorium –has no competing application unlike fossil fuel.[15]

Bangladesh is the world's most densely populated country. Agricultural land here is extremely expensive and becoming more so fast. Thus while considering commissioning of coal powered power plant, the likely damaging effects of coal mining as well as coal burning on agricultural land in particular and environment and public health in general should be accurately fed into concerned benefit cost accounting[16].

Concluding Recommendations: Waste disposal

Disposal personnel encapsulate nuclear waste in the US in fireproof, water-proof, and earth-quake-proof boron-silicate glass or ceramic and then bury these now effectively non-radioactive artificial rocks deep under ground. In Finland's Eurajoki nuclear waste will be stored at a maximum depth of 520 meters in shifts bored deep into the granite bedrock. We recommend UN-led approach to nuclear waste management on global basis in the Finnish manner.

Armenia is currently discussing the issue of constructing a new nuclear power plant of 1,000 MW, with a projected cost of $1.5 billion dollars. http://en.wikipedia.org/wiki/Metsamor_Nuclear_Power_Plant

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14 While a fossil fuel plant lasts between 20 and 30 years, (e.g., the Meghnaghat CCGT power plant is intended to be delivering output for 22 years), nuclear plants last upto sixty years according to the present technology.

15 Given the circumstances, Bangladesh also needs to be utmost conservative as regards using the available stock of fossil fuel considering the necessity of meeting a large number of heads of demand.

16 Other recommendations is include tapping of Nepal's hydroelectric potential. It is argued that Nepal has huge hydroelectric potential, which it can exploit not only to meet its own power deficits, but also to export to the neighboring countries. We are of the view that Nepal's hydroelectric potentia, if is exploited fully, can go some way but not very far to meet the regions energy deficits. According to some estimates Nepal's yet-to-be exploited hydroelectric potential is 43 GWs.

17 According to another study India's present electricity supply of 143 GW will have to be increased five-fold to over 700 Gws in the next 25 years to meet rising demand commensurate with expected rates of economic growth. Bangladesh's present supply, which is less than 4 Gw, too will have to be raised several fold to meet rising demands. Nepal's unexploited potential thus is much short of what will be the region's demand.

Regional Approach to Power Generation and Sale

Already under the auspices of the SAARC there is an initiative aimed for ensuring regional power security. Under this umbrella the member countries can proceed with some unified approach to nuclear power generation. This way they can realise a vast amount of economy of scale in operation as waste management. Regarding the latter they could also go beyond regional means: they might approach international organisations such as the UN. Given the world scenario, particularly, as regards prices of fossil fuel and state of development of alternative power technologies, the South Asian countries cannot afford to ignore the neclear route[17]. BPDB (2007): New Generation Projects up to 2012, System Planning Directorate, 17.06.07.

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