

Nuclear Energy: Time to revisit the option?

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The Philippines is now at the crossroad. We need a sufficient supply of cheap, safe, and reliable source of energy that will keep the country going in pursuing its goals. We have several choices, namely: hydro, biomass, oil, nuclear, geothermal, solar, etc. Each has its own advantages and disadvantages. They all need large amounts of investments, and intensive studies must be made in the selection of which energy source to favour.

Presently, the Philippines is heavily dependent on oil, natural gas, coal, etc. which are producers of greenhouse gasses. We also have geothermal energy sources, hydro, some solar and some wind energy sources. The government has initiated the use of alcohol and coconut methyl esters as additives or replacements of gasoline and diesel oil, respectively. However, the main problem is the uncontrolled price of oil which has reached US\$100/barrel, something unheard of before. When we were talking of nuclear power in the 70's and 80's, no one ever thought that oil will hit US\$100/barrel. With the present situation, I won't be surprised if one of these days, oil will sell at US\$200/barrel. Since the Philippines is not an oil producing country, we will starve on energy when this happens. For security, we must plan our source of energy strategy.

One of the choices of energy is nuclear energy. This has been with use since the explosion of the first atomic bomb in 1945. Since it was first introduced as a destructive device, it is not easy for us to accept nuclear energy as a useful and beneficial source of energy.

In 2007, 435 nuclear power plants (NPP) operated in 30 countries worldwide, with a total installed capacity of 367,500 MWe. The development of nuclear generating capacities in various regions differs. Growth from 1965 to 1985 was rapid. After 1985, growth in North America, OECD Europe and Eastern Europe was stunted, while in Asia, growth continued.

The reason for the stagnation in the eighties were: energy efficiency improvements, economic restructuring, drop in electricity demand due to excess generating capacity, oil prices collapsed, advent of high-efficient cheap gas turbine technology, little regard for supply security, Three Mile Island and Chernobyl accidents, break-up of the Soviet Union, and high interest rates.

In 2004, 16% of the global electricity generation was supplied by nuclear power plants.

The Regional Primary Energy Consumption Pattern in 2006 is shown in the next slide.

The Annual Incremental Nuclear Capacity Additions and Total Nuclear Electricity Generation is shown in the graph.

One advantage of nuclear power plants is its high availability factor. This is shown in the next slide. An availability factor of over 81% is considered ideal.

If we look at the contribution of nuclear power in electricity generation around the world, the data as of 2005 is shown in the next slide. The highest is France with 78% and the lowest was China with 2%. Several countries are now building or planning to build new nuclear power plants and their contribution to electricity generation will increase.

There is a correlation between HDI (Human Development Index) and electricity use per capita. The data as of 2004 is shown in the next slide. HDI combines indicators of health, education, and economic prosperity. Industrialized countries have an HDI above 0.9 (on a scale of 0 to 1) and per capita energy consumption above 4000 kWe-hrs. Developing countries like China, India, Pakistan and Indonesia, are well below the industrialized country HDI and aspire to advance by rapid economic growth. Energy consumption per capita in the developing world is less than a fifth of that in the developed world. To alleviate poverty, we must help our poor people get access to cheaper electricity.

What is the state of Nuclear Power Today?

- a. **Investment Costs for a 1,000 MWe – comparing coal, clean coal, nuclear, wind farm and natural gas. The most expensive is nuclear.**
- b. **Typical Turn-key Costs – again nuclear is the most expensive**
- c. **Impact of Non-fossil generation on Electricity Rates - These are shown in the next slide. You will note that France, Ireland, and Korea have their electricity rates going down since they have non-fossil generating plants, while the rest of the world are not so fortunate.**
- d. **Levelized Generating Costs of New Facilities – Nuclear is competitive. Data was before oil hit \$100/barrel. Also licenses to operate nuclear power plants have been extended by usually another 20 years. This brings down the cost of electricity produced.**

The next slide shows the effect of doubling the price of the resource, which is applicable today.

The external cost figures for electricity generation in the EU for existing technologies are shown in the next slide. You will see that nuclear is very competitive.

On Global Warming and the Environment, which is the Soup of the Day, Nuclear Power has more advantages than disadvantages. These are summarized in the slide.

Greenhouse gas emissions of nuclear power are the lowest. See slide. Climate change brought about by greenhouse gas emissions will ultimately raise the sea levels by meters. If this is not abated we should think of transferring our capitol city Manila to Quezon City.

The impact of carbon dioxide penalties to be levied upon polluters will make nuclear cheaper than the others as shown in the next slide.

What is the waste generation from fuel preparation and plant operation of various fuels? The information is shown below.

The carbon emissions predicted up to 2030 is shown to reach 6,000 to 10,000 GtC, the main contributors being power and heat

followed by transport and industry. With the coming carbon penalty, the cost of fossil fuels and carbon emitting fuels will increase as shown.

Twenty five years ago, the aim of scientists was to convert petroleum oil into food. There was not enough food within the reach of poor people. Now, we are converting food into energy. If we do not study the problem thoroughly, we may not have enough food and energy. The bio fuel program seeks to convert corn, starches, etc. (food) into alcohol to be used in internal combustion engines. It also aims to convert vegetable oils into methyl esters to be used by diesel engines. What is better is to spend money in converting celluloses to alcohol, something we can not eat. But remember all of these when used produce carbon dioxide and this leads to global warming, which is bad for the environment.

In the future, say twenty five years from now, internal combustion engines may be phased out. Instead we will use hydrogen cells to drive our cars and small utilities. So what will happen to our investment on bio fuels?

Nuclear power has been tested for more than twenty five years and has been found to be cheap, safe, reliable, and environment friendly. Electricity produced by nuclear power can produce hydrogen from water to be used in charging hydrogen cells.

We must revisit the use of nuclear power in the Philippines. Ultimately it will be our main source of power and energy. As a first step let us find out whether the PNRR-1 can be refurbished and used as the first nuclear power plant operating in the Philippines

In summary, I present the following slides:

I hope that this short talk will convince you to give Nuclear Power a try. You will not regret it.

Thank you for listening