CRITICAL ISSUES FORUM

BENCHMARK III

Topic: “Nuclear Renaissance: Risk versus Benefits”

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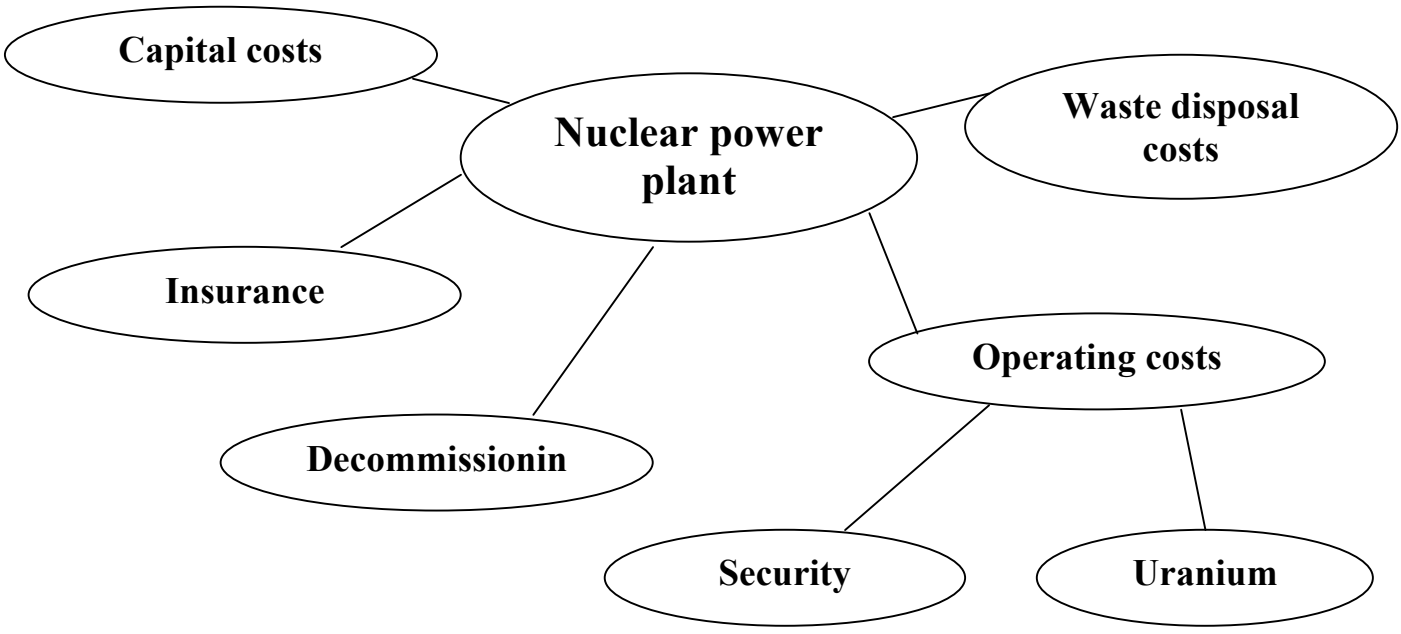
The economic domain

In Benchmark III we are going to demonstrate an understanding of the economic domain of nuclear energy.

The **economics of new nuclear power plants** is a controversial subject. On the one hand capital costs are high, but fuel costs are low. The question about building a nuclear power plant or not is strongly dependent timescales and capital financing. Cost estimates also need to take into account plant decommissioning and nuclear waste storage costs. On the other hand measures to lessen global warming, such as a carbon tax or carbon emissions trading, may favor the economics of nuclear power.

Analysis of the economics of nuclear power must take into account future risk uncertainties associated with construction costs, operating performance, fuel price, and others. Many countries have now liberalized the electricity market where these risks, and the risk of cheaper competitors, are borne by merchant plant suppliers rather than consumers, which can lead to a significantly different evaluation of the economics of new nuclear power plants. **[2]**

The economics of nuclear power plant



Picture 1 **Designed by the authors**

Capital costs

Because of the large capital costs for nuclear power, and the relatively long construction period before revenue is returned, servicing the capital costs of a nuclear power plant is the most important factor determining the economic competitiveness of nuclear energy. The investment can contribute about 70% of costs of electricity. Construction delays can happen (e.g. changes in licensing, inspection and certification) adding significantly to the cost of a plant. Because a power plant does not yield profits during construction, longer construction times translate directly into higher interest charges on borrowed construction funds. Modern nuclear power plants are planned for construction in four years or less (42 months for CANDU ACR-1000, 60 months from order to operation for an AP1000, 48 months from first concrete to operation for an EPR and 45 months for an ESBWR) as opposed to over a decade for some previous plants. However, despite Japanese success with ABWRs, the first EPR (in Finland) is significantly behind schedule.

In Japan and France, construction costs and delays are significantly diminished because of streamlined government licensing and certification procedures. In France, one model of reactor was type-certified, using a safety engineering process similar to the process used to certify aircraft models for safety. That is, rather than licensing individual reactors, the regulatory agency certified a particular design and its construction process to produce safe reactors.

In 2006, *Business Week* magazine stated, "..., the [US] industry is aiming to build new plants for $1,500 to $2,000 per kilowatt of capacity ...». However, they also added, "Trouble is, the cheapest plants built recently, all outside the U.S., have cost more than $2,000 per kilowatt."

To encourage development of nuclear power, under the Nuclear Power 2010 Program the U.S. Department of Energy (DOE) has offered interested parties the opportunity to introduce France's model for licensing and to subsidize 25% to 50% of the construction cost overruns due to delays for the first six new plants. **[2]**

Operating costs

In general, coal and nuclear plants have the same types of operating costs (operations and maintenance plus fuel costs). However, nuclear has lower fuel costs but higher operating and maintenance costs. **[2]**

Decommissioning

At the end of a nuclear plant's lifetime (estimated at between 40 and 60 years), the plant must be decommissioned. This entails Dismantling, Safe Storage or Entombment. Operators are usually required to build up a fund to cover these costs while the plant is operating, to limit the financial risk from operator bankruptcy.

In the United States, the Nuclear Regulatory Commission requires plants to finish the process within 60 years of closing. Since it may cost $300 million or more to shut down and decommission a plant, the NRC requires plant owners to set aside money when the plant is still operating to pay for the future shutdown costs. [2]

Insurance

Insurance for nuclear or radiological incidents in the U.S. is organized by the Price-Anderson Nuclear Industries Indemnity Act. In general, nuclear power plants have private insurance and assessments that are pooled into a fund currently worth about $10 billion. Insurance claims beyond the fund's size would be organized by, and probably paid by, the U.S. government. In July 2005, Congress extended this Act to newer facilities. [2]

Cost per kWh

Factoring in all these issues, various groups have attempted to calculate a true economic cost for electricity generated by the most modern designs proposed.

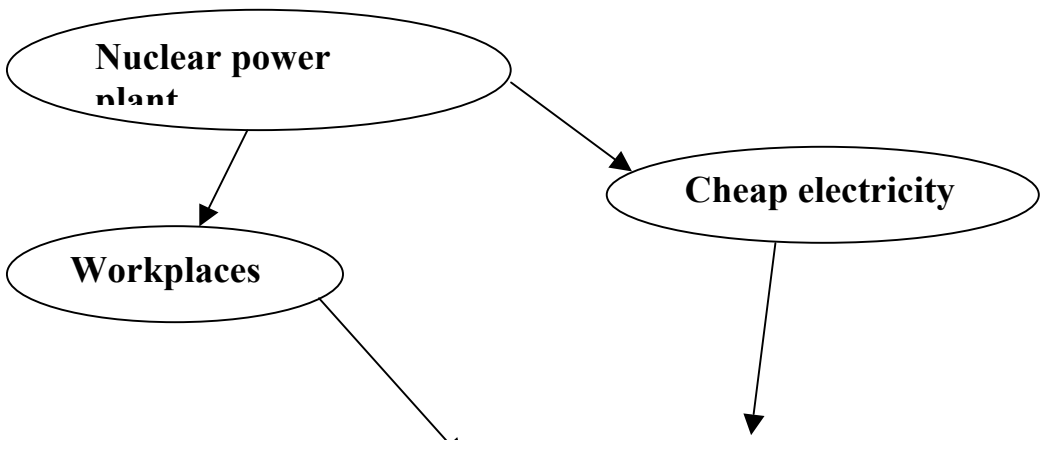
If an actual cost per kWh can be calculated, then it is possible to compare it to other power sources to determine if such an investment is economically sound.

In 2003, the Massachusetts Institute of Technology (MIT) issued a report entitled, "The Future of Nuclear Power". They estimated that new nuclear power in the US would cost 6.7 cents per kWh. However, the Energy Policy Act of 2005 includes a tax credit that should reduce that cost slightly.

The lifetime cost of new generating capacity in the United States was estimated in 2006 by the U.S. government. Nuclear power was estimated at $59.30 MWh. However, the "total overnight cost" for new nuclear was assumed to be $1,984 per kWe – as seen above in Capital Costs, this figure is subject to debate. [2]

Decision-making bodies must operate all these costs.

Nuclear power plant economic impacting



Picture 2
Designed by the authors

Developing countries

A **developing country** is that country which has a relatively low standard of living, an undeveloped industrial base, and a moderate to low Human Development Index (HDI) score and per capita income, but is in a phase of economic development. Usually all countries which are neither a developed country nor a failed state are classified as developing countries.

Countries with more advanced economies than other developing nations, but which have not yet fully demonstrated the signs of a developed country, are grouped under the term **newly industrialized countries**. Other developing countries which have maintained sustained economic growth over the years and exhibit good economic potential are termed as **emerging markets**. The application of the term *developing country* to any country which is not developed is inappropriate because a number of poor countries have experienced prolonged periods of economic decline. Such countries are classified as either least developed countries or failed states.

Development entails a modern infrastructure (both physical and institutional), and a move away from low value added sectors such as agriculture and natural resource extraction. Developed countries, in comparison, usually have economic systems based on continuous, self-sustaining economic growth in the tertiary and quaternary sectors and high standards of living. **[2]**

These countries need **big amount** of **cheap** electricity. So, they used to make electricity from fossil fuels.

Energy price

In the following table you may see the cost of energy (kWh) produced by various types of power plants.

Electricity generation type	Costs (USD cents per kWh)
Wind	4–8 ¢/kWh
Solar photovoltaic	25–160 ¢/kWh
Solar thermal	12–34 ¢/kWh
Large hydropower	2–10 ¢/kWh

Small hydropower	2–12 ¢/kWh
Geothermal	2–10 ¢/kWh
Biomass	3–12 ¢/kWh
Coal	1–4 ¢/kWh
Natural gas	2–4 ¢/kWh
Nuclear	2–6 ¢/kWh

* (alternative)
* (fossil)
* (nuclear)

Picture 3 **Designed by the authors**

The alternative energy is the most expensive type of energy, but it is also the less harmful for the environment of our planet. Scientists suppose that most of the countries will change their preferences in the type of electricity generation during the following 50 years, because the prices of fossil and nuclear fuels are growing too rapidly.

Electricity generation capacity

In the following table you may see power generation capacity of various types of power plants.

Power plant type	Capacity (MW)
Wind	50–250 MW
Solar	1–7 MW
Hydro	1 330–6 400 MW
Geothermal	3–5 MW
Coal	2200–4200 MW

Natural gas	2400–4800 MW
Nuclear	800–1500 MW

* (alternative)
* (fossil)
* (nuclear)

Picture 4 **Designed by the authors**

Fossil and nuclear power plants produce more energy than alternative power plants, but they are more harmful for the environment of our planet. Modern technologies of construction hydropower plants assume even higher level of energy producing than fossil and nuclear power plants use to do.

Conclusion

In reality, for those countries with rapidly expanding economies which have large rivers, there is an alternative to fossil fuel except nuclear energy. It is hydro power. Hydro power has a good price and hydro power plants are powerful enough.

Free market

A **free market** is a market in which prices of goods and services are arranged completely by the mutual consent of sellers and buyers. By definition, in a free market environment buyers and sellers do not force or mislead each other nor are they forced by a third party. The effect of these decisions is described by the natural law of supply and demand. Free markets contrast sharply with controlled markets, in which governments directly or indirectly regulate prices or supplies, distorting market signals. In the marketplace the price of a good or service helps to quantify its value to consumers and thus balance it against other goods and services. In a free market, this relationship between price and value is clearer than in a controlled market. Through competition between vendors for the provision of products and services, prices tend to decrease, and quality tends to increase. **[2]**

Index of economic freedom

The Heritage Foundation, a conservative think tank, tried to identify the key factors which allow to measure the degree of freedom of economy of a particular country. In 1986 they introduced Index of Economic Freedom, which is based on some fifty variables. This and other similar indices do not *define* a free market, but measure the *degree* to which a modern economy is free, meaning in most cases free of state intervention. The variables are divided into the following major groups:

- Trade policy,
- Fiscal burden of government,
- Government intervention in the economy,
- Monetary policy,
- Capital flows and foreign investment,
- Banking and finance,
- Wages and prices,
- Property rights,
- Regulation, and
- Informal market activity. **[2]**

So, nuclear control is an intervention in the economy and decreases an index of economic freedom.

Conclusion

As you can see, sale of nuclear technologies is a controlled part of economy. Nuclear technology market is under control of NRC and other nuclear agencies; we have written some information about them in the previous Benchmarks.
It is regulated by the government's agencies. We don't think that governments violate the premises of a free-market economy.

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