

## *Cost Comparison for Nuclear vs. Coal*

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To accurately compare the cost of nuclear against other energy sources, one must include the following costs:

### *1. Fuel costs*

Costs associated with the fuel used in the production of energy.

For a nuclear plant, these tend to be lower even though the following steps occur in the production of the fuel assemblies used in the reactor:

1. mining of the uranium ore,
2. conversion to  $U_3O_8$  (uranium oxide - yellowcake form),
3. conversion to uranium hexafluoride,
4. enrichment from 0.7%  $U^{235}$  to 2-5%  $U^{235}$ ,
5. conversion to uranium dioxide ( $UO_2$ ) pellets,
6. loading of the pellets into rods, then into fuel assemblies.

Transportation costs are high for coal because of the amount of material needed to generate the same energy as the nuclear fuel.

1. As more nuclear plants are built around the world, one can expect the uranium cost to vary or increase. Since 2000 there has been considerable variation. The [Uranium Exchange \(Ux\) Company](#) website is a good resource for checking out the price variation.

### *2. Capital costs*

Costs associated with initial construction of the plant and the modifications. These end up as embedded costs.

For a nuclear plant these may be higher than for other energy forms because the buildings used for containment or for safety-related equipment must meet higher standards than the traditional structures. Also, safety-related systems are redundant. Such considerations are not important in other energy forms. On the other hand, coal plants are required to include scrubbers to remove airborne pollutants as sulfur dioxide, nitrous oxides, and particulates.

However, these costs are influenced by factors as:

1. When the plant was built (capital costs for plants finished in the 80's were higher due to inflation. Following the Arab oil embargoes in 1973 and 1979, there was considerable emphasis on energy conservation. Also, energy costs rose which had

a significant impact on inflation. Because of the drop in expected energy demand, utilities delayed plants under construction, many of which were nuclear and had long lead times for completion. The debt for the delayed plant still incurred interest charges in times when rates exceeded 15%. Short term interest rates in the 80-81 time-frame was 20%. As with the federal government debt, that total interest kept increasing so that when the plant went on-line, the total cost of the plant was higher than if the plant had been completed on time. Another related factor was that the delays resulted in higher labor costs - the plants were completed when wages had risen because of inflation. Also, following the Three Mile Island event in 1979, the NRC mandated a number of plant design changes for plants coming on line.

2. Major equipment replacements. During the 1980's, many older BWRs replaced the recirculation system piping due to corrosion cracking. Some PWRs have had to replace steam generators. Eventually it is expected that most, if not all, PWRs will have to replace steam generators prior to the end of their NRC operating license. In some cases, plants have upgraded turbine generator units to improve power output.

Capital costs are usually amortized over a period of time as allowed by IRS regulations.

### ***3. Operation and Maintenance costs***

The day to day costs associated with operating the nuclear power plant. This includes the costs of:

1. labor and overheads (e.g. medical and pension benefits),
2. expendable materials,
3. NRC (e.g. license changes, on-site and regional inspectors, and headquarters staff) and state (e.g. health department, emergency planning) fees,
4. local property taxes (varies from state to state).

Labor costs in a nuclear plant include those for operators, maintenance personnel (electrical, mechanical, instrument and controls), health physics technicians, engineering personnel (mechanical, electrical, nuclear, chemical, radiological, computer).

Materials costs include replacement parts, computer parts, expendable office and other supplies.

NRC 1998 fee structure (PR 98-45, April 1, 1998) is:

1. \$2,980,000 per unit for power reactor licensees
2. \$57,300 for nonpower (research and test) reactor licensees
3. \$2,607,000 for high-enriched uranium fuel licensees
4. \$1,280,000 for low-enriched fuel fabrication licensees which manufacture fuel for nuclear power plants
5. \$14,100 for radiographers

- 6. \$23,500 for broad scope medical licensees

In addition, the NRC assesses for license reviews.

Property taxes can result in a plant paying up to \$ 15-20 million per year in property taxes.

**4. Waste-Related Costs**

The costs associated with the byproduct waste. For a coal plant this is ash. For a nuclear plant, these costs include the surcharge levied by the Department of Energy for ultimate storage of the high level waste. The DOE charge is a flat fee based on energy use.

**5. Decommissioning Costs**

The costs associated with restoration of the plant site back to "greenfield" status. Usually restoration would occur over a long period of time, e.g. 20 years. Parts of the plant could be used for energy generation by other sources.

Illustrative cost comparison. The table below compares nuclear versus coal specific item costs for similar age and size plants on a \$ per Megawatt-hour (10 \$/Mw-hr = 1 cent/kw-hr):

Item	Cost Element	Nuclear \$/Mw- hr	Coal \$/Mw- hr
1	Fuel	5.0	11.0
2	Operating & Maintenance - Labor & Materials	6.0	5.0
3	Pensions, Insurance, Taxes	1.0	1.0
4	Regulatory Fees	1.0	0.1
5	Property Taxes	2.0	2.0
6	Capital	9.0	9.0
7	Decommissioning & DOE waste costs	5.0	0.0
8	Administrative / overheads	1.0	1.0
Total		30.0	29.1

A number of factors can affect the annual costs during any given year:

1. How many outages does the plant have - usually 1 per 12 to 24 months. Outages usually mean a lot of maintenance and high labor costs due to working around the clock.
2. How quickly a plant is being depreciated-usually 35 to 40 years
3. When the plant was built
4. NRC regulatory costs are a pass-through from the federal government.
5. Number of capital projects or modifications being done.

For other specific costs and comparisons, please check out the following:

2. [Nuclear Energy Institute - Cost and Performance](#)
3. [Uranium Exchange \(Ux\) Company - Prices](#)
4. [New York & Washington Nuclear Comporations - Nuclear Fuel Prices](#)
5. [Jeffrey Lacruz' Technical Background Report - Discussion of various plant types and cost comparison](#) (partial report)
6. [NRC Cost Comparison \(note-NRC costs do not reflect decommissioning, capital, waste costs\)](#)
7. [Comparison of Fuel, Operations & Maintenance, and Capital Costs as a function of Unit Capacity Factor](#)