Nuclear vs. everything else
-Nirupama Sensharma

The most popular fuel choice is and has always been coal. The reason might be its easy availability, abundance or just the fact that most of the world has been blindly relying on it for over a century now thereby providing it with the dependability factor.

But we often forget that change is the essence of life. It is through change that mankind progresses and allows development to come through. However, at this point it is not just trying something different for fun. The present energy crises demands the world to make a paradigm shift to something which in addition to fulfilling our increasing demands, is also friendly to the environment.

The energy scientists have considered various options that could replace fossil fuels as our primary requirement to run a power plant. Be it hydro, wind, solar or nuclear, every fuel-type comes with a set baggage of merits and demerits. In such a situation, it is often wise to choose the option that has the ability to outnumber all the demerits that the others pose. So far, nuclear power has proved to be that option that has the ability to meet all our demands and at the same time is also cleaner than any other available energy source.

Let's start with a one-on-one comparison of nuclear power and coal in terms of the most important aspects that we need to consider when aiming to use one of these as our energy source.

AVAILABILITY OF FUEL

Carbon atoms of coal or any other fossil fuel burns and combines with oxygen to give energy.

$C + O2 \rightarrow CO2 + Energy$

Burning 1 kg of uranium in a power plant can generate about 950 megawatt of power per day. Whereas, the amount of coal that would be needed to produce the same amount of power is 2,750 tons. As of January 1, 2016, the US Energy Information Administration (EIA) estimated that the amount of recoverable coal reserves in the US is about 255 billion tons.

Considering an energy consumption of about 3,913,000,000 megawatt per year, the present coal reserves in the US might not last beyond a maximum of 30 years. Whereas working with the same statistics, the uranium reserves of about 1,227 million pounds (as in 2008) are enough to last for over 500 years.

It must also be remembered that electricity generation is not the sole purpose of coal. It also needs to be preserved for some other industries like steel and fertilizer.

ENVIRONMENTAL EFFECTS

The energy produced by burning coal or Uranium in the power plant is used to produce steam which runs a turbine and produces electricity. In case of a coal powered plant, the coal used has carbon along with large quantities of sulfur and produces huge amounts of CO2, CO, SO2, SO3, NO2 etc. in the burning process. These gases are called 'greenhouse gases' and lead to global warming and environmental pollution.

The haunting results of global warming are quite common and known to everyone. Reduced rainfall, melting of polar ice-caps, drying of rivers, sea level rising and inundating low-lying coastal areas, acid rains that pollute different drinking water sources, lung diseases and whatnot!

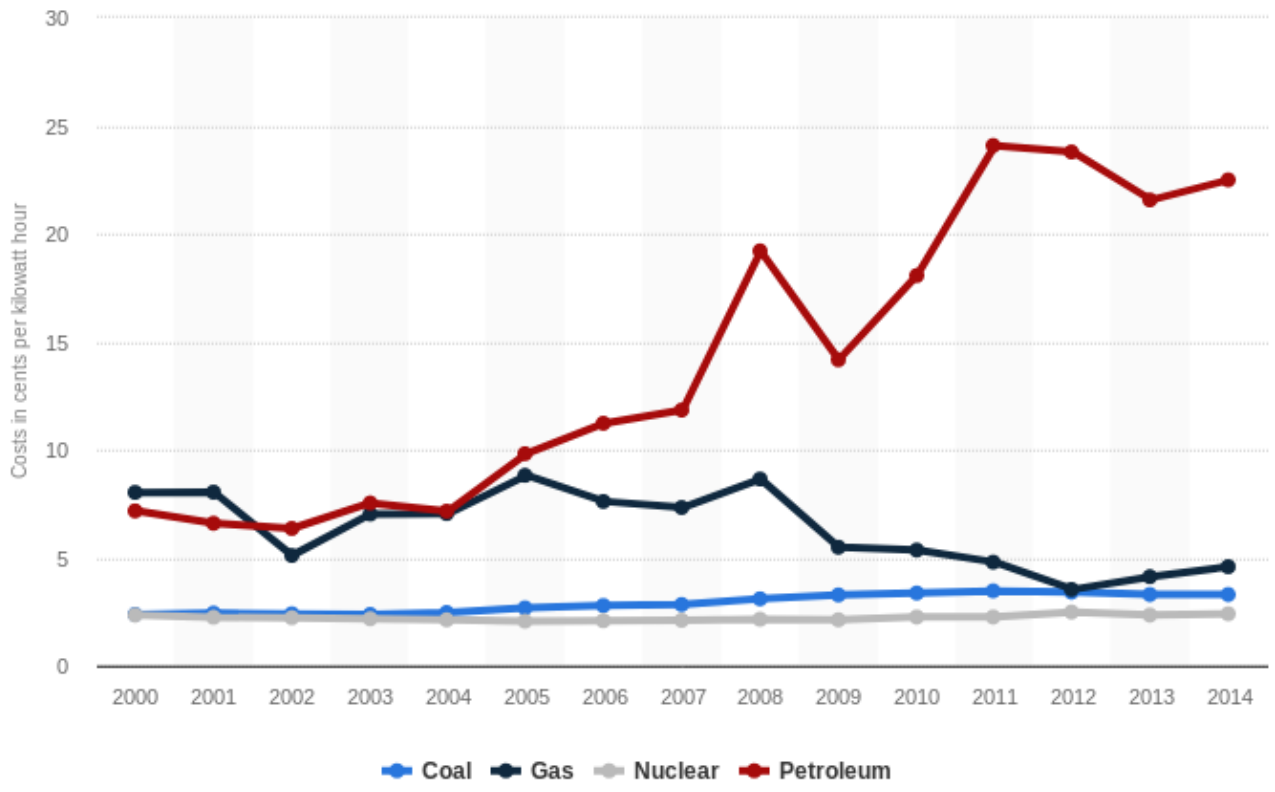
The Union of Concerned Scientists of USA (UCSUSA), in their website, provide some statistics on coal and other fossil fuel powered plants:

(*All figures based on the US Energy Information Administration (EIA) data)*
Coal needed for a typical 500 megawatt Thermal plant → 1.4 million tons/year
Ash produced in the plant →70,000 tons/year
Sulfur oxides produced → 14,100 tons/year
Nitrogen oxides produced → 10,300 tonne/year
Carbon oxides produced → 3.5 million tons/year

These pollutant figures are mind boggling and speak for themselves.

Whereas, the burning of uranium produces no carbon dioxide or any other green house gases. The only carbon dioxide that it releases is during the uranium mining phase which when compared with the coal statistics comes out to be of little importance. All the radiation generated in a nuclear power plant is safely contained within the reactor building by thick lead and concrete shielding all around it.

COST
The cost of electricity has three major components - (1) Fixed cost, (2) Operation and maintenance cost and (3) Fuel cost. For thermal power, the fuel cost varies from 30 – 40% of the total cost while for nuclear power, it is only 8% of the total cost. Therefore if coal price is doubled, the cost of electricity will increase by 40% while for a similar situation, nuclear electricity price will only increase by 8%.



The graph above shows how the US electricity production costs varied from 2000 to 2014 (in cents per kilowatt-hour). Different lines on the figure represent the costs for different fuel types. These statistics were published by the Nuclear Energy Institute (NEI) (U.S. Electricity Production Costs and Components (1995-2014) in 2015. While petroleum showed the maximum price hike with cost of electricity generation going up to 22.49 cents per kilowatt hour in 2014, coal amounted to 3.29 cents and nuclear amounted to only 2.4 cents per kilowatt hour.

Economically, nuclear electricity is more cost effective than thermal electricity. With multiplication of nuclear power plants, the cost of nuclear electricity is set to further go down in future.

ACCIDENT STATISTICS

If danger and accidents are a criteria to choose the kind of fuel to run a power plant, nuclear power should be our top choice. A quick look into Table 1 tells why. It is a list of the accident statistics in energy production comparing between different fuel types published in 1999 by the International Atomic Energy Agency (IAEA).

Fuel	Immediate fatalities (1970-92)	Affected persons	Normalized to deaths per million MWe Yr.
Coal	6,400	Workers	342
Natural Gas	1,200	Workers and Public	85
Hydro	4,000	Public	883
Nuclear	31	Fire fighting workers	8

Table1. A list of the accident statistics in the energy industry, published by IAEA in 1999.

LIFETIME

The designed life-time is 40 years and above for nuclear power plants whereas for thermal power plants, it is limited to 30 years. Because of various reasons like corrosion and erosion, life extension may not be possible for thermal power plants. However with better choice of materials and good maintenance practices, an extension of 10 to 15 years is usually possible for nuclear power plants. As a result, the generation cost beyond the lifetime of the plant will only include the running cost.

LAND REQUIREMENT

For thermal power plants, the land requirement is about 0.5 to 1.2 acres per MWe. However, for nuclear power plants this is just 0.20 to 0.25 acres per MWe. A 1 km radius is usually required for the construction of a nuclear power plant. However, the actual plant occupies only a small percentage of this area. In the remaining area, agriculture and common human activities can go on as usual.

OTHER DIRECT COMPARISONS

Mineral oil and Natural Gas – Whatever reserves of mineral oil and natural gas the world has is better to be used for transport and domestic purposes. Also, it is an equally potent source as coal for environment pollution and emission of greenhouse gases leading to global warming.

Hydel power plants – These plants are environment friendly which however is achieved at the cost of large areas of fertile land being submerged in water. Hydel power plants also create a lot of disturbance in the ecosystem of the surrounding area. Aquatic life as well as any other habitation settled around rivers need to be forcefully displaced.

Wind power – Another environment friendly source of power but is a huge contributor of noise pollution. Also since in most areas, sufficient winds are not available and therefore utilizing wind power for commercial purposes is usually not favorable.

Solar power – Also environment friendly but amounts to a very high cost of electricity. Also putting up commercial solar cells require vast areas of land for maximum exposure to sunlight to be able to produce enough power.

In light of all these arguments, nuclear power does undoubtedly stand out as the best available alternative to all other fuel kinds. There are logical reasons and significant statistics to support it. So when nuclear power is claimed to be a cheaper, greener and a better energy option, it is not just a loosely based claim but a strong and a well-supported fact. And it is high time the world accepts this fact before it gets too late!