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## **ROLE OF NUCLEAR ENERGY AS GREEN FUEL**

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Fuel is a material which is capable of releasing energy when subjected to some chemical change such as burning, or nuclear means, such as nuclear fission or nuclear fusion. An important property of a useful fuel is that its energy can be stored to be released only when needed, and that the release is controlled in such a way that the energy can be harnessed to produce work. The energy released can be utilized for variety of functions like cooking, powering automobiles, weapons ....., generation of electricity etc.

Energy generated from Fuels can be classified into two types: nonrenewable and renewable

Non-Renewable energy is the energy which is taken from the sources that are available on the earth in limited quantity and will vanish fifty-sixty years from now. Non-renewable sources are not environmental friendly and can have serious affect on our health. They are called non-renewable because they cannot be re-generated within a short span of time. Non-renewable sources exist in the form of fossil fuels, natural gas, oil and coal.: (<http://www.conserve-energy-future.com>)

Renewable energy is the energy which is generated from natural sources i.e. sun, wind, rain, tides and can be generated again and again as and when required. They are available in plenty and by far most the cleanest sources of energy available on this planet. For eg: energy that we receive from the sun can be used to generate electricity. Similarly, energy from wind, geothermal, biomass from plants, tides can be used to fulfill our daily energy demands (<http://www.conserve-energy-future.com>)

Over the decades nonrenewable resources have been the most used and in the early part of the twenty-first century, renewable sources have become more popular as nonrenewable sources have begun to be depleted and in particular focus is shifting towards energy generation from Renewable Resources([www.alrtenergy.org](http://www.alrtenergy.org)), ([saveenergy.about.com](http://saveenergy.about.com))



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## **Alternative Energy Resources ([www.alrtenergy.org](http://www.alrtenergy.org))**

Alternative Energy resources are becoming a much bigger deal as the level of fossil fuels remaining on earth slowly depreciates. Another issue is pollution. Eventually we won't be able to use gas and oil in our cars they will run solely on something like solar energy. Things like Hydroelectric power have been around for many many years, just not with such magnitude or demand. There are four main kinds of alternative energy sources, they are:

### **Solar Energy**

Solar energy is used to do various things. For instance, heat, light, and cooling are all very common uses for solar electricity. The solar rays are converted by solar cells that turn the light directly into electricity. This is a very good idea and in no way really pollutes the earth.

### **Wind Energy**

Wind energy is yet another for of alternative energy that has proven that if it can be harnessed, controlled, and used to suit our needs it can be a prominent source of energy. Three Huge blades are mounted on a rotor. These blades are spun by the wind and the rotors convert that into electricity. The rotor and blade is held high in the air by a large pole. This pole has all the equipment in it to transport the energy to the ground where it is then transported to the power plant. After this all that is left to do is send it to the customers

### **Geothermal Energy**

Geothermal Energy is a method which is less used than the previous two. It involves pumping heat and warm water up from the ground and is able to convert it into energy. This can be used nearly everywhere because the first ten feet of ground almost all around the world is able to maintain a pretty constant temperature.

### **Nuclear Energy**

Nuclear power is a source of energy drawn from the radioactive materials and enormous energy are produced. Besides electricity atomic power is used as fuel for marine vessel, heat generation for chemical and food processing plants and for space craft's.

Nuclear energy is a clean, safe, reliable and competitive energy source. It is the only energy source of energy that can replace a significant part of the fossil fuels (coal, oil and gas) which massively pollute the atmosphere and contribute to the Greenhouse effect.



## **Nuclear Energy** ([www.encyclopedia.com](http://www.encyclopedia.com) > Science and Technology > Physics)

Energy cannot be created nor be destroyed but it can be converted from one form to another. Nearly all the mass of the atom is concentrated in a tiny nucleus in the center. The nucleus is composed principally of two sorts of particles: the proton which carries the positive charge and the neutron which is electrically neutral and has a mass slightly bigger than that of proton. Nuclear energy is the energy released from the nucleus of an atom. When nuclear reaction occurs whether fission or fusion, it produces large amount of energy.

During the process, mass gets converted into energy. The relation between mass and energy is given by Einstein's famous formula,  $E=mc^2$ , where 'E' is energy, 'm' is mass, and 'c' is the constant speed of light. In brief, nuclear energy is the energy that is obtained from the splitting of atoms in a process known as 'nuclear fission'.

When the heaviest element, uranium was bombarded with neutrons, it was discovered that instead of inducing radioactivity as did other elements, something different happened. This process was named fission. When fission occurred, not only were two lighter elements and a lot of radiation produced, but also more neutrons. It was clear that these neutrons could in turn also cause fission, producing more neutrons and developing a chain reaction which might spread throughout all the uranium present.

In the fission of uranium 235 nucleus, the amount of energy released is about 60,000,000 times as much as when a carbon atom burns. Most of the energy from fission appears as kinetic energy as the fission products shoot apart and quickly share their energy with their surroundings, thus producing heat. The first reactors to produce a usable amount of power were built at Calder hall in England.

### **Advantages of Nuclear Energy** (: <http://www.conserve-energy-future.com>)

1. **Lower Greenhouse Gas Emissions:** As per the reports in 1998, it has been calculated the emission of the greenhouse gas has reduced for nearly half due to the popularity in the use of nuclear power. Nuclear energy by far has the lowest impact on the environment since it does not release any gases like carbon dioxide, methane which are largely responsible for greenhouse effect. There is no adverse effect on water, land or any habitats due to the use of it.



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Though some greenhouse gases are released while transporting fuel or extracting energy from uranium.

**2. Powerful and Efficient:** The other main advantage of using nuclear energy is that it is very powerful and efficient than other alternative energy sources. Advancement in technologies has made it more viable option than others. This is one the reason that many countries are putting huge investments in nuclear power. At present, a small portion of world's electricity comes through it

**3. Reliable :** Unlike traditional sources of energy like solar and wind which require sun or wind to produce electricity, nuclear energy can be produced from nuclear power plants even in the cases of rough weather conditions. They can produce power 24/7 and need to be shut down for maintenance purposes only.

**4. Cheap Electricity :** The cost of uranium which is used as a fuel in generating electricity is quite low. Also, set up costs of nuclear power plants is relatively high while running cost is low. The average life of nuclear reactor range from 4.-60 years depending upon its usage. These factors when combined make the cost of producing electricity very low. Even if the cost of uranium rises, the increase in cost of electricity will be much lower.

**5. Low Fuel Cost:** The main reason behind the low fuel cost is that it requires little amount of uranium to produce energy. When a nuclear reaction happens, it releases million times more energy as compared to traditional sources of energy

**6. Supply :** There are certain economic advantages in setting up nuclear power plants and using nuclear energy in place of conventional energy. It is one of the major sources of electricity throughout the nation. The best part is that this energy has a continuous supply. It is widely available, has huge reserves and expected to last for another 100 years while coal, oil and natural gas are limited and are expected to vanish soon.

**7. Easy Transportation :** Production of nuclear energy needs very less amount of raw material. This means that only about 28 gram of uranium releases as much energy as produced from 100 metric tons of coal. Since it's required in small quantities, transportation of fuel is much easier than fossil fuels. Optimal utilization of natural resources in production of energy is a



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very thoughtful approach for any nation. It not only enhances the socio-economic condition but also sets example for the other countries.

No doubt, nuclear energy has made its way towards the future but like other sources of energy, it also suffers from some disadvantageous

1. Although not much waste is produced, it is very, very dangerous. It must be sealed up and buried for many thousands of years to allow the radioactivity to die away. For all that time it must be kept safe from earthquakes, flooding, terrorists and everything else. This is difficult.

2. Nuclear power is reliable, but a lot of money has to be spent on safety - if it **does** go wrong, a nuclear accident can be a major disaster. People are increasingly concerned about this - in the 1990's nuclear power was the fastest-growing source of power in much of the world. In 2005 it was the second slowest-growing.

### **Nuclear Power – Indian Scenario**

Solar energy is the energy that we get from the sun. It is the major source of energy among all the nations. It is responsible for growth of plants and indirectly, the existence of all animal life. However, there are major drawbacks related to limited production as well as high costs that don't allow people to use it in a wider scale. What would we do on a cloudy day? We would have to just go without electricity. Some larger businesses have their own solar cell so that they can save money on energy they would normally have to purchase. What about the common man?

Wind energy is used in large farm fields where they can use windmills to provide power for the accomplishment of agricultural tasks has contributed to the growth of civilization. The main catch in this plan is: What if the wind isn't blowing? If the wind isn't blowing then we would have no energy. Of course we could always store it up, but that would be more hassle than it was really worth.



## **INDIA definitely needs better alternative** **India's economic growth is driving its energy consumption**

[www.eia.gov/toc](http://www.eia.gov/toc)

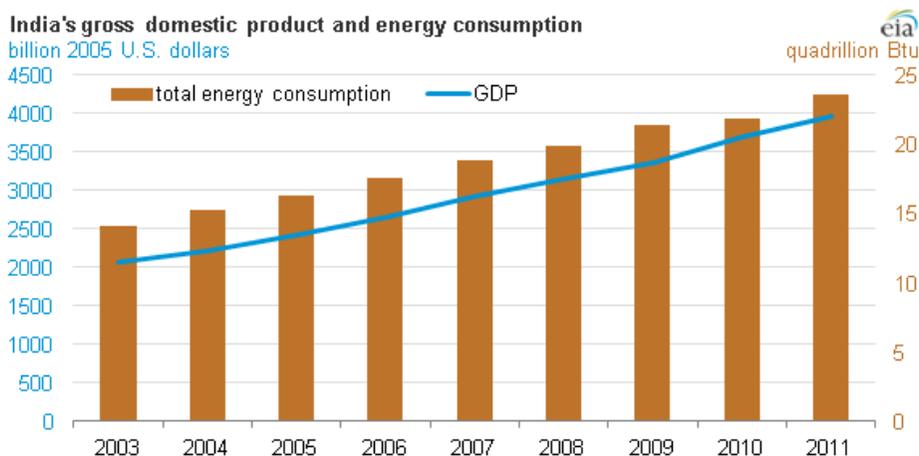


Figure 1

**Source:** U.S. Energy Information Administration, [International Energy Statistics](#), and Oxford Economics.

India is the fourth-largest energy consumer in the world, trailing only the United States, China, and Russia. In 2012 India had the tenth-largest economy in the world as measured in 2012 U.S. dollars (converted at official exchange rates), and the third largest economy in the world when GDP is adjusted for inflation and purchasing power. This inflation-adjusted GDP has grown at over 7% per year since 2000, although it slowed to just over 5% in 2012 according to the Indian Central Statistical Organization. As a result, the growth rate for total energy consumption likely fell from prior-year levels. However, forecasts suggest higher real GDP growth in 2013, which EIA expects to be accompanied with greater growth in energy consumption. EIA projects India and China to account for the lion's share of Asia's energy demand growth through 2035.

India's energy policy is focused on securing adequate energy resources to meet the growing demands of its economy. Primary energy consumption more than doubled between 1990 and 2011. India's dependence on imported energy resources and its inconsistent energy sector reform may make it difficult to satisfy rising demand. Despite its growing energy use,



India's per capita energy consumption remains much lower than that of developed countries, such as the United States.

Other aspects of the Indian energy industry include:

- India has 211 gigawatts of installed electric capacity, mostly in coal-fired plants. Because of insufficient fuel supply, the country suffers from a shortage of electricity generation, leading to rolling blackouts.
- Coal is India's primary source of energy; the power sector accounts for more than 70% of coal consumption. India has the world's fifth-largest coal reserves.
- India was the fourth largest consumer of oil and petroleum products in the world in 2011, after the United States, China, and Japan. India relies heavily on imported crude oil, mostly from the Middle East.
- India became the world's sixth-largest liquefied natural gas importer in 2011.
- India has 20 operational nuclear reactors, with seven more under construction; as electricity demand continues to grow, India plans to increase its nuclear share of generation to 25%, up from 4% in 2011.
- Rural areas in India rely heavily on traditional biomass, as they lack access to other energy supplies. According to the 2011 India census, more than 80% of rural households use traditional biomass (including firewood and crop residue) as the primary fuel for cooking, contrasted with 22% of urban households

**'Economic growth will need massive energy. Will we allow an accident in Japan, in a 40-year-old reactor at Fukushima, arising out of extreme natural stresses, to derail our dreams to be an economically developed nation?'**  
.....A.P.J Abdul Kalam, Srijan Pal Singh (<http://www.thehindu.com>)

The study indicates that most of the prosperous nations are extracting about 30-40 per cent of power from nuclear power and it constitutes a significant part of their clean energy portfolio, reducing the burden of combating climate change and the health hazards associated with pollution. Meanwhile in India, we are not generating even 5000 MW of nuclear power from the total of about 150 GW of electricity generation, most of it coming from coal ([thehindu.com/opinion/op-ed/article2601471](http://thehindu.com/opinion/op-ed/article2601471)).



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As rightly pointed out by all-time great Prof. **A.P.J Abdul Kalam** we and we alone will decide what is the best needed action for our economic prosperity, based on our context and resource profile. We are blessed with the rare, and very important, nuclear fuel of the future – Thorium. We cannot afford to lose the opportunity to emerge as the energy capital of the world, which coupled with the largest youth power, will be our answer to emerge as the leading economy of the world. India has the potential to be the first nation to realise the dream of a fossil fuel-free nation, which will also relieve the nation of about \$100 billion annually which we spend in importing petroleum and coal.

Civilian nuclear applications are to be encouraged, no doubt with proper safe guards.