

# [Indo-us civilian nuclear deal](https://assignbuster.com/indo-us-civilian-nuclear-deal/)

### INDIA’S ENERGY SECURITY WITH SPECIALREFERENCE TO INDO-US NUCLEAR DEAL

“ Consider the past 400 years of history. The world developed a new source of power, steam, and the industrial age came in. India with all her many virtues did not develop that source of power and it became a backward and a slave country. Now, we are on the verge of the atomic age. If we are to remain abreast in the world as a nation which keeps ahead of things, we must develop this atomic energy quite apart from war…of course, if we are compelled as a nation to use it for other purposes, no pious sentiments of any one of us can stop the nation from using it that way.”

– Jawaharlal Nehru, 06 April 1948

### CHAPTER – I

### INTRODUCTION AND METHODOLOGY

The energy security encompasses the oil & natural gas, fuel and electricity. However in the backdrop of Indo-US civilian nuclear deal we are referring to the electrical energy security generated from nuclear sources. The India’s nuclear reactors are fueled by uranium. India’s uranium is low grade and quantity and is about seven times costlier than what’s available in the world market. The Indo – US civilian nuclear deal encompasses the transfer of sensitive technology for reprocessing, enrichment of fuel and importing uranium for generation of electricity from nuclear energy. In recent years, if there is one issue that has been on the headlines at regular intervals besides terrorist attacks in different parts of our country, is the Indo-US civilian nuclear deal. So much so that it was on the verge of bringing down the world’s largest democracy. Never before in the history of independent India where any subject thought about, deliberated, argued and counter argued by the political, bureaucratic and the scientific elites. The main advantage of this deal is that the India not only got the assurance from the world to increase its electricity generating capacity but India can continue its nuclear weapon programme unhindered. The deal also gave strategic advantages to US.

### METHODOLOGY

### Statement of Problem

2. This paper aims to analyse “ Will India be able to fulfill its power demand by 2030 by generating electricity from nuclear power plants in light of Indo-US civilian nuclear deal.”

### Hypothesis

3. The extent of India’s strategic interest has expanded and span from the Gulf of Hormuze up to the Malacca Strait. It implies that India is on the threshold of becoming a regional super power, having a large say in the geopolitical affairs in South Asia. This situation has come about as a result of the economic liberalisation in last decade of the twentieth century, causing the economy to grow at appreciable rates of 7-8 % per year. Economic opportunities in India have made the world sit up and take notice, causing a huge influx of investments in all business and industrial sectors.

4. Given the above situation, India’s electrical energy needs are growing by leaps and bounds, and at a very rapid pace. The sources for generation of electricity to support this unprecedented growth are not adequate. Therefore, it is imperative that India must look for alternative sources to generate sufficient electricity not only to cater for future growth but also to bridge the gap between the demand and supply. This will also help India for realisation of her role as a regional power to satisfy her strategic aspirations.

### Justification of the Study

5. India is concern for energy security in general and electrical energy in particular for its economic development and uplifting the standard of living of its citizen. Indo-us civilian nuclear deal is a step towards to solve India’s energy problem which encompasses the generation of electricity from nuclear energy and transfer of sensitive technology including supply of raw material. But the deal has more strategic and international connotation. If we adopt the perspective of twenty years hence, will India be able to achieve its energy security?

### Scope

6. The scope of this study would be to look into India’s electric energy requirement by 2030, highlighting the electricity generating capacity and gap between demand and supply. Also to analyze the nuclear power plants’ generating capacity in a backdrop of Indo-US civilian nuclear deal with its strategic implications for India. The study would also suggest a way ahead for India to achieve total energy security. Other related issues such as electrification, transmission, distribution, billing, electrical energy conservation and regulatory commissions are not considered in this study.

### Operational Definitions

7. Energy Security.[1] A country’s ability to optimize its energy resource portfolio and supply of energy services for the desired level of services that will sustain economic growth and poverty reduction. It is a broad umbrella covers all type of energy and economic growth.

8. Nuclear Energy and Energy Security.[2] Nuclear Energy is the kinetic energy of the fragments that result from the fissioning or splitting of uranium and plutonium nuclei when they absorb neutrons. The kinetic energy is converted to heat as the fragments are slowed, and this heat is use to convert water into steam which in turn used for rotation of turbine thus producing electricity. This nuclear energy supplements the total energy requirement of our country with an aim to achieve energy security from all the sources including renewable, hydro and coal.

### Methods of Data Collection

9. The major source of data collection has been through library books, journals, articles from magazine & newspaper as well as internet.

Organisation of the Dissertation (Chapterisation)

### 10. The dissertation is organised as under : –

(a) Chapter I – Introduction and Methodology. This chapter introduces the subject ‘ India’s energy security with special reference to Indo-us nuclear deal.’ It also lays down the ‘ Statement of Problem’ providing a justification for the study and defines the scope of dissertation. The chapter also defines security in general and energy security in particular. Energy security encompasses oil, gas and electricity. The focus will be on nuclear power element of electricity/power security.

(b) Chapter II – India’s Electrical Energy Need and Present Status. This chapter brings out statistical data about the present power status in India from all sources including the contribution of nuclear power plants and predicting economic growth vis-a-vis India’s electrical energy needs by 2030.

(c) Chapter III – Nuclear Energy – Its Myth and Reality. This chapter analysis the nuclear power generating capacity by 2030, technology and raw material requirement and its contribution towards achieving energy security. It also covers advantages and disadvantages of nuclear power over conventional sources of power generation.

(d) Chapter IV – Indo-US Civilian Nuclear Deal. This chapter covers India’s nuclear history in brief and Indo-US civilian nuclear deal in detail. It also brings out the stance of International atomic Energy Agency (IAEA) and Nuclear Suppliers Group (NSG). This chapter also highlights the pros and cons and views of political parties in India.

(e) Chapter V – Implications of the Deal. This chapter highlights the strategic implications in terms of economic, geopolitical and military of Indo-US civilian nuclear deal.

(f) Chapter VI – The Way Ahead for Energy Security. Initially India neglected its power requirement and now going for nuclear power. On one hand developed country like Germany is against nuclear power and on other side France in going for it. This chapter covers the analysis of this dichotomy and India’s necessity to go for it. In the end, recommendations for way ahead for India to achieve total energy security.

### CHAPTER – II

### INDIA’S ELECTRICAL ENERGY NEED AND PRESENT STATUS

### India’s Energy Security Challenge[3]

1. Electricity is one of the most important inputs to support the growing economy. Today, there is the requisite buying power to support the rapid growth of the power sector. At the same time, there are severe resources constrains looming large. The non-availability of power in required amounts could, in fact, severely restrict our developmental aspirations.

2. There is a need to look at nuclear energy associated with processes involving the nucleus of an atom in several million folds higher than the energy associated with processes that involve electron that orbit around the nucleus. The later forms the basis of energy through burning of fossil fuels. Nuclear energy released through fission or fusion of atomic nuclei and solar energy that we receive from the sun are the only two viable basic energy sources capable of meeting our long term energy needs.

3. Electricity – Present Status in India?[4] India is a power deficit country with a high base and peak load deficit of around 9. 8% and 16. 6%, respectively. Currently, though coal-based plants contribute around 58 % of the installed capacity, that alone would not be sufficient to secure and fulfill India’s long-term Energy requirements. A broad estimate suggests that if the country’s coal consumption continues to grow at 5% pa, going ahead we might run out of coal reserves over the next 40-50 years, and even if new coal reserves are discovered and extracted, we might still run out of coal in the next 70-80 years. Installed Capacity > 120 GW. Gross Generation is 620 billion kWh. The current per capita power consumption in India is about 612 KWH per year. While the world average is 2596 KWH. Out of total power available in India, thermal power constitutes 64. 6%, hydro power 24. 7% and nuclear power 2. 9%. The present power status of India is shown in fig 1. The details of nuclear power is shown in fig 2

### Indian Energy Scenarios: 2030

4. Nuclear Power[5] will play a significant role in the long-term energy mix of the country with the government planning to raise its contribution from the current level of 2. 9% (4, 120 MW) to around 10% (64, 000-65, 000 MW) of the country’s installed capacity by 2030.[6]

5. Details of Nuclear Power Plants in India.[7] Currently, seventeen nuclear power reactors produce 4, 120 MW (2. 9% of total installed base).

Power station

Operator

State

Type

Units

Total capacity (MW)

Kaiga

NPCIL

Karnataka

PHWR

220 x 3

660

Kakrapar

NPCIL

Gujarat

PHWR

220 x 2

440

Kalpakkam

NPCIL

Tamil Nadu

PHWR

220 x 2

440

Narora

NPCIL

Uttar Pradesh

PHWR

220 x 2

440

Rawatbhata

NPCIL

Rajasthan

PHWR

100 x 1,

200 x 1,

220 x 2

740

Tarapur

NPCIL

Maharashtra

BWR(PHWR)

160 x 2,

540 x 2

1400

Total

17

4120

6. The projects under construction are:

Power station

Operator

State

Type

Units

Total capacity (MW)

Kaiga

NPCIL

Karnataka

PHWR

220 x 1

220

Rawatbhata

NPCIL

Rajasthan

PHWR

220 x 2

440

Kudankulam

NPCIL

Tamil Nadu

VVER-1000

1000 x 2

2000

Kalpakkam

NPCIL

Tamil Nadu

PFBR

500 x 1

500

Total

6

3160

7. The planned projects are:

Power station

Operator

State

Type

Units

Total capacity (MW)

Kakrapar

NPCIL

Gujarat

PHWR

640 x 2

1280

Rawatbhata

NPCIL

Rajasthan

PHWR

640 x 2

1280

Kudankulam

NPCIL

Tamil Nadu

VVER-1200

1200 x 2

2400

Jaitapur

NPCIL

Maharastra

EPR

1600 x 4

6400

Kaiga

NPCIL

Karnataka

PWR

1000 x 1,

1500 x 1

2500

Bhavini

PFBR

470 x 4

1880

NPCIL

AHWR

300

300

NTPC

PWR

1000 x 2

2000

NPCIL

PHWR

640 x 4

2560

Total

10

20600

8. The following projects are firmly proposed.

Power station

Operator

State

Type

Units

Total capacity (MW)

Kudankulam

NPCIL

Tamil Nadu

VVER-1200

1200 x 2

2400

Jaitapur

NPCIL

Maharashtra

EPR

1600 x 2

3200

Pati Sonapur

Orissa

PWR

6000

Kumaharia

Haryana

PWR

2800

Saurashtra

Gujarat

PWR

Pulivendula

NPCIL 51%,

AP Genco 49%

Andhra Pradesh

PWR

2000 x 1

2000

Kovvada

Andhra Pradesh

PWR

Haripur

West Bengal

PWR

Total

15

16400

9. The following projects are proposed and to be confirmed soon.

Power station

Operator

State

Type

Units

Total capacity (MW)

Kudankulam

NPCIL

Tamil Nadu

VVER-1200

1200 x 2

2400

Total

2

2400

10. Summary of total nuclear power generation capacity by 2030.

Sl No.

Project

Units

Total capacity (MW)

1

Present nuclear power reactors

17

4120

2

Projects under construction

06

3160

3

Planned projects

10

20600

4

Projects firmly proposed

15

16400

5

Proposed and to be confirmed

02

2400

Total

50

46680

11. Department of Atomic Energy. This independent department has all matter related to atomic energy under its purview, and is responsible for designing, commissioning, constructing and operating nuclear power plants.

12. National Electricity Policy.[8] The GOI decided and notified the National Electricity Policy in Feb 2005 (Min of Power, 2005). The policy aims at accelerated development of power sector, providing supply of electricity to all areas and protecting interests of consumers. The policy prescribes development of rural electrification distribution backbone to be completed in next five years, Some of the points on which the policy emphasizes on are:-

(a) Nuclear power is an established source of energy to meet the base load demand. Share of nuclear power in the overall capacity profile will need to be increased significantly.

(b) Creation of adequate generation capacity with a spinning reserve of a least 5% by 2012 with availability of installed capacity at 85%.

(c) Full development of hydro potential.

(d) Development of National Grid.

(e) Exploitation of non-conventional energy such as small hydro, solar, biomass and wind for additional power generation capacity.

13. Outcome of the Deal. The Indian nuclear power industry is expected to undergo a significant expansion in the coming years thanks in part to the passing of the Indo-US nuclear deal. This agreement will allow India to carry out trade of nuclear fuel and technologies with other countries and significantly enhance its power generation capacity. India is expected to generate an additional 25, 000 MW of nuclear power by 2020, bringing total estimated nuclear power generation to 45, 000 MW. Following a waiver from the Nuclear Suppliers Group in September 2008 which allowed it to commence international nuclear trade, India has signed nuclear deals with several other countries including France, United States, Namibia, Mongolia and Kazakhstan while the framework for similar deals with Canada and United Kingdom are also being prepared. In February 2009, India also signed a $700 million deal with Russia for the supply of 2000 tons nuclear fuel. India now envisages to increase the contribution of nuclear power to overall electricity generation capacity from 4. 2% to 9% within 25 years. In 2010, India’s installed nuclear power generation capacity will increase to 6, 000 MW. As of 2009, India stands 9th in the world in terms of number of operational nuclear power reactors and is constructing 9 more, including two EPRs being constructed by France’s Areva. Indigenous atomic reactors include TAPS-3, and -4, both of which are 540 MW reactors. India’s $717 million fast breeder reactor project is expected to be operational by 2010.

14. Nuclear Power Growth. India, being a non-signatory of the Nuclear Non-Proliferation Treaty, has been subjected to a defacto nuclear embargo from members of the Nuclear Suppliers Group (NSG) cartel. This has prevented India from obtaining commercial nuclear fuel, nuclear power plant components and services from the international market, thereby forcing India to develop its own fuel, components and services for nuclear power generation. The NSG embargo has had both negative and positive consequences for India’s Nuclear Industry. On one hand, the NSG regime has constrained India from freely importing nuclear fuel at the volume and cost levels it would like to support the country’s goals of expanding its nuclear power generation capacity to at least 20, 000 MW by 2020. Also, by precluding India from taking advantage of the economies of scale and safety innovations of the global nuclear industry, the NSG regime has driven up the capital and operating costs and damaged the achievable safety potential of Indian nuclear power plants. On the other hand, the NSG embargo has forced the Indian government and bureaucracy to support and actively fund the development of Indian nuclear technologies and industrial capacities in all key areas required to create and maintain a domestic nuclear industry. This has resulted in the creation of a large pool of nuclear scientists, engineers and technicians that have developed new and unique innovations in the areas of Fast Breeder Reactors, Thermal Breeder Reactors, the Thorium fuel cycle, nuclear fuel reprocessing and Tritium extraction & production. Ironically, had the NSG sanctions not been in place, it would have been far more cost effective for India to import foreign nuclear power plants and nuclear fuels than to fund the development of Indian nuclear power generation technology, building of India’s own nuclear reactors, and the development of domestic uranium mining, milling and refining capacity.

15. India has already been using imported enriched uranium and are currently under International Atomic Energy Agency (IAEA) safeguards, but it has developed various aspects of the nuclear fuel cycle to support its reactors. Development of select technologies has been strongly affected by limited imports. Use of heavy water reactors has been particularly attractive for the nation because it allows Uranium to be burnt with little to no enrichment capabilities. India has also done a great amount of work in the development of a Thorium centered fuel cycle. While Uranium deposits in the nation are limited, there are much greater reserves of Thorium and it could provide hundreds of times the energy with the same mass of fuel. The fact that Thorium can theoretically be utilized in heavy water reactors has tied the development of the two. A prototype reactor that would burn Uranium-Plutonium fuel while irradiating a Thorium blanket is under construction at the Madras/Kalpakkam Atomic Power Station.

### CHAPTER – III

### NUCLEAR ENERGY – ITS MYTH AND REALITY

### Nuclear Energy in India[9]

1. Nuclear energy is the fourth-largest source of electricity in India after thermal, hydro and renewable sources of electricity. As of 2008, India has 17 nuclear power plants in operation generating 4, 120 MW while 6 other are under construction and are expected to generate an additional 3, 160 MW. Since early 1990s, Russia has been a major source of nuclear fuel to India. Due to dwindling domestic uranium reserves, electricity generation from nuclear power in India declined by 12. 83% from 2006 to 2008. To appreciate the Indo US nuclear deal better, let us understand the basics of generation of nuclear energy.

2. Nuclear Reactor. The basis of nuclear power is the fission process. This is the process of splitting of a fissionable atom’s nucleus, releasing energy in the form of heat, which can be converted through steam turbine and a generator into electricity. The only naturally occurring fissionable material is Uranium and said to be ‘ fissile’ because its nucleus has an affinity to a colliding neutron which it absorbs, splits into two smaller particles and emits two or more neutrons and produces vast amounts of energy. This process is called fission chain reaction. The neutrons produced as result of fission reaction in the reactor have excessive energy levels and they move at a great speed. In a nuclear reactor a chain reaction cannot be sustained with fast moving neutrons. So the fast paced neutrons are slowed down by an element called a moderator. The two substances that are used as a moderator in a Uranium reactor are heavy water and graphite. A majority of the nuclear reactors in the world use natural uranium as fuel and light water as moderator and hence they are called the Light Water Reactor. These are essentially boiling water reactor (BWR) or Pressurized water reactor (PWR). In a BWR, the cooling water is allowed to boil inside the reactor at a temp of 290 deg and pressure of 70 atmospheres. The steam is then fed directly to the turbines and re-circulated to the reactor. In a PWR the pressure inside the reactor vessel is kept at 150 atmospheres so as to prevent the cooling water from boiling at temperatures up to 350 deg. This water is fed out of the reactor vessel to a steam generator where it passes through thousands of tubes immersed in water at a much lower pressure. The secondary cooling water boils and drives the turbines. The other type of reactors those use heavy water as moderator is called Pressurised Heavy Water Reactor (PHWR).

3. Nuclear Fuel Cycle. Nuclear fuel needs to be processed optimally for use and thereafter disposed off safely. All these activities form part of the nuclear fuel cycle. India’s share of Natural Uranium reserve of the entire globe is 0. 8 %. At the same time that of Thorium is over 32% of the world’s reserve. A Uranium Mill is a chemical plant designed to extract uranium from ore. The final product that goes out of from the mill, commonly referred to as “ yellow cake”, contains more than 60% of uranium.

4. Nuclear Waste Reprocessing. The fuel which went into the reactor is removed after anywhere between 18 months to about 3 years. This spent fuel highly radioactive waste. The Uranium which comprises about 96% of the spent fuel can be recycled as fresh fuel elements. It could be used to fuel breeder reactors or can be used to make a nuclear bomb.

5. Uranium Enrichment. Purification and chemical conversion of uranium concentrate to uranium hexafluoride is needed since yellowcake is not directly usable as nuclear reactor fuel. The uranium hexafluoride is used in a natural uranium fuel reactor. The enriched uranium is now sent to a fuel fabrication plant where it is changed into uranium dioxide powder. The powder is pressed into small pellets, which are then put into metal tubes, forming fuel rods. These fuel rods are put together to form a fuel assembly.

### Advantages and Disadvantages

6. The advantages of electricity produced from nuclear source are as follows :-

(a) Cost- Effective Option. A kilogram of uranium can produces a million times more energy as compared to a kilogram of coal or a kilogram of hydrocarbon. One kg uranium can produce as much electricity as 1500 tons of coal. It will not only diversify India’s power generation portfolio but also reduces pressure on railway transportation of coal for the thermal power plants.

(b) Environmentally Sustainable. Non-emission of greenhouse gases that have threatened the global climate. The reduction in annual coal consumption ~ 100 Million Tons. Reduction in annual CO2 Emissions > 170 Million Tons. This will help ease global demand for crude oil and natural gas.

### 7. The disadvantages of nuclear power plants are as follows :-

(a) Initial Cost. Conventional nuclear plants are expensive, being perhaps two to three times the cost of comparable coal or gasification plants, with much of this expenditure required to insure the safety of the public. The production process is relatively simple and involves using nuclear heat to create steam that subsequently drives a turbine generator. However, the high cost of the plants (billions of dollars) can introduce potentially high financial risks to owners and investors alike, as history has demonstrated. While the plants are relatively inefficient (~33%), the price of nuclear fuel, as with coal, is a fraction of the cost of natural gas. Nuclear plants operate at full power for technical reasons and avoid the daily routine large load swings of the electrical grid. Fossil plants are normally used for such purposes.

### India’s Nuclear Energy Programme

8. India’s nuclear resource endowments are modest in terms of uranium, which is the only naturally available material that contains a fissionable component. On other hand thorium endowments are vast. But unlike uranium it is non fissionable.

9. Three-StageProgramme India’s strategies for large scale development of nuclear energy focused towards utilization of thorium and three stages nuclear power program is as given under :

(a) The first stage of Indian Nuclear Power employs the PHWRs fuelled by uranium, to produce plutonium.

(b) The second stage, Plutonium put in Fast breeder reactor with uranium, with a blanket of thorium, to convert some of the thorium into uranium.

(c) In the third stage, Advanced Heavy Water Reactors (AHWRs) would burn Thorium and U 233 as fuel. This is what we finally want to achieve in the years to come. The AHWR test reactor is in final phase of design.

10. Nuclear Energy for India’s Energy Security.[10]&[11] The

### CHAPTER – IV

### Indo – US Civilian Nuclear Deal

### Indo-US Relations

1. Historical Perspective. The nuclear energy history started way back in 1950 when US helped India to develop nuclear energy under the atoms for peace program. In 1968 India refused to sign the Non-Proliferation Treaty (NPT) claiming it was biased. India, Pakistan and Israel never signed NPT and North Korea signed but withdrew later. In 1974 came a turning point when India tested its first nuclear bomb made by the materials from the Canadian reactor. Canada and US stopped selling nuclear fuel to India and US placed severe restrictions on transfer of dual use technologies to India. India was a target of American ideological and geopolitical antagonism. Bilateral relations between the two countries were victims of incompatible obsessions of India’s with Pakistan and America’s with the erstwhile USSR.

2. Post Pokharan II. India’s nuclear blasts of 1998 not only shook the Thar desert, but also rocked the very foundations of the Global Nuclear Order. US administration promptly imposed sanctions and also mobilized other nations in doing so. India’s nuclear policy thus became the single most contentious issue in bilateral relations. The country was treated like pariah, especially by the US and 45 member Nuclear Suppliers Group (NSG) countries and isolated India for more than three decades, refusing nuclear co-operation. Sanctions were heaped on India. Indian nuclear scientists were unwelcome at international seminars in their field.

3. Post 9/11. In 2000, the US has moved to build a “ strategic partnership” with India. The terrorists strike of 11 Sep 01 resulted in convergence of strategic interests of both the sides. India supported American actions whole heartedly and defence cooperation was at new heights. An agreement on Next Steps in Strategic Partnership (NSSP) was signed in Jan 2004 which included areas such as missile defence, cooperation in civilian nuclear, space programme and high technology trade. The foundation and indeed the underpinning of the nuclear agreement was the signing of a ten year New Framework for Defence Relationship (NFDR) in June 2005 as a prelude to the historic agreement of 18 Jul 05, when India and the US agreed to cooperate in the field of civilian nuclear agreement.

### Landmark Deal

4. On 18 Jul 2005, India and the US sign the landmark Civilian Nuclear Deal in Washington DC and surprise the world. The deal was signed by US President Mr George Bush and Indian Prime Minister Dr Manmohan Singh. The US dismantle the complex architecture that it had set up to isolate India after 1974 nuclear test and deny it access to civilian nuclear technology.

5. Hyde Act. On 18 Dec 2006, the US congress passed the Henry J Hyde United States-India peaceful atomic energy co-operation act 2006 (PAEC Act 2006) popularly called as ‘ Hyde Act’, amending the atomic energy act that had prohibited American entities from trading with countries that didn’t sign the NPT or had done a nuclear test. India fitted into both categories. The US Senate voted emphatically in favor of 86 to 13. In reality, the Hyde Act is an enabling legi