

FUTURE OF NUCLEAR ENERGY

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INTRODUCTION

The paper looks at the relative significance of the key determinant components prone to influence what's to come of atomic power in a cost benefit analysis. The paper analyses as to how the nuclear energy will affect the climate and also the use of fossil fuels in order to generate energy. Coal is a major and developing supporter to the outflow of carbon dioxide that as a result leads to global warming. As compared to other energy sources, nuclear power requires consistent government involvement because of security as well as other important reasons. The test is to guarantee satisfactory supply of energy while constraining the negative complications of energy creation. Burning of natural resources such as coal, fuel and gas results in generation of 75% of carbon dioxide, which is the major contributor to climate change.¹ Nuclear power is one of the sources that has been tested and is effectively free of greenhouse gas releases. As a result of this, there is a lot of interest in this form of energy. But due to the risks that are attached to this form of energy, the future of such energy is not yet stable. One of the main aims of the paper is to analyse the current situation of nuclear energy and what the future holds for the energy.

¹ Intergovernmental Panel on Climate Change (IPCC), "Carbon Dioxide Capture and Storage," 2005, Special Report, http://www.mnp.nl/ipcc/pages_media/SRCCSfinal/IPCCSpecialReportonCarbondioxideCaptureandStorage.htm, p. 55.

EMERGENCE OF NUCLEAR ENERGY

USSR's Obninsk Nuclear Power Plant became the world's first nuclear power plant to generate electricity and it produced around 5 megawatts of electric power. This was on 27th June, 1954.²

By 1970, around 90 atomic plants with a limit of 16,500 Megawatt-electric (Mwe) were operational in 15 nations; by 1980, the figure had bounced to 252 plants with a limit of 1,35,000 Mwe spread over 22 nations.³ But the nuclear power industry didn't attract much of investment; as a result, from 1980 onwards there was a decline in demand for nuclear energy.⁴ The latter half of twentieth century saw establishment of nuclear power plants in Asia. In 1990's only 19 more nuclear power plants were added to the overall tally. Nuclear energy came to be seen as expensive and ineffective; therefore, there was this sudden decline in its demand.⁵

Since around 2001 the term nuclear renaissance has been utilized to allude to a conceivable atomic force industry recovery, determined by climbing fossil fuel costs and new worries about meeting greenhouse gas emission limit.⁶ The likes of China, India and United States have shown interest in nuclear capacity and have already launched projects for setting up nuclear power plants. The World Nuclear Association declared in 2012, that the nuclear energy generation in that year was the lowest since 1999. There has been this imbalance with regard to nuclear energy.⁷

² "From Obninsk Beyond: Nuclear Power Conference Looks to Future". International Atomic Energy Agency, <http://www.iaea.org/newscenter/news/2004/obninsk.html>

³ Hans Blix, "Nuclear Power in the 21st Century," Nu-Power, Nuclear Power Corporation of India Limited, Vol. 11, No. 1-3 (1997), http://www.npcil.nic.in/nupower_vol11_1-3/hansblix.htm

⁴ Richard L. Itteilg and James Pavle, "Nuclear Plants' Anticipated Costs and Their Impact on Future Electric Rates," Public Utilities Fortnightly, March 21, 1985, pp. 35-37.

⁵ International Atomic Energy Agency (IAEA), "Energy, Electricity and Nuclear Power: Developments and Projections—25 Years Past and Future," 2007, p. 45.

⁶ "The Nuclear Renaissance". World Nuclear Association, <http://www.world-nuclear.org/info/Current-and-Future-Generation/The-Nuclear-Renaissance/>

⁷ World Nuclear Association, "Nuclear power down in 2012", World Nuclear News, (20 June 2013), http://www.world-nuclear-news.org/NN_Nuclear_power_down_in_2012_2006131.html

As of now, there are 439 nuclear power plants with a joined Gigawatt-electric (Gwe) limit of 372 spread over 31 countries.⁸ Moreover, 36 plants are under development and an alternate 93 are planned. Nuclear energy contributes 16 percent to worldwide power generation.⁹ The so called renaissance is a result of interest shown by countries like United State and India. The Middle Eastern countries are expected to play an important role in the future. In order to analyse the nuclear energy, we will look at nuclear energy's economic viability, its impact on climate and proliferation of nuclear weapons.

Economically, nuclear power plants are very expensive and their maintenance cost is even higher. Nuclear energy has to compete with not only fossil fuels such as coal, oil but they also have to compete with renewable sources such as Wind and Solar Energy. Presently, wind and sun powered energy represents only two percent of the world's energy; most recent evaluations suggest a pitiful development rate of 2.1 percent for every year until 2030.¹⁰ In India, the 10 major nuclear power plants have had cost overruns of 300 percent. At the beginning the estimated costs were \$5.2 billion, but the revised costs came out to be \$17.7 billion.¹¹ While venturing into a business, an entrepreneur critically examines the chances of him getting profit. Investment in nuclear energy is a very risky investment, because generation of nuclear energy can at times cause disasters and would in turn leave investors in frenzy. As a result, nuclear power plants are not only expensive, but they are dangerous to human life. In the market, they are not economically competitive with fossil fuels such as oil, gas and coal.

Climate change lobbyists support nuclear energy because of the fact that it is a cleaner source of energy as compared to fossil fuels. Fossil fuels are targeted because of the high level of carbon emissions. Release of carbon dioxide is one of the main causes for climate change and also global warming. It is of utmost important that there be reductions in carbon emissions.¹² To stabilize the amount of carbon dioxide in atmosphere, emission of carbon dioxide worldwide must be

⁸ "World Nuclear Power Reactors 2007-08 and Uranium Requirements," World Nuclear Association, June 9, 2008, <http://www.world-nuclear.org/info/reactors.htm>

⁹ Mycle Schneider, "The World Nuclear Industry Status Report 2007," Greens-EFA Group in the European Parliament, January 2008, <http://www.greens-efa.org/cms/topics/dokbin/206/206749.pdf>

¹⁰ Energy Information Administration, "Annual Energy Outlook2008," Department of Energy, Report No. DOE/EIA-0383, June 2008, <http://www.eia.gov/oiaf/archive/aeo08/>

¹¹ M.V. Ramana, "Nuclear Power in India: Failed Past, Dubious Future," Non-proliferation Policy Education Center, May 10, 2006, <http://www.npec-web.org/Essays/Ramana-NuclearPowerInIndia.pdf>

¹² Intergovernmental Panel on Climate Change (IPCC), "Climate Change 2001: The Scientific Basis" (Cambridge: Cambridge University Press, 2001), Working Group I Report, p.13.

reduced to 50 percent by 2050.¹³ The chain of nuclear production contributes between 10 to 25 grams of carbon dioxide per kWh that is around 20 to 50 times less than the fossil fuels.¹⁴ Nuclear energy is a clean source of energy. Low carbon emissions will not make the nuclear energy, economically viable. Perhaps one of the better ways to reduce emissions of carbon dioxide would be instituting the carbon tax. Countries like Sweden and England have already introduced this form of tax.¹⁵ But putting tax on fossil fuels like coal and gas is a political question.

Nuclear energy has certain safety requirements that are unique, and any breach would result in severe consequences. Damage to the core reactor could lead to catastrophe. The major nuclear disasters that have rocked the world, Chernobyl in 1986 and the Three Mile Island incident in 1979 were all due to damage in the core reactor. The safety concerns and disasters add to the public concern. And this merry-go-round tale will continue. Till the time public is not convinced regarding the safety of nuclear plants, it will be very difficult for investors to invest heavily in nuclear energy. The destiny of the whole nuclear energy industry would depend on only one disaster. Developing countries generally have a perspective of having a laid back approach regarding safety. The second potentially dangerous things that comes from nuclear energy plant is the radioactive waste. The spent fuel waste remains radioactive for thousands of years.¹⁶

Nuclear weapon proliferation is at the centre of controversy when it comes to international affairs. Uranium can be upgraded to form Highly Enriched Uranium (HEU) that will make it the weapons grade. It is one of the most important security challenges that the world community is facing currently. Pakistan has shown that even though by having weak technology, it is not impossible for countries to get hold of enriched Uranium. Nuclear fuel available from processing plants provides an easier route towards nuclear weapon proliferation. Even some officials in the United Nations have agreed that they can't stop some nations to produce nuclear weapons out

¹³ Ted Nordhaus and Michael Shellenberger, "Scrap Kyoto," *Democracy*, Issue 9 (Summer 2008), p. 12.

¹⁴ Nuclear Energy Agency, "Nuclear Power and Climate Change," 1997, <http://www.nea.fr/html/ndd/climate/climate.pdf>, p.11.

¹⁵ "Where Carbon is Taxed," Carbon Tax Center, June 19, 2008, <http://www.carbontax.org/progress/where-carbon-is-taxed/>

¹⁶ Gail H. Marcus, "Innovative Nuclear Energy Systems and the Future of Nuclear Power," *Progress in Nuclear Energy*, (2007), p. 93

of their nuclear reactors.¹⁷ At a stage it becomes impossible to keep a check on nations that are producing nuclear weapons. A program 'Megatons to Megawatts' was launched. In the program around \$8 billion of weapons rating Uranium has been converted to reactor rating Uranium, which means they have eliminated around 10,000 nuclear weapons.¹⁸

Even though carbon emissions are minimal, once a nuclear reactor is destroyed or is damaged, the consequences are severe.

THE FUKUSHIMA DAIICHI NUCLEAR DISASTER

The Fukushima Daichii Nuclear disaster took place on 11th March, 2011, as a result of which three of six reactors in the plant melted down. The failure took place due to the tsunami that hit the plant due to a 9.0 magnitude Tohoku earthquake.¹⁹ The incident caused the most extensive release of radioactive substance after the incident of Chernobyl and for that matter the Three Mile Island case. The incident took place due to the earthquake and also the tsunami that was triggered by the earthquake. Due to the tsunami, backup power systems were critically damaged and they were responsible for cooling down the reactors. As the reactors were not able to cool down, the process of fuel melting took place. In December, 2011 it was announced by the government that the reactors in the Fukushima Power Plant have reached 'cold shutdown' which means that there is a diminished threat of further release of radioactive substance.²⁰ One of the ministers from Japan also declared that \$15 billion has been allocated in order to decontaminate the area around the Fukushima plant.²¹ Japan has admitted that the entire cost for the complete shutting down of the plant would exceed \$75 billion.²² In 2008, an expert from International

¹⁷ Benjamin K. Sovacool (2011). *Contesting the Future of Nuclear Power: A Critical Global Assessment of Atomic Energy*, World Scientific, p. 190

¹⁸ "Megatons to Megawatts Eliminates Equivalent of 10,000 Nuclear Warheads". Usec.com

¹⁹ Phillip Lipsy, Kenji Kushida, and Trevor Incerti. 2013. "The Fukushima Disaster and Japan's Nuclear Plant Vulnerability in Comparative Perspective." *Environmental Science and Technology* 47 (May),

²⁰ Yuji Okada, Jacob Adelman, and Stuart Biggs, "Fukushima Dismantling to Start After Cold Shutdown," *Bloomberg*, December 16, 2011, <http://www.bloomberg.com/news/2011-12-15/tepcosaid-to-expect-approval-to-startdecommissioning-fukushima-station.html>

²¹ Toko Sekiguchi, "Japan Allocates Money for Decontamination," *Wall Street Journal*, December 19, 2011.

²² Shota Ushio, "Japan's Nuclear Power to Remain Competitive Through 2030: Panel," *Nucleonics Week*, December 22, 2011.

Atomic Energy Agency (IAEA) warned Japan about problems that an earthquake could cause during meeting of G8 on Nuclear Safety.²³ As of the latest studies, the approximate cost of the disaster would be \$105 billion which is more than the estimated in 2011.²⁴ In a recent interview Naoto Kan, Japan's Prime Minister at the time the incident took place revealed that there was a possibility of evacuating people living in Tokyo.²⁵ Tokyo Electric Power Company (TEPCO), the company in charge of nuclear power plant admitted that it failed to take required safety steps.²⁶ TEPCO could have prevented the incident if backup generators would have been placed. As a result of melting down of three reactors, a lot of radioactive waste has been released by the plant over the years. In order to isolate the toxic water that has been produced by the plant, Japan is planning to build an ice wall.²⁷ The ice wall will be 1.5 km. long and around 1500 pipes will be inserted in order to freeze the soil surrounding the soil and further prevent any sort of decontamination.²⁸

The efforts that have been made by the government as well as other local authorities to get to the root of the problem have been disappointing. There was misunderstanding as to how public and private entities are required to predict and mitigate such a disaster. Japan has a long history of earthquakes. The islands of Japan have been formed due to seismic activities. It should have been reasonable for government to predict that tsunami would be triggered due to an earthquake. Yet, the nuclear plant was made close to the sea. The result of the radiation has been

²³ "IAEA warned Japan over nuclear quake risk: WikiLeaks". physorg.com. Daily Telegraph. 17 March 2011.

²⁴ Rt.com, (2014). Fukushima disaster bill more than \$105bn, double earlier estimate – study. [online] Available at: <http://rt.com/news/183052-japan-fukushima-costs-study/> [Accessed 27 Aug. 2014].

²⁵ Moore, T. (2014). *Japan's former PM tells of Tokyo evacuation risk after Fukushima*. [online] Brisbane Times. Available at: <http://www.brisbanetimes.com.au/queensland/japans-former-pm-tells-of-tokyo-evacuation-risk-after-fukushima-20140827-1097na.html> [Accessed 27 Aug. 2014].

²⁶ FACKLER, M. (2014). *Tepeco Admits Inadequate Precautions at Nuclear Plant*. [online] Nytimes.com. Available at: http://www.nytimes.com/2012/10/13/world/asia/tepeco-admits-failure-in-acknowledging-risks-at-nuclear-plant.html?_r=1& [Accessed 29 Aug. 2014].

²⁷ BBC News, (2014). *Japan Fukushima ice wall work starts*. [online] Available at: <http://www.bbc.com/news/world-asia-27669393> [Accessed 30 Aug. 2014].

²⁸ *Id.*

so severe that thyroid gland cancer has been detected in youngsters in Fukushima. The victims of the radiation exposure suffering with thyroid gland cancer now total 104.²⁹

DECOMMISSION OF NUCLEAR REACTORS BY GERMANY

As a result of the disaster and the financial burden, nuclear energy turns out to be a very big gamble. After Fukushima disaster, German Chancellor Angela Merkel declared that Germany will shut all its nuclear reactors by 2022.³⁰ A panel was set up by the Chancellor in order to analyse whether Nuclear Power Plants should be shut down. In wake of Fukushima disasters, Germany will shut all its reactors by 2022 even the newest ones. Prior to shutting down of 8 reactors, Germany got 23% of its energy from the nuclear reactors.³¹ The Fukushima was the changing point, as the incident has instilled fears in the hearts of policy makers and as well as the public. In Germany, there were protests against the use of nuclear power. They were regarded as one of the biggest protest in the history of Germany against nuclear energy.³² After some nuclear reactors were shut down, it was feared that Germany would face electricity black outs but that didn't happen. Germany increased its dependence on other sources of energy.

Fukushima accident and decommission of nuclear reactors by Germany are events that highlight the lack of trust that is there in nuclear energy. The destruction caused by Fukushima has hindered the growth and also the scope of nuclear energy. Not only Germany, but Switzerland has decided to ban the construction of any other new nuclear plants.³³ Spain has also said that they will be phasing out there current stock of nuclear reactors and will look for a cleaner source

²⁹ AJW by The Asahi Shimbun, (2014). *Thyroid cancer diagnosed in 104 young people in Fukushima - AJW* by The Asahi Shimbun. [online] Available at: <http://ajw.asahi.com/article/0311disaster/fukushima/AJ201408240011> [Accessed 29 Aug. 2014].

³⁰ Uk.reuters.com, (2014). *German government wants nuclear exit by 2022 at latest | Reuters*. [online] Available at: <http://uk.reuters.com/article/2011/05/30/us-germany-nuclear-idUKTRE74Q2P120110530> [Accessed 30 Aug. 2014].

³¹ BBC News, (2011). *German nuclear plants to be shut*. [online] Available at: <http://www.bbc.co.uk/news/world-europe-13592208> [Accessed 30 Aug. 2014].

³² BBC News, (2011). *Anti-nuclear protests in Germany*. [online] Available at: <http://www.bbc.co.uk/news/world-europe-12872695> [Accessed 30 Aug. 2014].

³³ KANTER, J. (2014). *Switzerland Decides on Nuclear Phase-Out*. [online] Nytimes.com. Available at: http://www.nytimes.com/2011/05/26/business/global/26nuclear.html?_r=2& [Accessed 30 Aug. 2014].

of energy.³⁴ Spain has joined Sweden, Germany, Italy and Belgium as the fifth European country to abandon nuclear power. In the European Union Austria, Denmark, Ireland, Greece and Portugal are strongly anti-nuclear.³⁵ As the future for nuclear energy is still unsure, it will be great to see how other countries deal with the prospect of adopting nuclear power. With the serious concerns over global warming and carbon emissions, only time will tell whether countries choose nuclear energy or other forms of energy generation.

CONCLUSION

Nuclear energy is a clean energy and there is nothing opposing it. Nuclear energy is a cleaner source of energy as compared to limited fossil fuels. Global warming and carbon emissions have triggered a need for an alternative source of energy. As a result, emergence of wind, solar and nuclear energy as substitutes has attracted a lot of investors. But the deficiencies and less amount of energy generation makes wind and solar less favourable. The energy that is clean and produces a good amount of energy is Nuclear energy. But the reputation built by nuclear energy over the years gets spoilt when a nuclear accident takes place. The industry and market for nuclear energy is very fragile. It's a very big risk for investors to invest because of security concerns and it is very expensive. Fukushima disaster changed the approach of many countries in the world and they are scared to face the same fate as Japan. Japan has actually paid the cost which no one even imagined during the construction of the nuclear plant. All the major countries are sceptical about this form energy and are beginning to phase-out their own nuclear reactors. But as circumstances have arisen, nuclear energy is less preferred because of safety concerns and also because it has led to proliferation of nuclear weapons. Even the countries which do not have sophisticated technology have managed to develop nuclear weapons. The presence of nuclear power in a country is a threat because non-warranted use will be detrimental to the public. Nuclear energy has positives as well as negatives and it gets really difficult to balance the two in order to achieve and extract the best out of nuclear energy. The future depends on how far are nations willing to go in order to make sure that energy generation is clean and green.

³⁴ Greenpeace International, (2014). *Spain says "Adios" to nuclear power*. [online] Available at: <http://www.greenpeace.org/international/en/news/features/spain-adios-nuclear-31-06-06/> [Accessed 30 Aug. 2014].

³⁵ The Economist, (2011). *When the steam clears*. [online] Available at: <http://www.economist.com/node/18441163> [Accessed 30 Aug. 2014].

