

Economics and Environmental Benefits of Nuclear Against Fossil Power Industry

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Abstract

Nuclear power was introduced for commercial energy sector during 1950 to meet the global power demand. In United states, according to Langton. L. (2014) currently about 20 percent of electricity is produced by nuclear power industry and 67 percent of power is supplied by fossil industries, which release significant amount of greenhouse gases. Nuclear power is proven environmentally economic, reliable, efficient and greener. However, nuclear waste disposal technique and Fukushima Daiichi, Chernobyl and recently Fukushima Daiichi Nuclear power plant accidents created waves of fear and concern to environmentalist. Industrialist and environmentalist started to debate on nuclear power expansion project based on pro and cons of nuclear power. Environmentalist opposed and claiming nuclear power is expensive and dangerous to health, safety and environment. Further, they suggested and recommended that alternative energy such as wind, solar and thermal industry to be focused and invested for sustainable future. Economist emphasized that the nuclear power industry investment cost is more expensive than fossil and other renewal energy industries. However, industrialist argued that we have improved modern engineering and technology to reduce the initial construction cost, run safer and manage the nuclear waste to keep away from health, safety and environmental hazards. They also highlighted that the nuclear industry is highly regulated by Government to monitor and keep the hazard within permissible limits. Fossil resources such as oil, gas and coal are extensively used for energy sector which create unsustainability and push United States to depend on foreign oil resources. This paper consists of analysis and summary of various authors and environmentalist argument on this subject. At the end, in the summary the economic and environmental benefits of nuclear energy against fossil energies are emphasized.

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Introduction

Due to the heated political situation in the world during the Second World War the rapid development of nuclear weapons technology was imminent in the United States. So, in the beginning Nuclear power was developed and intended for military purpose. After the war, nuclear energy development turned in the direction of the peaceful use for the production of electricity. During 1950s, commercial nuclear power plant was first established in Russia, and then followed in United States of America. According to Nuclear Energy Institute (2014), 12.3 percent of world's electricity is produced by nuclear power plants and about 20 percent of US electricity is supplied by nuclear power plants. Compared to coal and other fossil power, using nuclear power in energy industry was considered as economic, reliable, efficient and environmentally greener. However, consequently few negative impacts were arising including high cost, safe operation, nuclear waste management, health hazard and risk of weapon proliferation. Huge investment, inadequate operation technology, resource, waste disposal techniques and security control are blamed for ineffective nuclear power plant operation. Then, few nuclear power plant accidents occurred due to improper operation and natural calamity which cost human life and devastating environment pollution. Since the accidents and improper radioactive disposal are dangerous to the industries economic, environment and humans, nuclear power energy become debatable issue, environmentalist and related groups strongly opposed the nuclear power industry. Though fossil energy industry is comparatively cheaper and safer, they result significant environment impacts such as releasing more greenhouse gases to atmosphere. Though there are risks involved with respect to health and safety in nuclear power industries, the modern improved engineering and technology can overcome negative impacts.

Review of Literature

Davis, L. (2012) discussed and analyzed the prospect of nuclear power in this environmental era along with potential consequence of the economic impacts on the power industry. The analysis highlighted that the nuclear power energy is better alternative source of power than the fossil energy because it is reliable, environmental friendly and cost effective in longer run. The main concerns against nuclear industry are high construction costs and the risk associated with safe plant operation, nuclear waste disposal and the proliferation of nuclear

weapons in the facilities reprocessing nuclear waste. The author concluded with strong statement that a single pound of reactor-grade uranium oxide produces as much electricity as over 16,000 pounds of coal and burning 16,000 pounds of coal generates thousands of pounds of carbon dioxide, sulfur dioxide, and nitrogen oxides nuclear power is virtually emissions free (Davis, L., 2012). Thomas A. Easton (2011) supported the idea that nuclear power is safe, green and reliable. This statement is further supported by the article on "*Safety of Nuclear Power Reactor*" (2013) which stated that the number of significant accidents is comparatively very low for the total number of reactors operating in world. Though there are hundreds of reactors operated all over world, we have witnessed only three major disasters such as Three Miles Island, Chernobyl and Fukushima. According to Wester. K (2013), in United States, based on the work place safety data compared to private industry, nuclear plants are relatively safe place to work. The article "*Safety of Nuclear Power Reactor*" (2013) supports nuclear power safety and stated the US Nuclear Regulatory Commission (NRC) specifies criteria for reactor designs against core damage frequency; however modern designs exceed this requirement.

Iain Murray also debated nuclear powers are also comparatively cheaper and reduced global warming. As cited in (Thomas, 2011) Murray supporting the statement by referring the Congressional Budget Office report and justified cost of nuclear power energy is cheaper than coal power energy. "When it comes to operating costs, nuclear power is much less expensive" (Thomas, 2011, p.228). He also stated that nuclear power is the most attractive source of electricity and provides "economic benefits regardless of the carbon price". This statement is further supported by Wester. K (2013) which stated that the cost of electricity can be much lower from nuclear industry due to reduced cost of air pollution control, air permit exempts, and cost of plant maintenance. The article also stated, in addition to environmental benefits, it provides significant economic benefits as well. Bruno Comby's argument supported this cost benefit view saying "The cost of nuclear power is competitive and stable. The cost of nuclear fuel is a small part of the price of a nuclear kilowatt-hour, whereas fossil fueled power, especially oil and gas, is at the mercy of the market" (p.5). However, Steven Cohen (2013) argued though we have resource to manage such nuclear waste and meet the Nuclear Waste Act, the economic benefit of nuclear power is not significant.

In addition, according to Wester. K (2013), "Nuclear power plants produce no controlled air pollutants, such as sulfur and particulates, or greenhouse gases. The use of nuclear energy in

place of other energy sources helps to keep the air clean, preserve the Earth's climate, avoid ground-level ozone formation and prevent acid rain". Nuclear power plant is the best option to meet the U.S. Clean Air Act of 1970 by reducing emission of greenhouse gases such as sulfur dioxide, nitrogen oxides, carbon and so on. This statement is further referred to Energy Information Administration annual performance report; stated millions of tons of greenhouse gas emission are prevented from entering earth's atmosphere on every year. The author Wester. K (2013) further highlighted nuclear power energy also provides water quality and aquatic life conservation due to huge amount of clean water discharge comes from cooling process and "they are often developed as wetlands that provide nesting areas for waterfowl and other birds, new habitats for fish, and the preservation of other wildlife as well as trees, flowers, and grasses. Many energy companies have created special nature parks or wildlife sanctuaries on plant sites" Wester. K (2013). However, per Niki Fear (2009), "Nuclear Power can contaminate water supplies and cases of water contamination with radioactive substances have occurred around over a dozen different nuclear sites around the country. The process of mining materials used in nuclear power plants such as uranium and titanium run a very high risk of water contamination and improper handling can affect water quality in adjacent water sources including ground water". Also, according to Easton (2011), the environmentalist Kristin argued that nuclear power can be risky and impractical. He further quoted government's own data which expressed nuclear reactors are highly potential for nuclear accident and may resulted killing people and contaminate huge area. To add this statement Steven Cohen (2013) criticizes the media for trying to make believe that environmentalist embraced the nuclear power is the "new green-energy" option because it is carbon free source of power. Primary nuclear waste such as spent fuel rods is so toxic and difficult to get rid of it because of longer decay period. According to Wester. K (2013), "Nuclear power plants produce no gases such as nitrogen oxide or sulfur dioxide that could threaten our atmosphere by causing ground-level ozone formation, smog, and acid rain. Nor does nuclear energy produce carbon dioxide or other greenhouse gases suspected to cause global warming". The same message is agreed by Bruno Comby in *Environmentalists for Nuclear Energy (n.d)*, "Nuclear energy produces almost no carbon dioxide, sulfur dioxide or nitrogen oxides as released in vast quantities when fossil fuels are burned. One gram of uranium yields about as much energy as a ton of coal or oil - it is the famous "factor of a million".

Nuclear waste is correspondingly about a million times smaller than fossil fuel waste, and it is totally confined”.

Steven Cohen (2013) also argued that the possibilities of nuclear disaster are low; however, the impact of accident is very high as we witnessed Chernobyl disaster. In addition, Niki Fears (2009) support this view saying nuclear power can be harmful to human and environment, expensive in total and create more problems than benefits. Investment cost is more compared to other energy industry, example “Florida Power and Light Company”. She did not agree that nuclear power will reduce carbon emissions compared to coal plants in whole process. Nuclear power plant waste management is not safe enough to prevent harming environment and human; nuclear industry disasters are supported this view. She also highlighted that exposure to radiation and serious consequence of health and safety including cancers and infertility problems. However, Comby. B (2006) differed to this view, saying Three Mile Island and Chernobyl incident are the only two commercial nuclear plants involved. Also, stated Three Mile Island is the worst incident, however impact was very well managed, radiation was contained, and no causality and it was a real success story for nuclear safety. He also highlighted industrial fatalities are much more in coal and fossil industries when compared to nuclear power sector.

According to Wester. K (2013) the nuclear power energy is more reliable than any other industry and not affected much due to unreliable weather or climate condition, cost fluctuation and independent for foreign resources. Comby. B (2006) also supported this view point, saying that nuclear reactors can provide power over 90% of the time; and the refueling time does not affect the production due to modern maintenance system”. Niki Fears (2009) and Easton (2011) suggested that clean and renewable forms of safe energy such as solar and wind that have lower costs than fossil and nuclear. However, Wester. K (2013) indicated that due to nature of construction, solar and wind farms must be sited in geographically unpopulated areas and occupy substantially more land and far from energy demand area. He further highlighted that expanding nuclear energy industry could create thousands of new jobs, boost the economy, and give us a safer solution for global warming. Comby. B (2006) argued and blaming environmentalist not accepting the fact that solar, wind and geothermal are quantitatively incapable of supplying the energy required by industrial civilization.

Body paragraphs

Nuclear power energy can be the best future hope for an environmental friendly and reliable power source even though the danger of nuclear waste management is debatable issue. Nuclear power energy is better alternative source of power than the fossil energy because it is cost effective, reliable, environmental friendly and not affected much due to unreliable weather or climate condition. Nuclear reactors can provide power over 90% of the running time with less maintenance and independent of foreign suppliers. “The use of nuclear energy in place of other energy sources helps to keep the air clean, preserve the Earth's climate, avoid ground-level ozone formation and prevent acid rain” (Wester. K 2013). Emission of greenhouse gases such as sulfur dioxide, nitrogen oxides and carbon are much lesser in nuclear power industry. Nuclear power energy also provides water quality and aquatic life conservation due to huge amount of clean water discharge comes from cooling process.

Nuclear power plant is the best option to meet the U.S. Clean Air Act of 1970 and related requirement in terms of reducing greenhouse gases such as sulfur dioxide, nitrogen oxides, carbon and so on. Such performance is well proven by annual report issued by Energy Information Administration stated that millions of tons of greenhouse gas emission are prevented from entering earth's atmosphere on every year. Cost of electricity can be much lower from nuclear industry due to reduced cost of air pollution control; air permit exempts due to lower emission, and reduced cost of plant maintenance. Since nuclear power plant produce power with minimal environmental impact, it can be called as “ecological efficient” of all sources. In United States, based on the work place safety data compared to private industry, nuclear plants are relatively safe place to work.

Though there are hundreds of reactors operated all over world, we have witnessed only three major disasters such as Three Miles Island, Chernobyl and Fukushima so; potential for accidents by human factor is low. The US Nuclear Regulatory Commission (NRC) specifies criteria for reactor designs against core damage frequency; however modern designs exceed this requirement. “Defence-in-depth” approach is referred and described to achieve optimum safety in western world nuclear power operation. A comprehensive and transparent risk and safety assessments, the so-called "stress tests", was performed on Fukushima accident and outcome of operational control is applied to nuclear reactors in European Union countries. Severe natural

calamities such as earthquakes, volcanoes, flooding due to storms and tsunamis are the significant concern on safety of nuclear reactor facilities.

Nuclear energy is an important energy source in the development of such long-term energy and environmental strategies. “Nuclear energy can address global energy needs in regions of the world where energy demand growth is rapid, known gas and oil reserves are likely to be exhausted in a few generations, alternative resources are scarce, energy supply security is a priority, and the reduction in air pollution and greenhouse gas emissions is critical” (Apergis. N & Payne. J. 2009). According to Langston. L (2014) initial investment and construction cost are expensive to build nuclear power plant, however operational and maintenance cost are relatively cheap. The same view is supported by author Davis. L (2011) stated that nuclear power plants are high cost of capital and substantial regulatory risk, however operational and maintenance cost is inexpensive at the same time resulted substantial environmental benefit of emitting significantly less greenhouse gas compared to fossil industries. He further stated that several studies have initiated to learn the international construction experience and there are potential possibilities to improve the economics of construction cost in United States. Apergis. N & Payne. J (2009) criticized that the policy makers and stakeholder are still reluctant even though nuclear power could solve growing concerns over greenhouse gas emissions, energy independency and addressing local economy due to volatile oil and gas prices. They further addressed the causal relationship between energy consumption and economic growth by establishing various hypotheses and studying empirical equation modelling. At the end Apergis. N & Payne. J (2009) provided additional information in the discussion of the role of nuclear energy in satisfying global energy needs while reducing greenhouse gas emissions through an examination of the causal relationship between nuclear energy consumption and economic growth. “The interdependence between nuclear energy consumption and economic growth suggests that energy policies designed to increase the production and consumption of nuclear energy will have a positive impact on economic growth. Moreover, given the reduction in the emission of air pollution and greenhouse gases associated with nuclear energy, there is also a positive spillover to the environment” (Apergis. N & Payne. J, 2009). The authors Omri. A & Chiai. A (2014) also analyzed empirical modeling approach and supported the view of interdependence between nuclear energy consumption and economic growth. The authors Sertyesilisik, B., & Melaine, Y. (2010) stated that it is difficult to calculate the true total cost of

nuclear power because fossil energy support maintenance and waste management sector of nuclear power industry. They further argued nuclear power cannot compete with fossil industries unless government subsidies. Feed in tariff (FIT) instrument approach is proposed by an author Cooper. M. (2014) for stimulating deployment of innovative clean energy technologies to the developers and proposed FIT rating for nuclear energy industries for stimulating and deploying technologies.

Organization for economic co-operation and development (OECD) is a unique forum established during 1958 by various democratic countries with a mission assisting member countries to maintain and further developing safe, environmentally friendly and economical use of nuclear energy. OECD (2012) recognized the offsets are long construction period and high investment cost which affects financing costs. The forum further demanded supportive public policy framework and appropriate financing models to manage the high investment financial costs. OECD (2012) analyzed and provided breakdown of costs electricity generation from renewable, nuclear, coal and gas sources at 5 percent discount rate and highlighted that nuclear investment cost place as 59 percentages and compared with 78 percent for wind energy and 26.1 percent for coal. To be economically competitive the forum suggested upgrading the nuclear plants instead of constructing new plants due to less expense and shorter period of modification.

Nuclear Energy Roadmap Report (2010) highlighted nuclear energy policy to achieve energy security, greenhouse gas reduction objective and urged government to develop and deploy environmental friendly domestic energy sources as soon as possible. This report further provided road map to demonstrate and ensure nuclear energy remains sustainable energy option. There are four research and development objectives established to address the challenges to expanding the use of nuclear power, and the primary objectives are “develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors; develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals; and develop sustainable nuclear fuel cycles” (NERR, 2010).

Economic benefit of nuclear power is proven by nuclear power in France. Nuclear power in France is one of the successful implementation evidence and proved nuclear power can be primary power source if managed well and supported by government and stakeholders. France produces approximately 80 percent of total electricity from nuclear power, 17 percent of

electricity is from recycled nuclear fuel and exports 20 percent to other European countries, as the result gains over Euro 3 billion per year. The article *Nuclear Power in France* (2014) stated that the nuclear power can only be viable, clean and safe source of power generation and fossil power generation techniques have led to more casualties and environmental disasters than nuclear power ever and further quoted that coal burning releases more radioactive uranium and barium than all the world's nuclear plants ever have.

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Conclusion

World is completely relying on important resource of energy to run day to day life and industry. Nuclear power industry may be dangerous only if it is not regulated and managed accordingly. Industrialist and economist believe that nuclear power energy could be the future' best hope for an environmental friendly and reliable power source. Information and data support that nuclear power construction cost is expensive but operational and maintenance cost are cheaper, at the same time environmental benefit is substantial compared to fossil industries. As many authors highlighted and observing the analysis and information that the modern improved engineering and technologies available to reduce the main issue of initial cost, nuclear power industry can be the future energy source to be more economical, save natural resource and improve human triggered environmental performance. France success story is one of the proven evidence that nuclear power can be economically and environmentally beneficial.

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