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ENERGY AND THE ENVIRONMENT
WHY NUCLEAR ENERGY MAY NOT BE THE ANSWER

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Regina S. Axelrod

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RADIOACTIVE WASTE OR SPENT NUCLEAR FUEL

While nuclear energy is being marketed as the answer to the world's energy problems, serious problems with technology, safety and security issues, uncertainties surrounding licensing and financing and construction of new reactors, and the regulatory costs remain. This study will outline some of these issues focusing on the US, as well as Europe and Asia.

In the US, a new plant has not gone online since 1996 and no reactors have been ordered since 1973. Plants are aging and will need to be replaced in the US, the UK and France; some in the next few years. Governments are under pressure to extend the life of reactors beyond their 40-year limit for another 20 years.[1] Extending the life of older plants, however, creates additional safety issues.[2]

The by product of nuclear generated electricity is radioactive waste or spent nuclear fuel. No country has yet established a safe long-term repository for nuclear waste. The extraordinary period needed to safeguard nuclear waste, up to 400,000 years, exceeds the entire history of humankind on this planet. No human political institution has lasted as long as it will take to safeguard nuclear waste up to 400,000 years. No commercial US nuclear plant has yet to be decommissioned. (This must be done when a plant reaches the end of its life from 40-60 years.) Cost estimates range from $150 to $600 million in 1995 US dollars.[3]

The Nuclear Waste Policy Act of 1982 (P.L. 97–425), amended in 1987, mandated that a site be found and designated for long-term disposal. There is pressure to find permanent storage sites for general nuclear waste or nuclear plants may be forced to close. Although Yucca Mountain, Nevada, (slated to open in 1988) was designated for long-term disposal, there have been political and serious technological problems that stand in the way. While awaiting final disposal, spent fuel remains on site at 104 nuclear plants in 31 states. Space is getting tighter as fuel rods are placed closer to each other in pools of water. Watching and waiting until technology finds a solution has become a practical strategy.

Another concern is that if there were a long-term disposal repository the number of shipments being transported west in the US would increase dramatically and communities may oppose trainloads of highly radioactive waste traveling through their communities. In Japan, the national power company has been unsuccessful in soliciting communities for disposal sites. Their inability to implement a long-term disposal strategy has compelled them to export uranium – sending spent fuel to France and the UK for reprocessing. The danger in such shipments is not only leakage, but potential terrorism at sea. The EU (France and the UK) no longer want to keep the toxic by-products, so countries like Italy are under pressure to find long-term disposal sites, but face stiff public opposition.

RECYCLING AND REPROCESSING

The reprocessing and recycling of spent nuclear fuel extracts plutonium and uranium. It is a complicated process with the potential for accidents and the production of additional toxic waste. The fuel rods are isolated, cut and put in nitric acid. What is left aside from plutonium and uranium are various levels of radioactive waste and radioactive discharges into the air and water. The resultant plutonium can be used for nuclear weapons and the uranium in civilian nuclear power plants.

The US discontinued the development of recycling during the Carter administration due to concerns about the dangers of nuclear weapons proliferation. Recycling requires a breeder reactor to keep on reprocessing spent fuel and producing plutonium. However, some countries recycle using the uranium and plutonium by-products to create mixed oxide fuel (MOX). France, Japan, Russia and India are the only countries with such reprocessing capacity. However, only France has successfully produced MOX. Russia would like to import waste that it could use in civilian nuclear plants it hopes to build. In 2003, it is estimated that worldwide there are, "240 metric tons of separated plutonium – enough for 40,000 nuclear weapons."[4]

The recycling of spent nuclear fuel may not even reduce the total volume of material for disposal. There is controversy as to whether reprocessing actually reduces nuclear waste because after the separation process more toxic material remains, some of which is dumped of in the ocean because there is at present no cost-effective means for isolation and disposal.

In addition to the difficulties associated with radioactive waste handling and long-term disposal there are also two other problems: the high cost of recycling and the potential for nuclear weapons proliferation. The potential weaponization of nuclear fuel has become a major international political issue. That is an issue confronting International Atomic Energy Agency (IAEA), which can only ask for voluntary compliance from its members and cannot enforce rules. Recycling costs are still high and until that changes, mining for uranium is still more economical.

The Global Nuclear Energy Partnership proposed by President George Bush in February 2006, encourages development of new nuclear power plants.[5] Methods for recycling nuclear waste were proposed by partnering with other nuclear states, i.e. the United Kingdom, France, Russia, China and Japan. Radioactive waste from developing countries would be transferred to the US and its partners who would burn it in advanced reactors. The final waste product would be sent to the US and other participating countries. This would hypothetically decrease opportunities that spent fuel would be used to make nuclear weapons.

Russia may soon be willing to accept nuclear waste for a price and this may be an option for countries without a long-term repository. President Bush has kept open the possibility that Yucca Mountain would also recycle or that a different site in the US would be found. Towards that end he proposed loan guarantees, production tax credits and federal risk insurance. With this potential addition of reprocessed waste to the already burdened Yucca Mountain facility, the nuclear industry is pressuring the government to lift the 70,000 metric tons limit at Yucca Mountain currently in place. There are serious problems at Yucca Mountain. The site has experienced water seepage, falsified documents by US Geological Survey workers were discovered, and the project has exceeded its budget. There is also a state's rights issue since Nevada officials oppose the project. Another unsolved problem is how to store nuclear waste for 400,000 years without it percolating through rock and into the ground water. An October 2005 National Academy of Sciences Report[6] warned of significant radiation release if there were a fire. It also recommended that an independent group further examine security issues.

In the UK, Prime Minister Tony Blair has been pushing for the location of a long-term underground storage site before the construction of new sites and Sellafield is the favorite. The Sellafield site, however, had a major leak in May 2005 (undiscovered for weeks) when a burst pipe released 100 tons of corrosive nitrous acid, mixed with radioactive material, uranium and plutonium, forcing one of its reprocessing centers to close. There have also been assertions of radiation pollution in the Irish and North Seas from the Sellafield site. The UK gets one fourth of its electricity from its 14 nuclear reactors. Like the US and Canada it must find a strategy to deal with its radioactive waste or plants will have to be closed.[7] The potential closing

of nuclear power plants because of the absence of a long-term disposal strategy provides a strong incentive to solve the nuclear waste problem.

In July 2006, the Department of Energy announced that Yucca Mountain would begin accepting nuclear waste in March 2017. It is expected to apply for an Nuclear Regulatory Commission license in 2008 and after receiving it, would begin construction in 2011. Nevada congressional representatives still oppose the plan and have begun to create a surrounding wilderness area that would serve to block a potential railroad needed to deliver the radioactive material to Yucca Mountain. The shift in control of the US Congress to the Democrats may also deal a blow to the Yucca project. Congressman Henry Reid (D-NV) has been a staunch opponent and will likely influence any further appropriations. The Democratic House leadership, e.g. Congresswoman Nancy Pelosi (D-CA), has also been an opponent.

The government and the nuclear waste industry, however, have a second strategy for separating the building of new nuclear plants from the issue of long-term waste disposal. If the nuclear industry threatens to cease building nuclear plants if a long-term waste disposal site is not completed and ready to receive nuclear waste, this would exert pressure on the government to find an alternative to Yucca Mountain by licensing interim disposal facilities. (Such a strategy could compromise safety and security.) A consortium of electric utilities formed the Private Fuel Project. Their plan is to store nuclear waste in dry casks on the reservation of the Goshute Indians in Skull Valley, Utah (50 miles southwest of Salt Lake City). The Native American tribe stands to collect some US$83 billion for allowing up to 40,000 tons (10 million rods in 4,000 casks) of waste shipped by trains that would have the technology to communicate safety conditions via satellite. This proposal is being challenged by Utah officials. Nuclear utilities will try to use federal law to preempt state law in siting controversies.

The United States government would like to reduce the total amount of generated waste. It is reassessing its prior position opposing the recycling of nuclear waste. This could even be marketed as a "green strategy." Critics point out, however, that recycling is expensive and increases the other risks of terrorism and the use of nuclear fuel for weapons. Recycling would certainly promote the use of nuclear energy outside of existing nuclear states. Countries would in essence be "renting" the nuclear fuel.

France is sometimes looked upon as a model nuclear country because approximately 75 percent of its electricity is produced by nuclear power plants. French energy policy and its nuclear sector were developed by an agency of government. By the late 1970s, France realized that to meet its energy demand while avoiding the uncertainties of fossil fuels, nuclear energy should be developed. Électricité de France, a government-owned company, has subsidized reactor research with neither significant public debate nor interference; nuclear technology was free to develop without criticism from the public or elected officials. Although France is the largest reprocessor of nuclear waste handling material from Belgium, the Netherlands, Switzerland and Japan, it also lacks a permanent long-term solution for storage.

US DEPARTMENT OF ENERGY SUPPORT OF NUCLEAR ENERGY

A level playing field does not now exist for research and development in energy. The US government actively supports nuclear energy.[8] It will pay a large portion of the application costs for new reactors. Permit applications for nuclear reactors at three sites in Illinois, Mississippi and Virginia have been filed by an industry consortia for reactor development. The nuclear industry does not want to incur the financial risk. Instead it has sought government assistance and that help has been forthcoming. To offset construction cost overruns due in part to delays and challenges to the Energy Policy Act of 2005, the NRC will pay up to US$750 million for the first six reactors.[9] Another incentive to the nuclear industry in the Energy Policy Act of 1992[10] was the collapse of the 2-stage construction and operation licensing process. No longer does a utility have to obtain a separate construction license permit and a separate permit to operate the plant when it is completed. The nuclear industry and utilities argued that the 2-step process was a burden because of long delays in part due to correction of construction errors and introduction of increased safety measures. Others contend that the lengthy process resulted in a safer nuclear power plant, because there was opportunity to identify problems during the testing operational stage before the final license was approved. Often times these start-up periods are the most problematic. (Since the Temelin nuclear power plant in the Czech Republic has been on-line since 2000, it has experienced numerous problems during the testing stage but received an operating license nevertheless.) In 1992, the licensing process was consolidated eliminating informational public hearings. The nuclear industry did not want an opportunity whereby a community could use the licensing process to shelve a plant, as occurred with the Shoreham Nuclear Power Plant in New York.[11] The nuclear industry has now pulled together forming a consortium to support each other in the licensing process, sharing information and pooling resources, e.g. Exelon Energy and Southern Company. This will be a test for them and the NRC.

The pressure to support nuclear energy and the recycling of spent fuel is growing. According to Senator Pete Domenici (R-NM), former chair of the Energy & Water Development subcommittee and former chair of the Energy & Natural Resources Committee, "With the recent passage of the Energy Policy Act, utilities are deciding that the time is right to build nuclear power plants in America. In fact, as of last week, light utilities across the United States have announced plans to take the first step in building 13 new nuclear power plants. [...] [W]hat do we do with our spent-fuel?"[12] He suggests moving beyond Yucca Mountain and the development of a spent fuel recycling program.

Another safeguard for the nuclear industry is the limit on liability in case of a nuclear accident. The Price-Anderson Act (of the Atomic Energy Act of 1954, 42 U.S.C. 2210), eliminated risk by making sure the public would be compensated and the utilities protected. Utilities have insurance but the liability is capped under revisions to the Act at US$10.7 billion.[13] The proposed Energy & Water Development Appropriations Bill of 2006 (H.R. 2419) provides incentives for site selection for the recycling or reprocessing of nuclear waste. There are funds for research to select recycling technology, design completion, as well as assistance for site selection and an environmental impact assessment.

In July 2006, the NRC announced a reorganization and the creation if the Office of New Reactors (NRO) by January 2007 to facilitate the licensing and construction of new nuclear electric-generating plants. There will also be a new office to oversee inspections, located in Atlanta. This reorganization plan demonstrates how serious the NRC takes the push for new reactors. The NRC has been granting some extensions of 20 years to existing plants. Some argue that the life-span of 40 years was arbitrarily set by the NRC without the benefit of experience and could be extended. Nevertheless, older plants may be more expensive and unreliable to operate. Metal pipes get brittle and crack from constant bombardment of nuclear particles. Continual attention to safety could increase the operational costs of nuclear power plants.[14] But without these extensions these plants will cease to operate and by mid-21st century there will be no nuclear energy generated in the US unless there is a resurgence in nuclear energy plant construction now.

REPROCESSING PITFALLS

Reprocessing of spent nuclear fuel gives the appearance that something is being done to address the increasing amount of nuclear waste accumulating on site at nuclear power plants. Recycling is supposed to reduce the amount of waste that needs to be stored or disposed of thereby extracting fuel for further uses; however, the by-product can be more toxic than the original waste. The plutonium that is separated out can be used to make nuclear weapons. It could be the target of terrorists because less radioactive plutonium can be more easily handled. The US and Germany abandoned their capability, although President Bush has proposed to revive reprocessing (perhaps because of the frustrations over the problems associated with Yucca Mountain as the single US long-term repository). However, the costs are higher than mining for uranium and there is the potential for theft. Stolen radioactive material could be used with conventional explosives to make a dirty bomb. To eliminate this danger the US has removed spent fuel from reactors in Uzbekistan, Bulgaria, Latvia and the Czech Republic sending it to Russia for storage. Other dangers of reprocessing include the radioactive gas released into the atmosphere and an increase in low-level radioactive waste, including uranium. Public opposition has limited the availability of disposal sites.

As discussed earlier, creating a new waste stream of reprocessed plutonium could present new dangers and, contrary to common thinking, the total amount of nuclear waste isn't reduced unless it is continually reprocessed and reused: a process that has not yet been perfected. Even if it were, the government would incur a large financial responsibility overseeing the process. DOE Secretary Samuel Bodmen warned, "...[t]he stores of plutonium that have built up [in other countries] as a consequence of conventional reprocessing technologies pose a growing proliferation risk that requires vigilant attention.[15]

TERRORISM AND RADIOACTIVE MATERIAL TRANSIT

The prospects of terrorism at nuclear power plants, as well as, the consequences of an increase of nuclear waste and its transit around the world pose additional challenges. Even small amounts of radioactive material can be used to make a dirty bomb. In the five years since September 11th, the US is still not able to effectively monitor radioactive material crossing its borders. Radioactive material has been smuggled into the US during government undercover investigations. Vulnerability is particularly troublesome at ports where federal money has not been appropriated quickly enough. Port operators warn against a reduction in the movement of goods if there were inspection of all containers entering US ports. Congressional investigators claim the goal of installing 3,000 new detectors would miss the September 2009 deadline and would carry a cost overrun of US$342 million of the original US$1.2 billion budget.[16] Presently, only 37 percent of incoming cargo is inspected with radiation detectors, and they often do not work.[17]

The enriched uranium needed to make an explosion exists in reactors in 24 countries. Detecting radioactive material crossing borders is recognized as an international problem. It has been discovered in airports in a number of countries, e.g. Ukraine, Czech Republic. There are many opportunities where terrorists could gain access to radioactive material. To prove the point, NATO simulated a nuclear incident in Brussels with thousands of potential victims.

With Russia now proposing to be the major future destination for recycling spent fuel, questions arise about its ability to provide adequate safety. In 2005, a worker was killed and others injured at the closed nuclear town of Sosnovybar near St. Petersburg when molten metal splashed on them. The smelting plant was near the nuclear reactors, one similar to the Chernobyl model and near a covered radioactive liquid waste pond.[18] In other cases there have been leaks of radioactive gases and iodine. Without independent safety regulatory oversight there is uncertainty about Russia's ability to manage massive quantities of radioactive fuel that must be transported, stored for hundreds of thousands of years.

Since September 11th, safety and terrorism at nuclear power plants continue to be major concerns. When the NRC conducted mock terror drills for certain nuclear power plants, security was breached and personnel were able to enter the plant and achieve their goal without the knowledge of plant officials and personnel.

The Indian Point nuclear power plant on the Hudson River, north of New York City, was under the flight path of one of the planes that crashed into the World Trade Center. There was pressure to institute a "no-fly" zone around the plant or in the proximity of it, but neither action has happened.

In the National Academy of Science report to Congress on "Safety and Security of Commercial Spent Nuclear Fuel Storage,"[19] it was concluded that spent fuel rods were a potentially successful terrorist target and that an attack could lead to a fire that would release large amounts of radioactive material. The report also warned that a theft of spent fuel was also possible. The NRC refused to supply information to the committee writing the report, on measures taken to defend against attacks on spent fuel storage. It was concluded that theft and removal of fuel rod(s) was possible during an attack and remained a vulnerability. The report recommended that the NRC upgrade safety of spent fuel rods, analyze and address any insufficiencies that would lead to a fire and improve information-sharing including independent and public analyses between it and the nuclear industry. No agency is responsible for defending nuclear facilities against an attack such as on September 11th. The NRC and the nuclear industry claim it is not the responsibility of the NRC but the US government. However, the Department of Homeland Security and the Department of Transportation have yet to claim responsibility.

A unique and creative program to reduce the threat of nuclear proliferation from former Soviet nuclear stockpiles was the Nunn-Lugar Cooperative Threat Reduction Program (PL 102-228) begun in 1991. Through projects funded by the US Congress, assistance would be given in the transportation and elimination of nuclear materials and weapons. They would be stored and safe-guarded against proliferation until their destruction. Funds averaged US$300-500 million annually, but opponents in Congress defunded the construction of a necessary chemical weapons dismantlement facility.

The program was created in response to the disintegration of the Soviet Union and a concern for lost or stolen nuclear weapons that could be sold on the black market. There would also be opportunities to keep former Soviet physicists from selling their knowledge to other states. The program was expanded in 1997 to include countries outside Russia that might have stored nuclear weapons or material, such as Belarus, Ukraine and Kazakhstan. The US assisted by providing safety during transportation, i.e. special railroad cars. A facility to store nuclear warheads and plutonium has been completed but there is disagreement between Russia and the US over transparency, i.e. proof that the materials to be stored are from disabled nuclear weapons.

Congress appropriated US$152 million in 2003 to build a MOX conversion facility in Savannah, Georgia.[20] It would process US surplus plutonium to MOX to be used in civilian reactors. The original agreement between the US and Russia was to either convert plutonium to MOX or dispose of it. Russia prefers the first option, but it has been slow in assuring that the plutonium would not be converted to weapons grade material and exported to other states. The US, UK, France and Japan have pledged considerable funds to cover the costs of converting Russia's plutonium, althought further problems remain over liability and need to be resolved. Russia is considering developing a fast breeder reactor that will produce plutonium, which may affect US funding.

NUCLEAR PLANT SAFETY

Nuclear energy advocates view the Chernobyl accident of April 1986 as an event that should never be repeated. The radiological impact was greatest in the Ukraine, Belarus and Russia. There were 31 immediate deaths and thousands of additional cancer related deaths especially childhood thyroid cancer. In Belarus, the thyroid cancer rate increased up to 10,000 times the normal rate.[21] A 2006 UN report claimed the death toll at 4,000 to 6,000 while Greenpeace reported more than 90,000 would die of cancer related diseases.[22] There are discrepancies over the actual numbers of deaths and predicted deaths due to discrepancies in accounting procedures and follow-up measures. The numbers of deformed births and related health problems such as immune deficiency associated with Chernobyl continue to rise. A lingering problem is the future of the cracked and corroded sarcophagus – hastily built to cover the plant and prevent the escape of nuclear fuel – which if destroyed in another explosion would result in the spread of radioactive dust into the atmosphere carried by the wind. Nuclear reactions are still occurring inside the reactor, the replacement of the sarcophagus should have been completed in 2006 but work is slow because of dangerous radiation levels.

The safety record of operating nuclear power plants in the US also reveals problems. The most glaring safety infraction was in 2002, at the Bessie Davies Plant, near Toledo, Ohio, which leaked boric acid onto the reactor cap, which led to its corrosion and the formation of a hole in the vessel lid which could have resulted in a serious accident. The plant operator was severely fined and the reactor was shut down for two years. When a consultant (a former NRC official) wrote a report criticizing management for poor practice, he was ordered to change the report. Instead, he quit. At issue was the lack of a "culture of safety" at the plant. Past safety events were not thoroughly investigated and workers and management accepted conditions that could be dangerous. The report also found disgruntled workers, slow preventative maintenance and lengthy closures for refueling.[23]

A similar situation plagued Reactor No. 1 in the South Texas Project, but the boric acid was found at the bottom of the reactor vessel, difficult to detect. The NRC has had to revise its understanding of such leaks that were not calculated to occur. It had been thought that leaks would be the result of the cracking of brittle pipes, and it instructed utilities to inspect plants for these kinds of leaks more frequently.

At Hope Creek, New Jersey, a leak at from a cracked steam pipe was the result of poor communication between workers and management: an open valve was the cause of the crack.[25]

NRC standards are being relaxed to cope with potential fires. Utilities claim they are unable to comply with existing regulations that mandate automatic shutdowns. Instead workers must manually shutdown a reactor if there is a fire. Fires do occur a few times a year and could ignite cables eventually causing the reactor core to overheat. This happened to a plant (Brown's Ferry) in 1975 and safety equipment became inoperative.

A corroded coolant pipe in the Mihanna nuclear power plant in Japan released super-heated steam killing 5 workers in 2004. The ruptured pipe had not been properly inspected because of inadequate safety reporting practices.

There have been leaks of tritium into underground water, such as at the Braidwood Nuclear Power Plant in Illinois and the Indian Point Nuclear Power Plant in New York, both of which have contaminated drinking water.[26] Tritium is almost impossible to remove from the water supply.

In Hungary, the Paks Nuclear Power Plant had the highest alert situation because of dense smoke as a result of a cigarette butt that ignited insulation material in 2004. A year earlier radioactive gas was released when fuel rods overheated when the cooling system failed. The rods remained in a deep water tank located near the reactor.

Inadequate record-keeping has resulted in poor tracking of the storage and transfer of nuclear fuel. For instance, nuclear fuel rods have been sent to the wrong country or left unattended at airport tarmacs undiscovered for days. Pieces of radioactive fuel rods have gone missing from a southeast Georgia plant. Looking harmless, its possible they may have been disposed of without proper precautions.

The worst fears of the nuclear industry that could affect its future are another Chernobyl or

Three Mile Island accident. On 25 July 2006, one of Sweden's nuclear power plants experienced a near-critical accident.[27] The nuclear power plant at Forsmak was shut shown after there was a cut in power to the nuclear facility. For approximately 20 minutes there was a lack of information about the status of the reactor and therefore no action was taken. There was also concern about a possible melt down. Two back-up generators were able to assist in cooling the reactor. As a precaution two other nuclear power plants were closed because their security could not be guaranteed, cutting in half the number of plants operating. Even a former official at the plant considered it to be serious and criticized Swedish officials for minimizing the potential danger. It remains to be seen whether this accident affects Swedish public opinion, which had been turning more favorably to nuclear energy as the country was implementing a program to close its plants.

The NRC, so far, has not required utilities' to submit new designs for nuclear power plants to ensure that the structures can withstand an airplane attack. Utilities claim security is an NRC responsibility and therefore they are not required to make changes to existing plants or even future ones. According to the industry, simple and inexpensive changes could be made on-site to reduce vulnerability, e.g. having back-up generators on different sides of the facility.[28]

CONCLUSION

Nuclear energy has been proposed as a clean and safe way to meet the challenge of climate change and security of fossil fuel supplies. Many analysts claim that without nuclear energy it will be impossible to meet our future global energy needs. The nuclear industry is already engaged in Asia. In the US and Europe, there remains the potential for public opposition because of the memory of Three Mile Island and Chernobyl accidents. Some European states have declared a moratorium on building new nuclear power plants. In the US, the government is actively supporting the rebirth of nuclear energy; however, nuclear power companies want financial guarantees before they will move ahead. US utilities recall the decline in dividends along with a deteriorating financial situation of the Long Island Lighting Company, which built the Shoreham Nuclear Power Plant in New York. Nuclear energy cannot be financially competitive with other sources of energy without government subsidies and shortened construction and licensing processes. A carbon tax would also help by giving nuclear energy an advantage. Omitted from the financial accounting is the cost of the disposal of nuclear waste. Cost is a significant factor in the decline of nuclear energy in the US in the 1970s and 1980s. Potential public opposition due to concerns about the safety and security of nuclear power plants and nuclear waste storage sites remains problematic. The lack of a permanent solution to the disposal of radioactive waste by any country may be the biggest hurdle for nuclear energy supporters. If new plants are built, tons of radioactive waste will continue to accumulate on plant sites. Moreover, the transit of this material to temporary above ground storage sites will pose additional security risks. Reprocessing can reduce nuclear waste but creates other problems. Such facilities could be used to produce nuclear weapons and the transit of radioactive material poses security problems because of accidents and terrorism.

Some commentators on energy policy claim that nuclear energy must play a role because without it fulfilling our energy needs will be impossible.[29] Solving the climate change problem by increasing reliance on nuclear energy may be swapping one global problem for another. It reduces attention on the real work of implementing sustainable solutions to meet energy demand. Funds that could be used to subsidize and make alternative and renewable energy commercially marketable are spent on promoting nuclear energy. There are other strategies such as reducing energy consumption, diversifying energy sources and increased investment in non-nuclear technologies that are safer, cheaper and environmentally more benign. A nuclear option is not the only one.

ENDNOTES

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