It is time to re-think on environment, energy and economics (E3)

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It is Time to Re-think on Environment, Energy and Economics

(E3)

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Abstract: Il documento sintetizza alcune teorie che relazionano scientificamente Ambiente, Energia ed Economia. Il progetto di seguito descritto fornisce approfondimenti sui problemi teorici e fatti relativi ad inquinanti ambientali e dei suoi effetti sull'economia e l'importanza di basare la produzione energetica dei paesi, su fonti energetiche alternative per soddisfare la crescente domanda di energia elettrica. Inoltre, il documento si prefigge di comparare e confrontare le differenze tra paesi industrializzati e paesi in via di sviluppo, nonché, circa il loro effetto sull'ambiente e sulla loro capacità nella produzione di energia nucleare, il livello di produzione e anche il legame tra scienza ed economia ambientale. Le conclusioni della ricerca ci permetteranno di asserire che i paesi industrializzati non stanno adempiendo ai loro impegni. Il dato rilevante è dato dal fatto che ogni anno circa 7 miliardi di tonnellate di carbonio equivalenti a gas serra nocivi, non dichiarati da parte dei paesi industrializzati, vengono immessi nell'atmosfera. In particolare, la quota degli Stati Uniti è del 24% seguita dal Giappone e dai paesi in via di sviluppo dall'Europa che rappresenta il 26%. Gli altri paesi in via di sviluppo contribuiscono per il 13%, esclusa la Cina. Attualmente soltanto otto stati detengono armi nucleari, mentre, sessanta reattori nucleari sono stati costruiti o sono in fase di realizzazione, oltre quelli già esistenti. Le centrali nucleari in fase di realizzazione, quindi non ancora attive, integreranno la produzione energetica nucleare, per il 17% della capacità esistente, mentre oltre 150 centrali sono in fase di approvazione, quindi, è prevista la realizzazione a breve, che permetterà di produrre un ulteriore 46% della capacità attuale. Sedici paesi dipendono dal nucleare per almeno un quarto della loro elettricità. Tra i paesi sviluppati, la Francia è al primo posto per la produzione di energia dal nucleare, ed ottiene circa tre quarti della sua potenza produttiva da tale tipologia di energia. Nella pianificazione della realizzazione delle centrali nucleari i paesi in via di sviluppo rappresentano una piccolissima quota delle realizzazioni e quindi della produzione mondiale di energia nucleare. Dopo il disastro verificatosi in Giappone, molti paesi hanno

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modificato gli indirizzi politici relativamente ai tempi e modi di realizzazione della produzione di energia tramite sistemi nucleari. Inoltre, il Parlamento Italiano ha sospeso, per un anno, il lavori di approvazione dei progetti sulla produzione di energia attraverso centrali nucleari.

Abstract: The paper summarized some theories and facts related to Environment, Energy and Economics. This work paper provides some highlights about the theoretical issues and facts regarding to environmental pollutions and its effect on economy and the importance of relying on other source energy to fulfil the increasing demand of power or electricity. Moreover, the paper also discussed by making comparison between industrialized and developing countries about their effect on environment and their capacity in producing nuclear energy and production level and also the link between environmental science and economics. This paper concluded that the industrialized countries are not fulfilling their commitments. About 7 Billion Metric Tons of carbon equivalent harmful greenhouse gases are omitted by industrialized countries every year and the share of U.S.A is 24% followed by Japan & Developed European Nations which accounts 26%. Whereas developing nations contributes 13% other than china. Currently only eight countries are known to have a nuclear weapons capability and sixty further nuclear power reactors are under construction, equivalent to 17% of existing capacity, while over 150 are firmly planned, equivalent to 46% of present capacity. Sixteen countries depend on nuclear power for at least a quarter of their electricity. From developed countries, France is the first country that gets around three quarters of its power from nuclear energy. Whereas most developing countries under design and some of them have small share as compared to industrialized countries. After the disaster in Japan, many countries have changed policies on the implementation of nuclear power plants. In addition, the Italian Parliament was suspended for one year, the work of approving projects on the production of energy through nuclear power plants.

Key words: Environment, Economics, Energy;

JEL classification: N5, N7, A12;

Contents: Part one: 1. Introduction; Part two: 2. Environmental pollution and protection: 2.1 Environmental Pollution – 2.2 Environmental Pollution by Developed and Developing Countries - 2.2.1 Developed Countries and Pollution - 2.2.2 Developing countries and Pollution; Part three: 3. Economical effects of Environment; Part four: Nuclear Energy 4.1 Nuclear Energy - 4.1.1 Advantage of Using Nuclear Energy - 4.1.2. Disadvantage of Using Nuclear Energy - 4.2 Comparisons among Various Energy Sources - 4.3 Countries Comparison on Generation and Consumption of Nuclear Power - Conclusion.

Part One

1. Introduction

Though studies on environmental science are plentifully available, they do not cover the economic content of environment and the possible practicable solutions to protect the earth planet from disaster. Similarly, early economists of the classical and neoclassical regime made specific comments about the significance of nature and environment, but did not include them in their exposition of theories. Today, people all over the world have realized that environment is not just the study of flora and fauna, but a synthesis of study of various branches of knowledge like Science, Economics, Philosophy, Ethics, Anthropology, etc. Therefore, a study of environmental economics calls for a detailed understanding about various environmental factors, their influence in the economy, their functions upon the environment, and their impacts upon the life of the people of the present and future. As the world's population increases and there is continued comparison to the current western European, Japanese, and North American living standards, there is likely to be demand for more electrical power. Energy sources available in the world include coal, nuclear, hydroelectric, gas, wind, solar, refuse-based, and biomass. In addition, fusion had been originally proposed as the long-term source. Because of the cost and environmental factors, the demand for nuclear energy increasing dramatically. As the world's population increases and there is continued comparison to the current western European, Japanese, and North American living standards, there is likely to be demand for more electrical power. Energy sources available in the world include coal, nuclear, hydroelectric, gas, wind, solar, refuse-based and biomass. Today, only eight countries are known to have a nuclear weapons capability. By contrast, 56 operate civil research reactors, and 30 host some 440 commercial nuclear power reactors with a total installed capacity of over 377,000 MWe. The main objective of this paper is to provide update information and facts about the environmental pollution and consumption and design of nuclear energy. The paper organized in the following way. The second part deals on environmental pollution and way of protecting pollution. It also discussed the cause of pollution and major pollutant by taking in to account the level of economic development. The third part mainly discussed about the economical effect of environmental pollution and included the relationship between environmental science, economics and the importance of economics to protect and use of natural resources. The fourth part analyzed the different sources of energy and the importance of nuclear energy. Moreover, it covered the design, production and consumption level of nuclear energy by different countries. The last part, part five, summarized the main issued discussed in each paper.

Part two

2. Environmental pollution and protection

2.1 Environmental Pollution

Climate change will affect the basic elements of life for people around the world access to water, food production, health, and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms. Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more. If no action is taken to reduce emissions, the concentration of greenhouse gases in the atmosphere could reach double its pre-industrial level as early as 2035, virtually committing us to a global average temperature rise of over 2 ºC. In the longer term, there would be more than a 50% chance that the temperature rise would exceed 5 ºC. This rise would be very dangerous indeed; it is equivalent to the change in average temperatures from the last ice age to today. Such a radical change in the physical geography of the world must lead to major changes in the human geography where people live and how they live their lives.

The following are the most Global Environmental Problems that require attention in order to protect our world from damage .

- Global Warming;
- Deforestation and Greenhouse Gas Production;
- Persistant Organic Pollutants (POPs);
- Transboundary Movements of Hazardous Wastes;
- Atmospheric Pollution from Civil and Military Air Craft, other gases (methane, carbon dioxide, nitrogen oxide, sulphur dioxide etc.);
- Wreck of old Satellite and Rockets;
- Radioactive Waste Disposal;
- Chemical and Radiological Weapons.

Environmental impacts raised from the civil technology developments as well as from developments and applications of military technology, whether conventional, nuclear or radiological, they all belong to the global problems. Chemical warfare like agent orange, agent blue, agent purple were used during the Vietnam War, others types of chemicals were applied in Kurdistan, Iraq, Tanganyika, (Africa) South

America, Afghanistan etc. In all these areas, health, economical and ecological problems still exist. Let us examine the effects of Depleted Uranium on human and environment.

To deal with global warming and its effect on human and environment, the Kyoto protocol has to be examined closer. The Kyoto conference (protocol)[3] held in February 2005 is understood as annexation of the United Nation Convention about the global emission. The main purpose of this protocol was that the industrialised countries should reduce the harmful greenhouse gas emissions at five percent (5%) below the level of 1990. The reduction process has to be completed by the year 2012. The global warming is due to climate change. According to earth and atmospheric scientists, since 1900 the temperature of our Planet has increased by 0.7 ºC (Degree Celsius). With global warming are associated, natural events like floods, hurricanes, that had occurred in the last two or three years in the world. In this context, also rising of sea level and ocean temperature can be mentioned. To protect the environment and promote the exchange of information about Persistent Organic Pollutants (Pops) the UNEP has organised the Stockholm Convention and has established an office known as Ozone Secretariat. The Secretariat deals with matters of the Vienna Convention for the protection of Ozone Layer and the Montreal Protocol on substances that deplete the Ozone Layer. To control trans boundary movement of hazardous wastes and to minimise the quantity the Basel Convention was established. Effective action requires a global policy response, guided by a common international understanding of the long-term goals for climate policy and strong frameworks for co-operation. Key elements of future international frameworks should include:

Emissions trading:

- Expanding and linking the growing number of emissions trading schemes around the world is a powerful way to promote cost-effective reductions in emissions and to bring forward action in developing countries.

- Strong targets in rich countries could drive flows amounting to tens of billions of dollars each year to support the transition to low-carbon development paths.

Technology co-operation:

- Informal co-ordination as well as formal agreements can boost the effectiveness of investments in innovation around the world.

- Globally, support for energy research and development should at least double, and support for the deployment of low-carbon technologies should increase up to five-fold.

[3] The Kyoto Protocol was an agreement negotiated by many countries in December 1997 and came into force with Russia's ratification on February 16, 2005.

- International co-operation on product standards is a powerful way to boost energy efficiency.

Action to reduce deforestation and Adaptation: The loss of natural forests around the world contributes more to global emissions each year than the transport sector. Curbing deforestation is a highly cost-effective way to reduce emissions; large-scale international pilot programmes to explore the best ways to do this should get underway very quickly. The poorest countries are most vulnerable to climate change. It is essential that climate change be fully integrated into development policy, and that rich countries honour their pledges to increase support through overseas development assistance. International funding should also support improved regional information on climate change impacts, and research into new crop varieties that will be more resilient to drought and flood.

The Design and Implementation of Climate Policy: The design of climate policy should account for international considerations. Kala Krishna uses a general equilibrium model to draw analogies between emission permit restrictions and quotas or other trade restrictions, with effects on output prices, factor prices, and traded quantities. Besides the effects on traded goods, climate policy might create trade in "offsets", with problems.

2.2 Environmental Pollution by Developed and Developing Countries

2.2.1 Developed Countries and Pollution

The Earth naturally absorbs incoming solar radiation and emits thermal back into space. Some of the thermal radiation is trapped by certain so-called greenhouse gases in the atmosphere, which increases warming of the Earth's surface and atmosphere; trap some of the thermal radiation. In recent years, carbon dioxide (CO_2) a naturally occurring greenhouse gas, has been building up in the atmosphere as a result of human activities burning of fossil fuels (coal, oil and natural gas) and deforestation Water vapour, methane (CH_4) Nitrous oxide (N_2O) and ozone (O_3) are also naturally occurring greenhouse Greenhouse gases that are mostly human-made include chlorofluorocarbons (CFCs) hydro-chloro-fluocrbons (FECs), and sulphur-hexafluoride (SF_6) Several non-greenhouse gases Carbon monoxide (CO), oxides of nitrogen (N_2O) and non-methane volatile organic compounds contribute indirectly to the greenhouse effect by producing greenhouse gases during chemical transformations.

In Dec, 1997, a United National summit on global warming was held in Kyoto, Japan, arranged by industrialized countries. Delegates from over 150 nations attended international treaty to set some limits on emission of (CO_2), CH_4, HFC_2, PFCs and SF_6, The accord, known as the Kyoto Protocol. Called for

an overall reduction in emissions of 5.2% below 1990 levels by the year 2021, significantly below the 15% reduction proposed by the European Union. Under the accord, the 15 EU nations agreed to reductions of 8% The U.S. to 7% and Japan to 6% the under developing countries were permitted to limit their emissions voluntarily. The accord allowed high emissions nations to meet their targets by Purchasing pollution rights nations that have exceeded their goal, although the mechanism for buying and selling such emission permits were not worked out. According to this agreement the industrialized countries agreed to provide 0.8% of their GDP which comes out to be 240 Billion US $ every year to the developing counties and their own industries to work for environmental protection. The industrialized countries are not full filling their commitments. About 7 Billion Metric Tons of carbon equivalent harmful greenhouse gases are omitted by industrialized countries every year. This quantity does not include carbon dioxide (CO_2) absorbed by the forests. The Industrialized countries are responsible for 78% direct environmental pollution as per EPA Washington U.S.A reports . The industrialized countries are exporting their waste by incineration process and pumping in to the atmosphere and the percentage polluting by industrialized countries would be:

1. U.S.A = 24%;
2. Japan & Developed Eu. Nations = 26%;
3. Eastern Europe and former USSR= 15%;
4. China = 13%;
5. India = 9%;
6. Other developing nations = 13%.

The Industrialized Countries are transferring out-dated technologies/processes and equipments to poor developing countries, which do not fulfill their own environmental standards, resulting lot of pollution in those countries. Not only this, they are dumping their hazardous wastes in poor developing countries. Due to lack of education in developing countries, the industrialized nations are exploiting and trying to get the environmental cost from them by various tactics and slogans i.e. Depletion of Ozone layer etc. Where in the industrialized countries are mainly responsible for the environmental pollution, damage to Ozone layer and global warming. The CFC's produced and marketed by industrialized countries like U.S.A. USSR, Japan European Union, Canada, Australia etc; has mainly damaged the Ozone layer. NASA has reported in 1995 that human produced CFC,s will continue depleting Ozone layer till 2020. They are not ready to pay its environmental damages cost which is in Trillions of dollars. It is suggested that in the larger interest of global peace and security/protection. The economic pollution may be first eradicated by financing the poor nations and bringing them to equal respectable level without any discrimination of religion, colour, race and region etc. Otherwise no one can protect the globe from nuclear disaster and other wars of terrorism. In the larger interest of global cleanliness the recycling

industries in particular should be promoted and the 21st century may be named as recycling century. To protect this Earth globe from environmental pollution, Technologies special grants and interest free financing, by international donor agencies should be provided all over the world with immediate effect on emergency basis for recycling industries.

2.2.2 Developing countries and Pollution

Industrial pollution is a more complicated problem in developing countries than in developed economies. There are greater structural obstacles to preventing and cleaning up pollution. These obstacles are largely economic, because developing countries do not have the resources to control pollution to the extent that developed countries can. On the other hand, the effects of pollution may be very costly to a developing society, in terms of health, waste, environmental degradation, reduced quality of life and clean-up costs in the future. An extreme example is concern for the future of children exposed to lead in some megacities in countries where leaded gasoline is still used, or in the vicinity of smelters. Some of these children have been found to have blood lead levels high enough to impair intelligence and cognition.

Industry in developing countries usually operates short of capital compared to industry in developed countries, and those investment funds that are available are first put into the equipment and resources necessary for production. Capital that is applied toward control of pollution is considered "unproductive" by economists because such investment does not lead to increased production and financial return. However, the reality is more complicated. Investment in control of pollution may not bring an obvious direct return on investment to the company or industry, but that does not mean that there is no return on investment. In many cases, as in an oil refinery, control of pollution also reduces the amount of wastage and increases the efficiency of the operation so that the company does benefit directly. Where public opinion carries weight and it is to the advantage of a company to maintain good public relations, industry may make an effort to control pollution in its own interest. Unfortunately, the social structure in many developing countries does not favour this because the people most negatively affected by pollution tend to be those who are impoverished and marginalized in society. Pollution may damage the environment and society as a whole, but these are "externalized dis-economies" that do not substantially hurt the company itself, at least not economically. Instead, the costs of pollution tend to be carried by society as a whole, and the company is spared the costs. This is particularly true in situations where the industry is critical to the local economy or national priorities, and there is a high tolerance for the damage it causes. One solution would be to "internalize" the external dis-economies by incorporating the costs of clean-up or the estimated costs of environmental damage into the operating costs of the company as a tax. This would give the company a financial incentive to control its costs by

reducing its pollution. Virtually no government in any developing country is in a position to do this and to enforce the tax, however.

In practice, capital is rarely available to invest in equipment to control pollution unless there is pressure from government regulation. However, governments are rarely motivated to regulate industry unless there are compelling reasons to do so, and pressure from their citizens. In most developed countries, people are reasonably secure in their health and their lives, and expect a higher quality of life, which they associate with a cleaner environment. Because there is more economic security, these citizens are more willing to accept an apparent economic sacrifice in order to achieve a cleaner environment. However, in order to be competitive in world markets, many developing countries are very reluctant to impose regulation on their industries. Instead, they hope that industrial growth today will lead to a society rich enough tomorrow to clean up the pollution. Unfortunately, the cost of clean-up increases as fast as, or faster than, the costs associated with industrial development. At an early stage of industrial development, a developing country would in theory have very low costs associated with the prevention of pollution, but hardly ever do such countries have the capital resources they need to do so. Later, when such a country does have the resources, the costs are often staggeringly high and the damage has already been done. Industry in developing countries tends to be less efficient than in developed countries. This lack of efficiency is a chronic problem in developing economies, reflecting untrained human resources, the cost of importing equipment and technology, and the inevitable wastage that occurs when some parts of the economy are more developed than others.

This inefficiency is also based in part on the need to rely on outdated technologies which are freely available, do not require an expensive licence or that do not cost as much to use. These technologies are often more polluting than the state-of-the-art technologies available to industry in developed countries. An example is the refrigeration industry, where the use of chlorofluorocarbons (CFCs) as refrigerant chemicals is much cheaper than the alternatives, despite the serious effects of these chemicals in depleting ozone from the upper atmosphere and thereby reducing the earth's shield from ultraviolet radiation; some countries had been very reluctant to agree to prohibit the use of CFCs because it would then be economically impossible for them to manufacture and purchase refrigerators. Technology transfer is the obvious solution, but companies in developed countries who developed or hold the licence for such technologies are understandably reluctant to share them. They are reluctant because they spent their own resources developing the technology, wish to retain the advantage they have in their own markets by controlling such technology, and may make their money from using or selling the technology only during the limited term of the patent. Another problem faced by developing countries is lack of expertise in and awareness of the effects of pollution, monitoring methods and the technology of pollution control. There are relatively few experts in the field in developing countries, in part because there are fewer jobs and a smaller market for their services even though the need may actually be greater.

Because the market for pollution control equipment and services may be small, this expertise and technology may have to be imported, adding to the costs. General recognition of the problem by managers and supervisors in industry may be lacking or very low. Even when an engineer, manager or supervisor in industry realizes that an operation is polluting, it may be difficult to persuade others in the company, their bosses or the owners that there is a problem that must be solved.

Industry in most developing countries competes at the low end of international markets, meaning that it produces products that are competitive on the basis of price and not quality or special features. Few developing countries specialize in making very fine grades of steel for surgical instruments and sophisticated machinery, for example. They manufacture lesser grades of steel for construction and manufacturing because the market is much larger, the technical expertise required to produce it is less, and they can compete on the basis of price as long as the quality is good enough to be acceptable. Pollution control reduces the price advantage by increasing the apparent costs of production without increasing output or sales. The central problem in developing countries is how to balance this economic reality against the need to protect their citizens, the integrity of their environment, and their future, realizing that after development the costs will be even higher and the damage may be permanent.

Part three

Economical effects of Environment

Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources. The environment provides both a direct value as well as raw material intended for economic activity, thus making the environment and the economy interdependent. For that reason, the way in which the economy is managed has an impact on the environment which, in turn, affects both welfare and the performance of the economy. One of the best known critics of traditional economic thinking about the environment is Herman Daly[4]. In his first book, Steady-State Economics, Daly suggested that "enough is best," arguing that economic growth leads to environmental degradation and inequalities in wealth. He asserted that the economy is a subset of our environment, which is finite. Therefore his notion of a steady-state economy is one in which there is an optimal level of population and economic activity which leads to sustainability. Daly calls for a qualitative improvement in people's lives – development – without perpetual growth. Today, many of his ideas are associated with the concept of sustainable development.

[4] Human Daly, The ecological economics perspective, p. 253.

Environmental economics takes into consideration issues such as the conservation and valuation of natural resources, pollution control, waste management and recycling, and the efficient creation of emission standards. Economics is an important tool for making decisions about the use, conservation, and protection of natural resources because it provides information about choices people make, the costs and benefits of various proposed measures, and the likely outcome of environmental and other policies. Since resources –whether human, natural, or monetary – are not infinite, these public policies are most effective when they achieve the maximum possible benefit in the most efficient way. Therefore, one job of policymakers is to understand how resources can be utilized most efficiently in order to accomplish the desired goals by weighing the costs of various alternatives to their potential benefits. In competitive markets, information exists about how much consumers value a particular good because we know how much they are willing to pay. When natural resources are involved in the production of that particular good, there may be other factors – scarcity issues, the generation of pollution – that are not included in its production cost. In these instances, scarcity issues or pollution become externalities, costs that are external to the market price of the product. If these full costs were included, the cost of the good may be higher than the value placed on it by the consumer. A classic example of an externality is discussed in Garrett Hardin's Tragedy of the Commons, which occurs in connection to public commons or resources-areas that are open and accessible to all, such as the seas or the atmosphere. Hardin observed that individuals will use the commons more than if they had to pay to use them, leading to overuse and possibly to increased degradation. There are three general schools of thought associated with reducing or eliminating environmental externalities. Most welfare economists believe that the existence of externalities is sufficient justification for government intervention, typically involving taxes and often referred to as Pigovian taxes after economist Arthur Pigou (1877-1959) who developed the concept of economic externalities[5]. Market economists tend to advocate the use of incentives to reduce environmental externalities, rather than command-and control approaches, because incentives allow flexibility in responding to problems rather than forcing a singular approach on all individuals. Free market economists focus on eliminating obstacles that prevent the market from functioning freely, which they believe would lead to an optimal level of environmental protection and resource use. The key objective of environmental economics is to identify those particular tools or policy alternatives that will move the market toward the most efficient allocation of natural resources.

[5] Environmental economics, The essential, Vol. I p.21.

Graph 1: an economic view of the environment[6].

Environmental and energy policy can affect employment, productivity, and growth, as well as emissions and overall economic welfare. Alternative policies differ in terms of these effects, and therefore deserve study. These policies certainly affect the price and availability of natural resources, including fisheries, land, water, and petroleum. Policies for environmental protection may affect the benefit or value of ecosystem services. A major economic impact of environmental policies is their overall cost. Because air quality varies through the course of the year, costs can be reduced by limiting driving more on high-zone days, for example by selling fewer permits to drive on those days. Absent coordinated and harmonized global climate change policy, emissions regulation imposed in one jurisdiction may lead to increases in emissions in other jurisdictions that are less stringently regulated.

One must also distinguish between energy efficiency and economic efficiency. Maximizing economic efficiency-typically operationalized as maximizing net benefits to society-is generally not going to imply maximizing energy efficiency, which is a physical concept and comes at a cost. An important issue arises, however, regarding whether private economic decisions about the level of energy efficiency chosen for products are economically efficient. This will depend on the economic efficiency of the market conditions the consumer faces (e.g., energy prices, information availability) as well as the economic behavior of the individual decision maker (e.g., cost-minimizing behavior). The global nature of climate change makes an economic analysis more complex than for any other local or regional environmental pollution problem. In addition, the fact that the impacts of climate change will not necessarily be felt immediately, but rather sometime in the future, complicates the analysis. Economic analysis of a

[6] Environmental economics, The essential, Vol. I p. 7.

problem with such a long time horizon will be highly dependent on what assumptions are made about the preferences of future generations. This study is neither global nor dynamic in scope, which means that we avoid some of the problems with an economic analysis.

Even if our analysis is not global or dynamic in scope, it does not mean that no difficulties remain. A careful economic analysis of climate change requires that all kinds of economic values associated with affected environmental systems are addressed. Natural systems provide goods and services that have value for society. In addition, certain attributes of an ecosystem, for example biodiversity, can be valuable because local people and/or people living further away value the fact that certain species exist. Values associated with the functioning of ecosystems can be divided into *use values* as well as *non-use values*, where the first type concerns the direct use of a natural resource and the second type refers to the *option value* for future use or even the *existence value* of just knowing that a resource exists. Use values can be further divided into *consumptive* and *non-consumptive* values. Consumptive use values could, for example, be the value of harvesting a resource such as timber, fish or trophy hunting tourism activities, or the value of production from agricultural land use. Non-consumptive use values are obtained without directly affecting the natural resource. They include recreation and wildlife viewing tourism activities. Within both the use and non-use categories, some values are hard to capture because markets for these ecosystem attributes do not exist. An example of a non-marketed use value could be the collection of firewood from forests. This activity can be very important for the livelihoods of rural households, but such values are typically not included in traditional national accounts. Non-use values are almost always non-marketed values, like for example the value people place on the conservation of an endangered species. To assess the total value of a natural resource or an ecosystem, all the values described above should be recognized. This is not an easy task, and as a result, most current economic studies considering climate change impacts are partial studies that concentrate on a specific area, such as agricultural impacts, and focus on the impacts that are reflected in the national accounts.

Part four

Nuclear Energy

4.1 Nuclear Energy

Nuclear energy is released from the nucleus of an atom. Nuclear reactions like fusion (when two atomic nuclei combine to form a single heavy nucleus) and fission (when a single heavy nucleus splits into two smaller nuclei), release very high amounts of energy. The mass of an atom gets converted into energy. Einstein's famous equation helps to calculate the amount of energy released during a nuclear reaction. This equation is given as:

$$E = mc^2$$

where, **E** is energy, **m** is mass, and **c** is the speed of light in vacuum. The energy released, is the result of the differences in the total mass of the participating elements, before and after the reaction. The process is a chain reaction and energy is released, until the atom becomes stable.

Nuclear energy, also called as atomic energy, was first discovered by French scientist Henri Becquerel in 1896. Nuclear energy is used as a power source. Nuclear reactors are the devices that initiate and control nuclear chain reactions. They are used as sources for generation of nuclear power. Currently, the fission process is prominently carried out in most of the nuclear reactors to generate energy. Uranium (U-235) is used as fuel for nuclear reactors because its atoms split very easily. Fission reaction generates heat which helps boiling of water and produces steam. The pressurized steam moves the steam turbines, resulting in the production of electricity. Nuclear energy has been proposed as an answer to the need for a clean energy source as opposed to (CO_2)-producing plants. Nuclear energy is not necessarily a clean energy source. The effects nuclear energy have on the environment pose serious concerns that need to be considered, especially before the decision to build additional nuclear power plants is made. Essentially, nuclear power seems quite simple. Nuclear fission heats water to generate steam, the steam turns turbines connected to a generator which in turn produces electrical power. Nuclear fission is the splitting of atoms, a process in which a great deal of energy in the form of heat is produced. Where things get complex are the controls and resources needed to keep the fission reaction safe.

4.1.1 Advantage of Using Nuclear Energy [7]

Carbon Dioxide: Nuclear power has been called a clean source of energy because the power plants do not release carbon dioxide. While this is true, it is deceiving. Nuclear power plants may not emit carbon dioxide during operation, but high amounts of carbon dioxide are emitted in activities related to building and running the plants. Nuclear power plants use uranium as fuel. The process of mining uranium releases high amounts of carbon dioxide into the environment. Carbon dioxide is also released into the environment when new nuclear power plants are built. Finally, the transport of radioactive waste also causes carbon dioxide emissions.

Low Level Radiation: Nuclear power plants constantly emit low levels of radiation into the environment. There is a differing of opinion among scientists over the effects caused by constant low levels of radiation. Various scientific studies have shown an increased rate of cancer among people who live near nuclear power plants. Long-term exposure to low level radiation has been shown to damage

[7] Nuclear energy-the future climate, June 1999, pp.10-14.

DNA. The degree of damage low levels of radiation cause to wildlife, plants and the ozone layer is not fully understood. More research is being done to determine the magnitude of effects caused by low levels of radiation in the environment.

Water Use and Environmental Stewardship: The large-scale generation of electricity and the large-scale production of usable water are interdependent. Water use is one of several interrelated environmental considerations that need to be analyzed together when considering electricity generation.

Sustainable Development and Ecology: Nuclear energy has a vital role to play in providing clean energy for sustainable economic development around the world. Nuclear energy has one of the lowest impacts on the environment of any energy source because it does not emit air pollution, isolates its waste from the environment and requires a relatively small amount of land.

Clean Electricity for Transportation: Research is under way to reduce air emissions from the transportation sector by developing electric vehicles that can run farther and longer between charges. Clean electricity from nuclear plants can make these vehicles truly "clean".

4.1.2. Disadvantage of Using Nuclear Energy[8]

The major disadvantage of nuclear power is safety. Proponents would argue that despite the two notorious nuclear accidents, nuclear energy still has a very good track record. That actually is correct, but like airplanes versus cars, the magnitude of a problem when it occurs however infrequently compounds the public perception of risk. For example, it is known that airplanes have a better safety record than automobiles, but when there is a plane crash it is a disaster and grabs headlines. Car crashes are so common that they are not even news. Similarly, any problem with nuclear power is a big issue and garners major media coverage.

Nuclear Proliferation: Proliferation is the spread of nuclear weapons to unreliable owners - a disadvantage of nuclear power. Increasingly proliferation is becoming the prime disadvantage. This is because it is an unfortunate reality of the world that a lot of governments cannot be considered reliable or trustworthy with dangerous substances, and increasingly it is feasible for them to develop nuclear weapons. In a world where freedoms and equality have been attacked, it becomes of concern that such governments might possess nuclear weaponry, or that non-governmental organizations like terrorist groups might use nuclear bombs to serve some twisted political agenda. In the cold war period, nuclear

[8] Nuclear energy-the future climate, June 1999, pp. 10-14.

weapons were only accessible to generally predictable powers, whether the United States or Soviet Union, or the U.K. or reportedly Israel. However, with the fragmentation and realignment following the end of the cold war increasingly weapon technology has found its way to less predictable powers.

Nuclear Waste Disposal: Another disadvantage of nuclear energy is disposal of the spent fuel rods. They remain radioactive literally for hundreds if not thousands of years. So they must be disposed of in a secure nuclear waste disposal facility. Naturally nobody wants a nuclear waste dump in their backyard, so location of a suitable long-term storage has bedeviled the industry for years.

Radioactive Waste: Radioactive waste is a huge concern. Waste from nuclear power plants can remain active for hundreds of thousands of years. Currently, much of the radioactive waste from nuclear power plants has been stored at the power plant. Due to space constraints, eventually the radioactive waste will need to be relocated.

There are several issues with burying the radioactive waste. Waste would be transported in large trucks. In the event of an accident, the radioactive waste could possibly leak. Another issue is uncertainty about whether the casks will leak after the waste is buried. There is no current solution to deal with the issue of radioactive waste. Some scientists feel that the idea of building more nuclear power plants and worrying about dealing with the waste later has the potential of a dangerous outcome.

Cooling Water System: Cooling systems are used to keep nuclear power plants from overheating. There are two main environmental problems associated with nuclear power plant cooling systems. First, the cooling system pulls water from an ocean or river source. Fish are inadvertently captured in the cooling system intake and killed. Second, after the water is used to cool the power plant, it is returned to the ocean or river. The water that is returned is approximately 25 degrees warmer than the water was originally. The warmer water kills some species of fish and plant life.

Nuclear Power Plant Accidents and Terrorism: According to the Union of Concerned Scientists, regulated safety procedures are not being followed to ensure that nuclear power plants are safe. Even if all safety precautions are followed, it is no guarantee that a nuclear power plant accident will not occur. If a nuclear power plant accident occurs, the environment and surrounding people could be exposed to high levels of radiation. Terrorism threats are another concern that needs to be addressed. A satisfactory plan to protect nuclear power plants from terrorism is not in place.

4.2 Comparisons among Various Energy Sources

As the world's population increases and there is continued comparison to the current western European, Japanese, and North American living standards, there is likely to be demand for more electrical power. Energy sources available in the world include coal, nuclear, hydroelectric, gas, wind, solar, refuse-based, and biomass. In addition, fusion had been originally proposed as the long-term source. Every form of energy generation has advantages and disadvantages as shown in the table below.

Sources	Advantage	Disadvantage
Coal	❖ Inexpensive ❖ Easy to recover (in U.S. and Russia)	❖ Requires expensive air pollution controls (e.g. mercury, sulphur dioxide) ❖ Significant contributor to acid rain and global warming ❖ Requires extensive transportation system
Nuclear	❖ Fuel is inexpensive ❖ Energy generation is the most concentrated source ❖ Waste is more compact than any source ❖ Extensive scientific basis for the cycle ❖ Easy to transport as new fuel ❖ No greenhouse or acid rain effects	❖ Requires larger capital cost because of emergency, containment, radioactive waste and storage systems ❖ Requires resolution of the long-term high level waste storage issue in most countries ❖ Potential nuclear proliferation issue
Hydroelectric	❖ Very inexpensive once dam is built	❖ Very limited source since depends on water elevation ❖ Many dams available are currently exist (not much of a future source[depends on country]) ❖ Dam collapse usually leads to loss of life ❖ Dams have affected fish (e.g. salmon runs) ❖ Environmental damage for areas flooded (backed up) and downstream
Gas / Oil	❖ Good distribution system for current use	❖ Very limited availability as shown by shortages during winters several years ago

	levels ❖ Easy to obtain (sometimes) ❖ Better as space heating energy source	❖ Could be major contributor to global warming ❖ Very expensive for energy generation ❖ Large price swings with supply and demand ❖ Liquefied Natural Gas storage facilities and gas transmission systems have met opposition from environmentalists.
Wind	❖ Wind is free if available. ❖ Good source for periodic water pumping demands of farms as used earlier in 1900's ❖ Generation and maintenance costs have decreased significantly. Wind is proving to be a reasonable cost renewable source. ❖ Well suited to rural areas. Examples include Mid-Columbia areas of Oregon and Washington, western Minnesota, Atlantic Ocean off Cape Cod	❖ Need 3x the amount of installed generation to meet demand ❖ Limited to windy areas. ❖ Limited to small generator size; need many towers. ❖ Highly climate dependent - wind can damage equipment during windstorms or not turn during still summer days. ❖ May affect endangered birds, however tower design can reduce impact.
Solar	❖ Sunlight is free when available ❖ Costs are dropping.	❖ Limited to southern areas of U.S. and other sunny areas throughout the world (demand can be highest when least available, e.g. winter solar heating) ❖ Does require special materials for mirrors/panels that can affect environment ❖ Current technology requires large amounts of land for small amounts of energy generation
Biomass	❖ Industry in its infancy	❖ Inefficient if small plants are used

	❖ Could create jobs because smaller plants would be used	❖ Could be significant contributor to global warming because fuel has low heat content
Refuse Based Fuel	❖ Fuel can have low cost ❖ Could create jobs because smaller plants would be used ❖ Low sulfur dioxide emissions	❖ Inefficient if small plants are used ❖ Could be significant contributor to global warming because fuel has low heat content ❖ Flyash can contain metals as cadmium and lead ❖ Contain dioxins and furans in air and ash releases
Hydrogen	❖ Combines easily with oxygen to produce water and energy	❖ Very costly to produce ❖ Takes more energy to produce hydrogen then energy that could be recovered.
Fusion	❖ Hydrogen and tritium could be used as fuel source ❖ Higher energy output per unit mass than fission ❖ Low radiation levels associated with process than fission-based reactors	❖ Breakeven point has not been reached after ~40 years of expensive research and commercially available plants not expected for at least 35 years.

Table 1: Different sources of energy.

4.3 Countries Comparison on Generation and Consumption of Nuclear Power

Today, only eight countries are known to have a nuclear weapons capability. By contrast, 56 operate civil research reactors, and 30 host some 440 commercial nuclear power reactors with a total installed capacity of over 377,000 MWe . This is more than three times the total generating capacity of France or Germany from all sources. Over 60 further nuclear power reactors are under construction, equivalent to 17% of existing capacity, while over 150 are firmly planned, equivalent to 46% of present capacity. Sixteen countries depend on nuclear power for at least a quarter of their electricity. France gets around

three quarters of its power from nuclear energy, while Belgium, Bulgaria, Czech Republic, Hungary, Slovakia, South Korea, Sweden, Switzerland, Slovenia and Ukraine get one third or more. Japan, Germany and Finland get more than a quarter of their power from nuclear energy, while in the USA one fifth is from nuclear. Among countries which do not host nuclear power plants, Italy gets about 10% of its power from nuclear, and Denmark about 8%.

As nuclear power plant construction returns to the levels reached during the 1970s and 1980s, those now operating are producing more electricity. In 2007, production was 2608 billion kWh. The increase over the six years to 2006 (210 TWh) was equal to the output from 30 large new nuclear power plants.
Yet between 2000 and 2006 there was no net increase in reactor numbers (and only 15 GWe in capacity). The rest of the improvement is due to better performance from existing units. In 2007 performance dropped back by 50 TWh due to plant closures in Germany, UK and Japan.In a longer perspective, from 1990 to 2006, world capacity rose by 44 GWe (13.5%, due both to net addition of new plants and up rating some established ones) and electricity production rose 757 billion kWh (40%).
The relative contributions to this increase were: new construction 36%, up rating 7% and availability increase 57%.One quarter of the world's reactors have load factors of more than 90%, and nearly two thirds do better than 75%, compared with about a quarter of them in 1990. For 15 years Finnish plants topped the performance tables, but the USA now dominates the top 25 positions, followed by Japan and South Korea. US nuclear power plant performance has shown a steady improvement over the past twenty years, and the average load factor now stands at around 90%, up from 66% in 1990 and 56% in 1980. This places the USA as the performance leader with nearly half of the top 25 reactors, the 25th achieving more than 98%. The USA accounts for nearly one third of the world's nuclear electricity. In 2009 and 2010 nine countries averaged better than 80% load factor, while French reactors averaged 73%, despite many being run in load-following mode, rather than purely for base-load power. Some of these figures suggest near-maximum utilization, given that most reactors have to shut down every 18-24 months for fuel change and routine maintenance. In the USA this used to take over 100 days on average but in the last decade it has averaged about 40 days. Another performance measure is unplanned capability loss, which in the USA has for the last few years been below 2%.

Part five

Conclusion

Our planet earth differs from other planets in having an environment. The biosphere in which begins have their sustenance has oxygen, nitrogen, carbon dioxide, argon and water vapor. All these are well

balanced to ensure a healthy life in the world. As we know environmental pollution should not be the concern of specific organization or country and could not be one time campaign. It requires a great deal of effort from each country to restore the polluted environment and to keep it for long-time. However, the degree of polluting by continent is not the same. For example, the industrialized countries about 7 Billion Metric Tons of carbon equivalent harmful greenhouse gases are omitted by industrialized countries every year. This quantity does not include carbon dioxide (CO_2) absorbed by the forests.

The Industrialized countries are responsible for 78% direct environmental pollution as per EPA Washington U.S.A reports. Industrial pollution is a more complicated problem in developing countries than in developed economies. Moreover, the effects of polluted environment by industrialized countries are greater structural obstacles to preventing and cleaning up pollution. These obstacles are largely economic, because developing countries do not have the resources to control pollution to the extent that developed countries can. On the other hand, the effects of pollution may be very costly to a developing society, in terms of health, waste, environmental degradation, reduced quality of life and clean-up costs in the future. An extreme example is concern for the future of children exposed to lead in some megacities in countries where leaded gasoline is still used, or in the vicinity of smelters. Some of these children have been found to have blood lead levels high enough to impair intelligence and cognition. Industry in developing countries usually operates short of capital compared to industry in developed countries, and those investment funds that are available are first put into the equipment and resources necessary for production.

The use of nuclear energy for the production of electricity is not only an appropriate alternative for industrialized countries; it is becoming the preferred choice for developing countries that do not have natural energy resources in their own territory. This is particularly true of countries within the Pacific Rim. The reliable and economic electricity from their nuclear power plants has been a significant factor in the development of the strong economies of countries such as China, India and South Korea. Moreover , other less developed nation should also rethink other source of energy like nuclear energy in order to bring sustainable development and to satisfy the growing demand of energy. Developed country like France gets 76% of its electricity from nuclear power, Lithuania, which gets 73% and Belgium, which gets 54%, rely most heavily on nuclear energy. Sixteen countries rely on nuclear energy to provide more than one-quarter of their electricity supply. The United States has the largest nuclear generating capacity in the world with 104 reactors in operation, generating almost 20% of the power required by Americans.

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Appendix

This table includes only those future reactors envisaged in specific plans and proposals and expected to be operating by 2030. Longer-range estimates based on national strategies, capabilities and needs may be found in the WNA Nuclear Century Outlook. The WNA country papers linked to this table cover both areas: near-term developments and the prospective long-term role for nuclear power in national energy policies.

COUNTRY	NUCLEAR ELECTRICITY GENERATION 2009		REACTORS OPERABLE 1 Mar 2011		REACTORS UNDER CONSTRUCTION 1 Mar 2011		REACTORS PLANNED March 2011		REACTORS PROPOSED March 2011		URANIUM REQUIRED 2011
	billion kWh	% e	No.	MWe net	No.	MWe gross	No.	MWe gross	No.	MWe gross	tonnes U
Argentina	7.6	7.0	2	935	1	745	2	773	1	740	208
Armenia	2.3	45	1	376	0	0	1	1060			56
Bangladesh	0	0	0	0	0	0	2	2000	0	0	0
Belarus	0	0	0	0	0	0	2	2000	2	2000	0
Belgium	45	51.7	7	5943	0	0	0	0	0	0	1052
Brazil	12.2	3.0	2	1901	1	1405	0	0	4	4000	311
Bulgaria	14.2	35.9	2	1906	0	0	2	1900	0	0	275
Canada	85.3	14.8	18	12679	2	1500	3	3300	3	3800	1884
Chile	0	0	0	0	0	0	0	0	4	4400	0
China	65.7	1.9	13	10234	27	29790	50	57830	110	108000	4402
Czech Republic	25.7	33.8	6	3722	0	0	2	2400	1	1200	680
Egypt	0	0	0	0	0	0	1	1000	1	1000	0
Finland	22.6	32.9	4	2721	1	1700	0	0	2	3000	468
France	391.7	75.2	58	63130	1	1720	1	1720	1	1100	9221
Germany	127.7	26.1	17	20339	0	0	0	0	0	0	3453
Hungary	14.3	43	4	1880	0	0	0	0	2	2200	295
India	14.8	2.2	20	4385	5	3900	18	15700	40	49000	1053
Indonesia	0	0	0	0	0	0	2	2000	4	4000	0

COUNTRY	NUCLEAR ELECTRICITY GENERATION 2009		REACTORS OPERABLE 1 Mar 2011		REACTORS UNDER CONSTRUCTION 1 Mar 2011		REACTORS PLANNED March 2011		REACTORS PROPOSED March 2011		URANIUM REQUIRED 2011
	billion kWh	% e	No.	MWe net	No.	MWe gross	No.	MWe gross	No.	MWe gross	tonnes U
Iran	0	0	0	0	1	1000	2	2000	1	300	150
Israel	0	0	0	0	0	0	0	0	1	1200	0
Italy	0	0	0	0	0	0	0	0	10	17000	0
Japan	263.1	28.9	55	47348	2	2756	12	16538	1	1300	8195
Jordan	0	0	0	0	0	0	1	1000			0
Kazakhstan	0	0	0	0	0	0	2	600	2	600	0
Korea DPR (North)	0	0	0	0	0	0	0	0	1	950	0
Korea RO (South)	141.1	34.8	21	18675	5	5800	6	8400	0	0	3586
Lithuania	10.0	76.2	0	0	0	0	0	0	1	1700	0
Malaysia	0	0	0	0	0	0	0	0	1	1200	0
Mexico	10.1	4.8	2	1600	0	0	0	0	2	2000	247
Netherlands	4.0	3.7	1	485	0	0	0	0	1	1000	107
Pakistan	2.6	2.7	2	400	1	300	2	600	2	2000	68
Poland	0	0	0	0	0	0	6	6000	0	0	0
Romania	10.8	20.6	2	1310	0	0	2	1310	1	655	175
Russia	152.8	17.8	32	23084	10	8960	14	16000	30	28000	3757
Slovakia	13.1	53.5	4	1816	2	880	0	0	1	1200	267
Slovenia	5.5	37.9	1	696	0	0	0	0	1	1000	145
South Africa	11.6	4.8	2	1800	0	0	0	0	6	9600	321
Spain	50.6	17.5	8	7448	0	0	0	0	0	0	1458
Sweden	50.0	34.7	10	9399	0	0	0	0	0	0	1537
Switzerland	26.3	39.5	5	3252	0	0	0	0	3	4000	557
Thailand	0	0	0	0	0	0	0	0	5	5000	0
Turkey	0	0	0	0	0	0	4	4800	4	5600	0
Ukraine	77.9	48.6	15	13168	0	0	2	1900	20	27000	2037

COUNTRY	NUCLEAR ELECTRICITY GENERATION 2009		REACTORS OPERABLE 1 Mar 2011		REACTORS UNDER CONSTRUCTION 1 Mar 2011		REACTORS PLANNED March 2011		REACTORS PROPOSED March 2011		URANIUM REQUIRED 2011
	billion kWh	% e	No.	MWe net	No.	MWe gross	No.	MWe gross	No.	MWe gross	tonnes U
UAE	0	0	0	0	0	0	4	5600	10	14400	0
United Kingdom	62.9	17.9	19	10962	0	0	4	6680	9	12000	2235
USA	798.7	20.2	104	101229	1	1218	9	11662	23	34000	19427
Vietnam	0	0	0	0	0	0	2	2000	12	13000	0
WORLD**	**2560**	**14**	**443**	**377,750**	**62**	**64,374**	**158**	**176,773**	**324**	**368,295**	**68,971**
	billion kWh	**% e**	**No.**	**MWe**	**No.**	**MWe**	**No.**	**MWe**	**No.**	**MWe**	**tonnes U**
	NUCLEAR ELECTRICITY GENERATION[9]		REACTORS OPERATING[10]		REACTORS BUILDING		ON ORDER or PLANNED		PROPOSED		URANIUM REQUIRED

Table 2: Comparison among countries on production of electricity, reactors operating and reactors building.

[9] International Atomic Energy Association 3 may 10 report.
[10] World Nuclear Association – 1^ march 2009 annual report.