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Empowering NGO's on nuclear power socio-economic and environmental hazards versus Renewables as energies of peace

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Ayoub Issa Aby-Dayyeh

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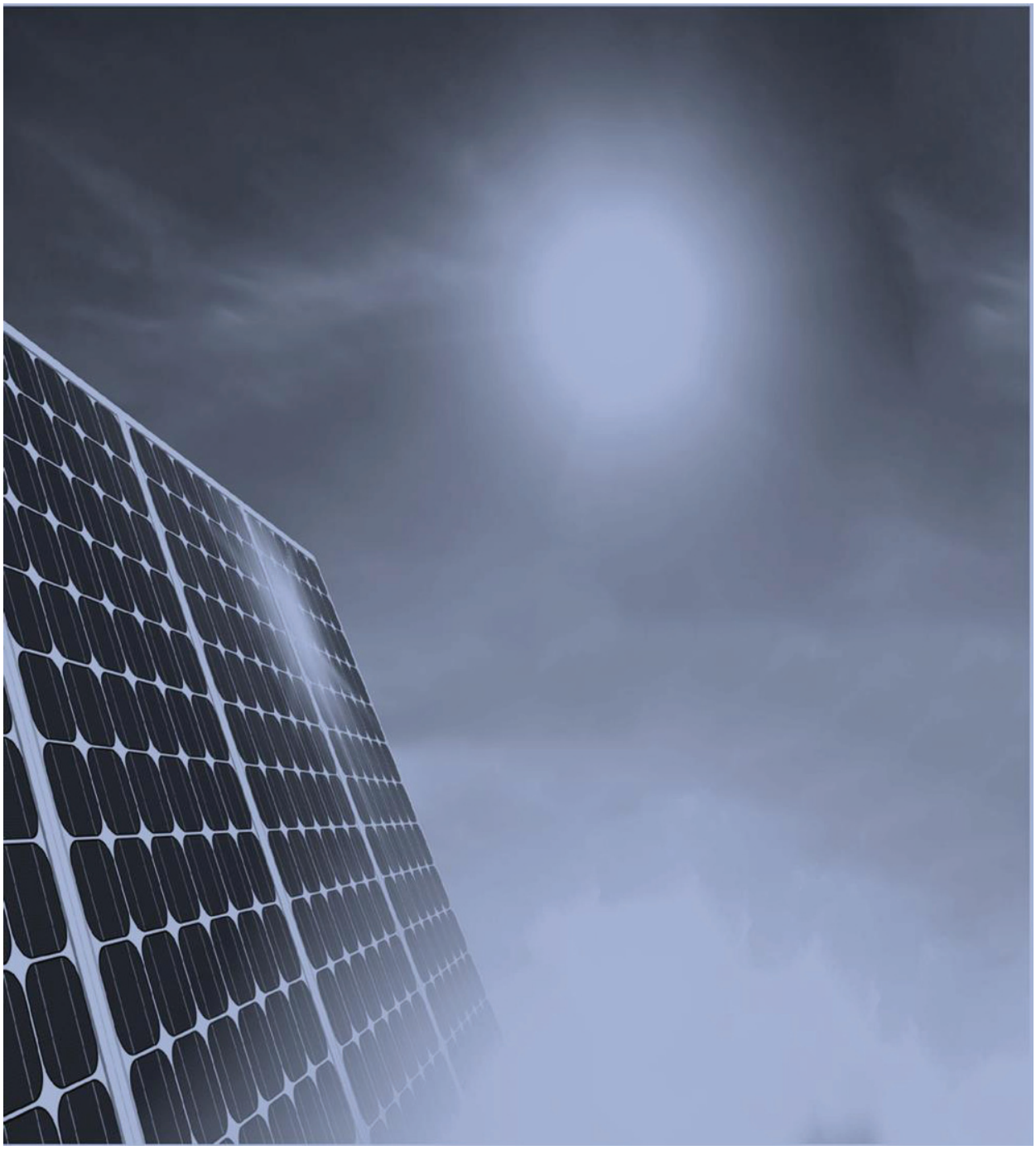

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Acknowledgement

I am indebted to the Takagi Fund for Citizen Sciences – Japan which facilitated undergoing this research aspiring to compare between the energy of war (Nuclear Energy) and the energy of peace (Renewable Energy) in the framework of human moral responsibility that is entailed in a socially, economically, politically and climatically fragile world.

I am also indebted to all my anti-nuclear colleagues, peace advocates and researchers worldwide, particularly in Jordan, Germany, Brazil and Japan who implicitly or explicitly supported and encouraged my work in nuclear energy since publishing my book "Nuclear Energy after Fukushima" in June 2011, only three month after the accident.

I am also indebted to FES – Amman for publishing this policy paper.

Introduction

Any introduction to a scientific work ought to explicate **what** the work that is being introduced is all about, **why** it was chosen as a research topic (purpose) and **how** it was approached (method)?

This work represents a cumulative experience of many years of studying, researching and actively revoking the idea of introducing nuclear power in Jordan and the Middle East on the basis of the universal ethical slogan that asserts the necessity to halt any activities that might expose people or biodiversity to radioactivity, if other safer alternatives are available.

Revoking the nuclear industry worldwide is also based on the "precautionary principle" published by UNESCO's world Commission on the Ethics of Scientific Knowledge and Technology (COMEST) 2005, which suggests that when human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.

Morally unacceptable harm usually refers to harm inflicted to humans or damage to the environment that is threatening human health, physical or psychological, or even human life; this threat is classified as serious and effectively irreversible, or the threat might be inequitable to present or future generations, or could be imposed without sufficient consideration to human rights.

Recommendation of COMEST for action goes as follows:

"*Actions are interventions that are undertaken before harm occurs that seek to avoid or diminish the harm. Actions should be chosen that are proportional to the seriousness of the*

potential harm, with consideration of their positive and negative consequences, and with an assessment of the moral implications of both action and inaction. The choice of action should be the result of a participatory process" [(1)].

Action also ought to be of an ongoing scientific experiential nature that is perpetually subjected to review in order to accommodate any changes.
As to the purpose of the study, it is intended to expand our knowledge over the nuclear debate versus renewable energies in a warming and fragile world. Aiming at refuting the myth of the "nuclear renaissance", justifying and consolidating the stance of the renaissance in renewable energy, being the energy of peace, and that nuclear energy is the energy of war.

When Francis Bacon (died 1626) claimed that "Knowledge is Power" he knew that conquering the world required understanding its materialistic characteristics and discovering the laws of nature. However, in our contemporary world in the 21st century, knowledge is still an empowering mechanism for raising social, economic and political awareness of mega-projects, such as that of nuclear power discussed in the first part of this research. The end goal is focusing particularly on the well-being of our communities, the environment as a whole and that of future generations.

We also aspire that this research would help to consolidate change in public support for clean energies that might affect government opinion and enhance policy making, thus directing investments towards safer, cleaner and more sustainable sources of energy.

Public opinion has become a decisive factor in nation`s actions or inactions over the nuclear power problematic issue. Examples are available from Switzerland, Sweden, Italy and Lithuania which decided through public referendums to shut down existing nuclear power stations. Other countries had already decided through referendums or public pressure not to start at all, such as Australia, New Zealand, Greece, Portugal, Denmark, Ireland, Portugal, Cyprus, Norway and others. This is the target of this research: to make a difference in public opinion and policy making.

The general public had always been enforcing "His" will on governments, even when nuclear projects reach its final stages. Projects were about to finish when the people decided not to commission the nuclear power plants, such cases existed in Austria and the Philippines. In April 2014 almost 28500 demonstrators forced the Taiwanese government to halt construction of the fourth Nuclear Power Plant (NPP)[(2)].

We also seek to change the myth of “clean nukes”, in relation to alleged low carbon emissions. It is been proved now, beyond any doubt, that the overall fuel cycle of nuclear energy, including mining, milling, yellow cake production, enrichment, fuel reprocessing, building and decommissioning of the NPP are not low on carbon emissions at all, but are more damaging to the environment than all traditional sources of fuel, depending on the concentration of Uranium ore; not to mention the hazards of managing high radioactive

nuclear waste, depleted Uranium and potential accidents that persist and require guarding for hundreds of thousands of years.

Finally, to answer how this work was approached; we have divided the work into two parts:
Part one, deals with the socio-economics of the nuclear power starting with the history of nuclear fusion, then discussing feasibility, liability, jobs created through the nuclear industry, safety and security, sustainability of both nuclear fuel and technology (from fission to fusion) and lastly environmental degradation caused by the overall cycle of nuclear fuel; from Uranium mining to decommissioning of the nuclear facility.
Part two, discusses renewable energy considered as energy of peace in comparison to nuclear energy as energy of war. The same approach will be used in the discussion and also the same criteria of that in the first part, as well as in the quantitative terms of the environmental carbon emission and radioactive print of each source of energy.

The work will temporarily end with a conclusion of the research in the spirit of moral responsibility and ethical behavior.

Part 1: Nuclear Energy Socio-economics:

1-1 Energy of war: A history on nuclear fusion: From Hiroshima to Fukushima

May be it was the well-known writer George Orwell who was the first to introduce the concept of the "cold war" in 1945, just after the horrific use of atomic bombs on Hiroshima and Nagasaki. The controversial bombing was a red line drawn with Japanese blood to warn the USSR not to cross over into Japan and to end the war quickly.

The first manufacturing of the Soviet Atomic Bomb was accomplished in 1949, immediately followed by China turning into communism in the same year, which necessitated the establishment of NATO in 1949. It also speeded up research on the Hydrogen bomb (H-bomb) which was ready for action by the USA in 1952. A 10 megaton H-bomb is equivalent to 625 times that of Hiroshima which was named: Little Boy, of 16 kt. TNT equivalent. A H-bomb is equivalent to 10,000 kt. of TNT. It has become obvious that a new era of horrific weapons have just been born!

It wasn't too long before the USSR tested their H-bomb in 1953, with 50 megatons of strength that incurred total destruction within 25 km radius and broke windows 900 km away. Now, it was obvious that the preparation for war would have to take a new turn!

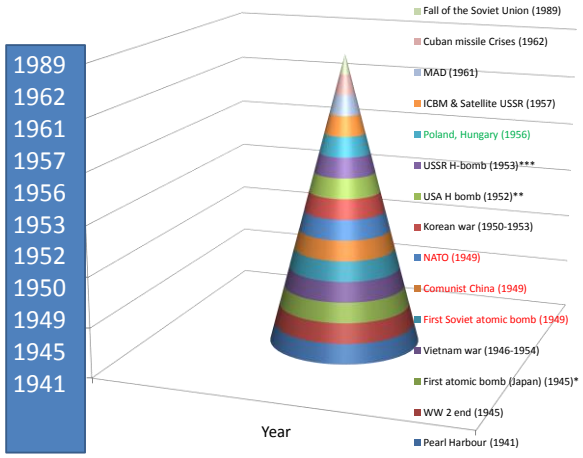


Plate 1: The Cold – war (1945 – 1989)

With the egregious weapons of mass destruction and the Intercontinental Ballistic Missile (ICBM) and the satellite systems which were available around 1957, it was possible to organize and orchestrate total destruction scenarios around the world. The concept of Mutual Assured Destruction (MAD) was prevailing amongst both blocks in the East and West to the extent that in 1961 it incited the Soviets to try to establish nuclear missiles launching sites in Cuba to shorten the time range of bombing the USA; from 30 – 40 minutes to 10 minutes only, starting from the time of launch to impact.

After a breathtaking standoff that kept the whole world uptight, the Cuban missile crisis ended up with some concessions by NATO on the eastern borders and hence the cold war shifted to nuclear submarines warfare in the deep seas.

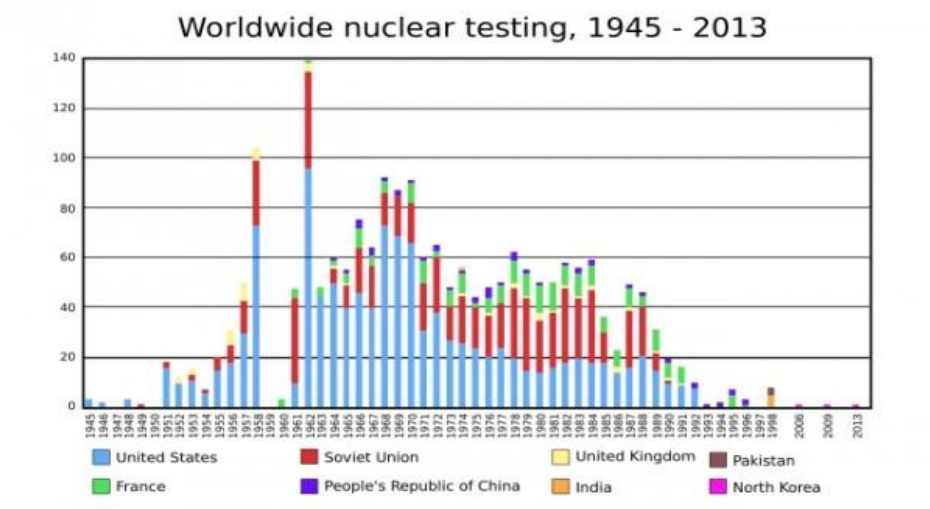


Plate 2: Worldwide nuclear testing (1945 – 2013) [3]

In plate 2, it can be seen how nuclear testing in the USA intensified after 1957 (with the development of ICBM)[4], conversely diminishing after the fall of the Soviet Union in 1989. However, nuclear testing stopped in the year 1986 (Chernobyl nuclear disaster), and halted after 1989.

Nowadays, the Chinese, Russians, South and North Korea as well as the Indians, have become a potential threat to world security. The fact that 28 nuclear reactors are being built in China at present, 7 in India, 10 in Russia and 5 in S. Korea (out of a total of 68 nuclear reactors under construction worldwide by the end of 2013)[5], give an indication that the appetite for nuclear warheads are still aspired for. Even Brazil is going forward with utilizing enrichment of Uranium to supply its nuclear submarine industry with nuclear fuel.

It is argued today that the 1986 Chernobyl nuclear disaster in the Ukraine has assisted in the fall down of the USSR in 1989, as recent studies have asserted that almost a million casualties were reported and at a total ongoing cost of $ 460 billion until this very moment[6].

Soon after the fall down of the Soviet Union 19000 rockets were dismantled in a 12 billion dollar deal to sell nuclear war heads to the USA as enriched fuel in order to run their 104 nuclear power stations in service. The deal was called Megatons to Megawatts (M2M) that changed the destructive potentials of warheads into electricity. The last shipment left Russia late 2013.

However, the American nuclear power commercial fleet hasn't actually expanded but it was increased in efficiency since the 1979 "Three Mile Island" nuclear accident. Other parts of the world had to wait till Fukushima, March 11th 2011, to make up their minds to shut down many nuclear reactors and suspend those proposed, such as Japan, Taiwan, Mexico, etc... On the other hand some countries are intentionally heading towards a nuclear future, such as China.

Russia passed a law in 2000 allowing imports of spent nuclear fuel. President Putin has promoted stringent laws to crack down on NGOs which lead the anti-nuclear campaigns since the 1990s, opening the way to a huge nuclear market around the world. Although a survey showed that 78% of the Russians opposed constructing new nuclear power plants (7) the government approved a plan to build new ones in 2008. The Russian nuclear market is expanding nowadays in the world markets; India, Turkey, Bulgarian*, Jordan and elsewhere.

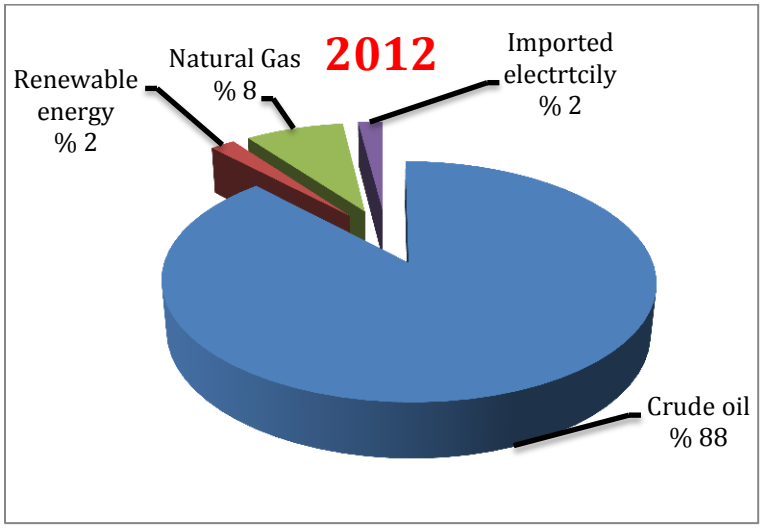
1-2 A history of the nuclear project in Jordan:

Jordan Atomic Energy commission (JAEC) was established in 2008 in the wake of soaring oil prices worldwide, coupled with the belief that Uranium is abundant in Jordan at feasible concentrations and with the conviction that nuclear power is the magic solution to electricity production and desalination of sea water.
Jordan imports 97% of its power consumption. Nothing considerable had been done about the energy crisis until the renewable energy law number 13 was passed in parliament in 2012; now it is back to parliament again for amendments.

Since 2013 almost 200 residences are connected to the grid with a two-way metering systems and in March 2014 the government signed agreements with 12 investors to buy a total of 200 MW from PV solar electricity generation at 12 JD cents per Kw.h; other stages will hopefully follow but at a lower tariff. A wind farm of 117 MW is also under construction, and is going to be expanded. The government have also signed on October 1st 2014, a contract with an Estonian company ENEFIT to produce electricity and oil from the rich oil shale deposits in Jordan**.

* Many disagreements with Indians are going particularly over "Liability". In Turkey many bypasses to avoid regulations are being now corrected, meanwhile the head of the nuclear project Mr. Faruk Uzel has resigned protesting the bad management to Russian "Rosatom". In Bulgaria the two nuclear plants at Bellene have stopped after a decision by parliament.
** A lone from China of 1.7 billion dollars was granted in September 2015.

The energy mix in Jordan 2012 looks as follows:



Source: NEPCO, JORDAN

Plate 3: Primary energy mix 2012

As for the 2020 energy mix scenario, it is still fluctuating; however, what is being discussed now is the following:

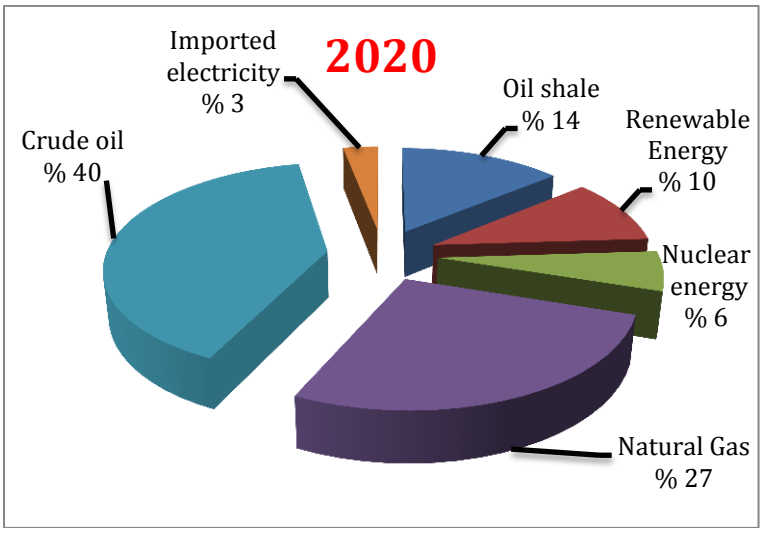


Plate 4: One scenario for the energy mix 2020 (Not official)

It can be seen that nuclear energy share constitutes 6% of the overall mix. However, it is not real because the two NPPs of 1100 MW are already late and have been dragging on since it was announced to be commissioned in 2015. Now, new predictions 2023 – 2025 are more likely. Even with the predicted 4500 MW Grid capacity in 2020, at almost 40 % electricity share of the primary energy mix, the projection of nuclear share would be around 18% in 2025*. If that is possible, why multiply oil shale percentage by 3 as well? Therefore, a genuine and professional mechanism must be applied for the energy mix future scenarios as soon as possible if any practical planning is aspired for![8]

In March 2011, the Fukushima – Daiichi disaster outlined a paradigm shift in conceiving nuclear power on a global scale; increasing safety measures, liability and risk assessment that have made investment in nuclear power almost impossible, particularly after the privatization of electricity utilities. Exceptions are made for surging economies which aspire for energy at any risk, such as China, Russia and India and except for countries of abundant surplus and high self-esteem such as Saudi Arabia and the UAE.

A hasty management of the Experimental Reactor (ER) at Jordan University for Science and Technology (JUST) in the north of Jordan has angered the population and local communities. The ER is situated on a site only few km away from the Syrian borders (8 km from the nearest border line). It has incited increasing local communities distrust in the benefits of the project compared to the risks, which forced Jordan Atomic Energy Commission (JAEC) to move the proposed site of the two 1100 MW commercial reactors from the north at *Majdal* site to the south east near *Amra Castle***, a UNESCO world heritage site, 50 km south east of Amman, and about 20 km west of the famous *Azraq* conservation, known as an oasis for migrating birds from Europe in winter (see satellite image in plate 5). This is the third location chosen hastily after moving the proposed site from *Aqaba* and *Majdal*.

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* 2200 MW out of 5000 MW expected load by 2025 equals to 44% of electricity load which is approx 40% of the energy mix, which rounds up unclear share to (0.4 × 0.44) = 17.6%.

** The first nuclear site chosen was near Aqaba on the Red Sea; it was dropped after a while for reasons not yet known.

Plate 5: Satellite image of the third proposed nuclear site

After the setback of Fukushima, another blow to the Jordanian nuclear project happened at the end of 2012. AREVA, which signed a Uranium exploration agreement with Jordan, decided to leave the country after discovering very low concentration of Uranium in the ore at a time when one pound of U_3O_8 has dropped from $ 143/pound in summer 2007 to less than $ 40 in 2012 (Plate 6), down to $ 37 in December 2014.

Regardless of all the setbacks, the Jordanian government is still going ahead with the project disregarding public consent, parliamentarian calls for a feasibility study environmental impact assessment (EIA), water scarcity and emergency evacuation plan. Issues are still being debated in the media on daily basis, such as water scarcity in Jordan, environmental damage, and the terrorist dangers in a torn up Middle East by ethnic wars, fundamentalism, etc….

Plate 6: U_3O_8 price fluctuation (2003 – 2013)

What made the public even more concerned and more furious was the manner in which JAEC handled the two experimental reactors at the University of Science and Technology (JUST). The extent of the local community's curiosity went as far as that the local people attacked and burnt the South Korean offices on the site in July 2012.

The first experimental reactor in the university is a sub-critical reactor commissioned by the Chinese in 2013 and the second is an experimental reactor of 5 MW bought at $ 130 million from the South Koreans and is expected to be commissioned by 2016. The following reasons are a sample of how bad management can backfire on a mega-nuclear project:

- The public and the local communities were not consulted.
- None of the deadlines announced were met.
- Construction works started before issuing the preliminary license.
- Feasibility study of either reactor is still not announced.
- Land of reactor ownership is still controversial as local owners are claiming it back.
- Environmental Impact Assessment (EIA) was done by an office in the university itself with no past experience in this field which resulted in an obvious conflict of interest.
- Unauthentic nuclear spare parts and corruption scandal in South Korea has made the public attitude even more furious [9].

We hence aspire that in covering this controversial history in Jordan's nuclear programme and the outcome of the worldwide nuclear power debate after Fukushima would reflect a global trend of thought over the grave issue of increasing risks. It has become a necessity to explain why many countries have decided to shut down nuclear reactors although a nuclear renaissance was in the horizon just before Fukushima?

1-3 Feasibility of nuclear power:

It has become vital in nuclear research to look for recently published data because data has been changing remarkably after Fukushima. It is also important to understand why the cost of electricity produced from existing nuclear power plants has not changed considerably over the years according to some statistics, such as that shown in plate 7.

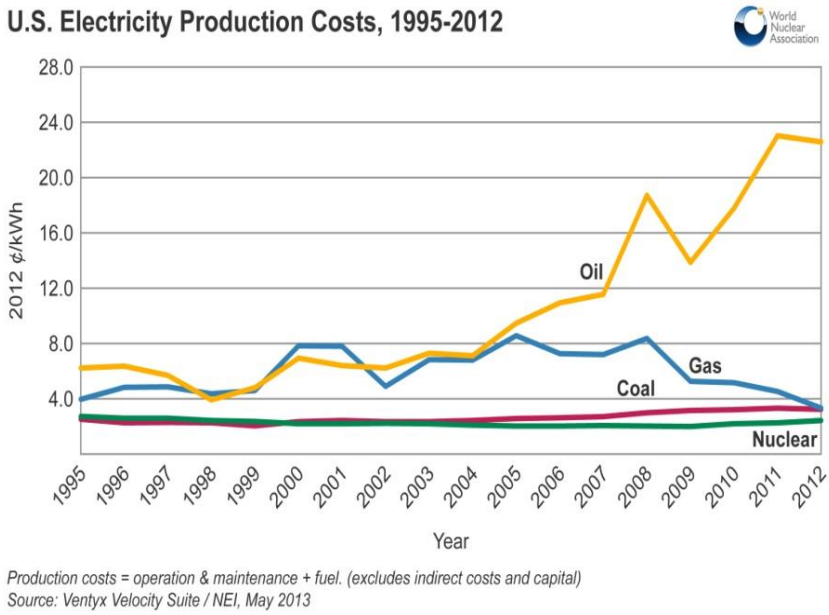

Plate 7: Electricity production cost in the USA 1995 – 2012 (10)

It is evident from the diagram that the nuclear electricity generation in the USA has been almost stable, since 1995 at least, being consistent with the myth: "too cheap to meter"! The reason is that the prediction cost excludes indirect costs (new investment, liability, maintenance, carbon tax, etc…) and excludes the capital cost too because nuclear power stations are already built and the capital cost already invested. Above all there haven't been new nuclear plants planned after the Three Mile Island accident in 1979, except for 6 plants with Early Site Permit (ESP) submitted licenses and only 2 of those are approved for construction, as follows (11):

- Southern Company in Burke County, CA (Vogtle 3, 4) of design AP 1000 (2 units), approval date 10th February 2012.
- South Carolina Electric and Gas in Jenkinsville, SC (Summer 2, 3) of design AP 1000 (2 units) approval date 30th March 2012.
- Tennessee Valley Authority in Rhea county, TN (Watts Bar 2) of design Gen II PWR (1 unit), **no** approval date yet.

- Detroit Edison in Newport, MI (Fermi 3) of design ESBWR (1 unit), **no** approval date yet.
- Dominion in Louisa County, VA (North Anna 3) of design ESBWR (1 unit), **no** approval date yet.
- Duke Energy in Cherokee County, SC (William States Lee 1, 2) of design AP 1000 (2 units) **no** approval date yet.

Furthermore, the nuclear power fleet of NPPs in the USA had been undergoing efficiency upgrading which was raised from 56% in 1980 to 91% in 2008. Also refueling time was reduced from 107 days in 1990 to 40 days in 2000, down to 15 days in 2013[(12)]. Eventually the "load factor" and the "efficiency factor" were both upgraded in the USA which reflected cost stability even irrespective of soaring inflation.

However, the reduction of electricity production cost from gas, which is denoted on plate 7, particularly after 2008, is explained by the increasing production of shale gas in the United States and hence the consequent increasing gas power plant capacity additions in 2013, as gas contributed to 6861 MW that year. This production exceeded all other sources of energy added that year in the USA (see plate 8)

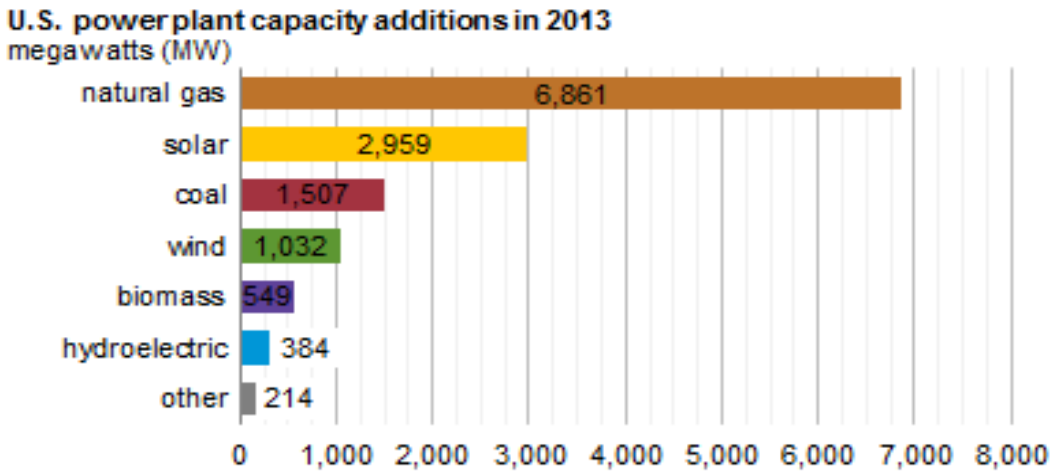

Plate 8: Added power plant capacity in the USA in 2013 [(13)]

One more reason for the cost stability of nuclear electricity showed on plate 8 is that the prices of the yellow cake U_3O_8 has dropped from almost $ 143 per pound in 2007 to less them $ 28 in May 2014 (plate 9). Adding up to the reduction in price margin, shutting down many reactors after Fukushima had also participated in the deterioration of the yellow cake prices worldwide.

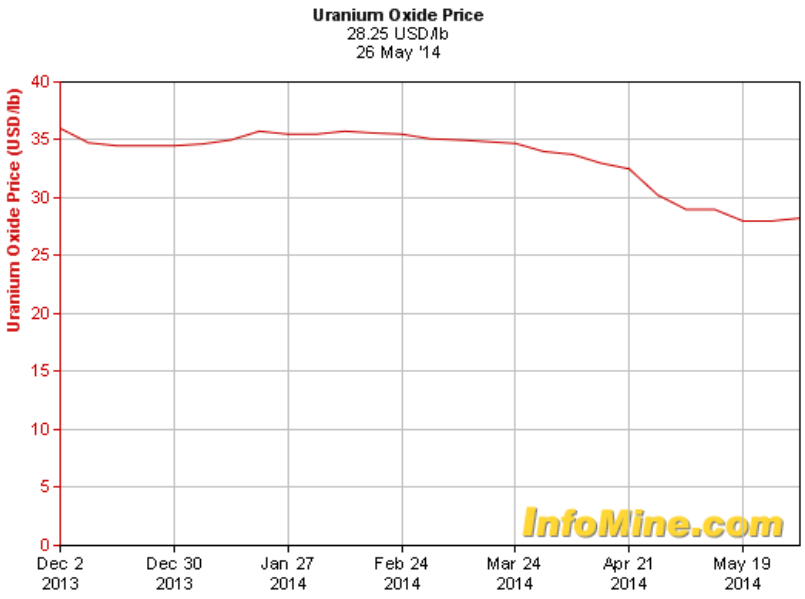

Plate 9: 6 Month Uranium price fluctuation [14]

However, to calculate the price of a MWh of electricity produced from constructing new nuclear power plants is a completely different scenario. Let us take live case studies from existing power plants under construction, as follows:

	EPC cost	capacity	Electricity cost
Gas combined cycle, gas @ $ 3.70/GJ	$ 1000/kW	90 %	$ 44.00/MW.h
Integrated gasification combined cycle, 1200 MWe	$ 3800/kW	85 %	$ 94.30/MW.h
Nuclear, 1400 MWe (EIA's EPC figure)	$ 5500/kW	90 %	$ 121.90/MW.h
Wind farm, 100 MWe	$ 1000/kW	30 %	$ 112.90/MW.h

Table 1: Electricity cost of different energy sources

Prices at 5% cost of debt, 15% return on equity and a 70 – 30 debt equity structure [15]

It is clear that the Engineering and Procurement Cost (EPC) of a nuclear power plant is the most expensive amongst the other sources of energy and so is the expected price of the consequent KWh.

We believe that the prices shown above are very low and far from being accurate concerning cost of nuclear electricity because many factors are excluded from the cost

analysis, such as liability, long term investment, fund raising, decommissioning and other risks and hazards, such as nuclear waste management (reprocessing and depositaries). In Moody's study forthcoming, the approximate prediction of a KW.h cost was $ 25 cents in 2008. However, we shall attempt to introduce new factors in this study to allow for other unseen risks and other unexpected circumstances.

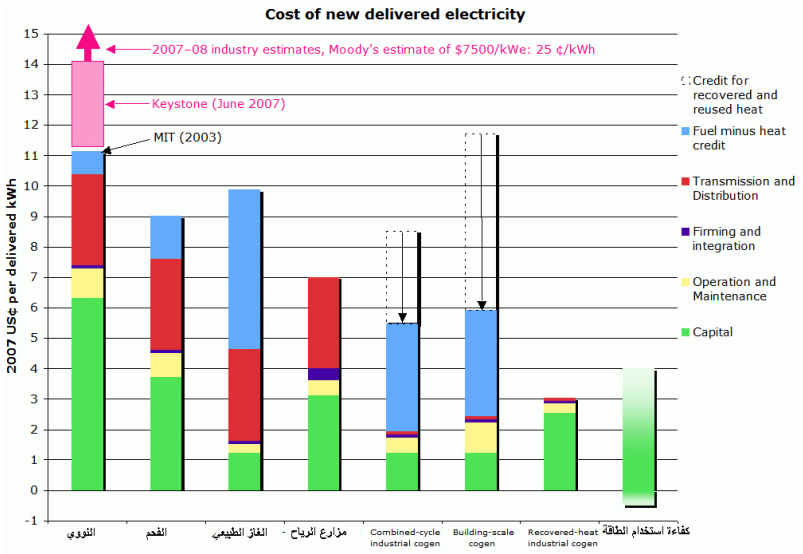

Plate 10: Cost of new delivered electricity (16)

The cost of nuclear power plants after Fukushima is of a different caliber compared to the pre-Fukushima era, as the Fukushima disaster has definitely raised not only the initial capital cost for safety requirements, but also raised issues of sustainability, environmental degradation, security, ethical obligations, psychological trauma and above all energy alternatives. Therefore, for each risk issue mentioned, and more, there ought to be a factor in the cost analysis to account for it. We suggest the following factors:

1-4 Liability of nuclear accidents:

The "cost of a nuclear accident" depends on unaccountable factors, some of the main factors are:-

- Type of reactor and fuel
- Accident precautionary measures
- Evacuation efficiency
- Accident management
- Culture of safety
- Degree of country development
- Degree of country Dependency on technology and aid
- Liability in national legislation and Compensation mechanism

- Liability in international legislation and Compensation mechanism
- Future energy mix

In this part of the research we shall mainly discuss published cost of serious nuclear accidents worldwide, then discuss liability under international conventions, then liability limits under national legislation and finally discuss an example of a nuclear accident cost categorization.

28 March 1979	Three Mile Island, USA	1034 Million dollars(17)
28 March 1979	Middletown, Pennsylvania, USA	2,400 Million dollars(18)
9 March 1985	Athens, Alabama, USA	1,830 Million dollars(18)
11 April 1986,	Plymouth, Massachusetts, USA	1,001 Million dollars(18)
26 April 1986	Chernobyl, Ukraine	235000 Million dollars(19)
4 May 1987	Kalpakkam, India	300 Million dollars(20)
24 Nov 1989	Greifswald, East Germany	443 Million dollars(18)

Table 2: Cost of some nuclear accidents worldwide (1979 – 1989)

These samples of estimates of nuclear accidents are by no means accurate and only cover one decade. To shed some light on the complexity of the issue let us look into the current perception to nuclear disaster insurance in Europe.

Nuclear insurance within Europe is mainly governed by the Paris Convention and the Brussels Convention. Most European countries have signed and ratified one or the other, or both. Regardless of the convention, both place full liability on the operator and force him to provide insurance however limited it may be. The only unlimited liability is available in Germany, Japan and Switzerland.

If operators of NPPs are insured for every potential damage, then, according to calculations mentioned earlier this would lead to a price escalation for nuclear energy that might touch €2.36 per kWh. However, the certain result would be to make nuclear electricity uncompetitive. For this reason operator's maximum liability tends to be capped, as in the UK [(21)].

So, operators seek third party insurance to cover damage caused by nuclear accident. However, international liability conventions work side by side with national laws to cover the cross-boundary damage incurred by a nuclear accident. So, liability beyond national and international legislation is covered by insurance, otherwise the state takes responsibility by default.

The national nuclear insurance pool was developed in the United Kingdom in 1956, and then it expanded in Europe and elsewhere. The international liability convention were embodied in the IAEA Vienna convention on civil liability which entered into force in 1977

(Amended 1997) and the OECD's Paris – Brussels convention on 3rd party liability which entered into force in 1968 (Amended 1982, 2004) and includes most EU countries.

In 1988 these conventions were linked by the joint protocol [18]. It imposed absolute liability on the operator; however, a limit was set whereas in the Vienna convention the upper ceiling for compensation was not fixed, but limited by legislation in each state. The joint protocol was intended to obviate any conflicts of law and entered into force in 1992. However, both conventions set a liability limit of about € 360 million in force since 2003[22].

The Paris – Brussels convention was amended in 2004 to encompass a wider range of nuclear damage; the industry, environmental damage, etc … and most important amendment was allowing states with unlimited liability to join the convention.

The IAEA parties adopted in 1997 a convention on supplementary compensation for Nuclear Damage (CSC); it provides additional amounts through contributions of states on the bases of installed MW. However, the CSC is not yet in force!

The Fukushima catastrophe in 2011 has reminded the world that the nuclear dinosaurs of the future, such as China and India have not ratified any international nuclear liability convention.

Actually, almost half the world's reactors are outside either convention. The main players are the USA and France and seem to be "championing different approaches"[23].
Thereafter, the situation is as follows:

1) Countries which are party of any or both International Conventions (IC) with national legislation.
2) Countries which are party of any or both International Conventions (IC) without national legislation.
3) Countries which are not party to any IC, but have national legislation [USA, Canada (signed only), Japan, S. Korea, and India (signed only)].
4) Countries not party to any IC and without national legislation (China Insurance pooling system) [23].

Hitherto, few main concerns expose themselves to criticism so far: who has the greatest number of NPP, how old, how much existing danger potentials to neighbors, susceptible to earthquakes, and whether national legislation liability exists or not? All these factors add up to increase the risk of possible future nuclear accidents.

1-5 Safety and security of the nuclear industry

The safety and security of a nuclear facility depend on numerous factors, some of which can be considered as unaccountable factors, others are considered highly unpredictable.

Some of the main factors are those mentioned earlier in the section of liability of nuclear accidents but expanded here as follows:

- Type of reactor and fuel
- Accident precautionary measures
- Evacuation efficiency
- Accident management
- Natural disasters management, including those related to climate change
- Culture of safety
- Ethics and responsibility
- Accessibility to clean and stable supply of cooling water
- War zones and political instability
- The system of governance in the country
- Transparency of all related nuclear activities
- Degree of the overall development in the host country
- Degree of host country dependency on foreign assistance
- Liability in national legislation and compensation mechanism
- Liability in international legislation and compensation mechanism
- Future energy mix designed for the country and electricity load management

The last factor, for instance, might instantly seem out of context; however, planning nuclear energy share temporarily at a low percentage of the overall energy mix would reduce the risk of a nuclear catastrophe. On the other hand, finding another sustainable and safe source as an alternative source of energy can alleviate the nuclear risk altogether. The extra electricity load management is also very critical in small grid capacity cases, such as in Jordan. If the safety of supplying the maximum electricity load is to be guaranteed all risks of reactor shut-down is to be minimized.

The importance of safety and security can be conceived through the Canadian nuclear licensees security obligations, which are simply as follows: to "take all reasonable precautions to protect and to maintain the security of nuclear facilities and of nuclear substances"[(24)].

So, security obligations entail a wide range of responsibilities for both; the facilities and the nuclear fuel which encompass the ecosystem as a whole (Man and Nature) as well as the commitment for the peaceful use of nuclear energy. Is that obligation possible in today's political tension worldwide?

We ought to remember that nuclear activities after the Second World War and in the following few decades were basically designed and built for military uses. In the process of the nuclear fuel cycle, Uranium can be enriched to very high levels enough to charge a nuclear warhead. Furthermore, reprocessing nuclear fuel can also produce Plutonium for

military use. U_{238} is also a byproduct of the nuclear industry and mining Uranium. Depleted Uranium had been widely used in producing enhanced quality ammunitions encasement and has already been used in conflicts around the world, such as the late Yugoslavia, Iraq and Afghanistan.

The conflict between Iran and the UN over Uranium enrichment is an example of how serious enriching nuclear fuel can be. Therefore the world is planning to confine enrichment in few facilities around the globe to make sure that this industry is under control. The other risk is the probability of sabotage, both from within the nuclear facility or from the outside, therefore the Canadian regulations also call to "**implement measures for alerting the licensee to acts of sabotage or attempted sabotage anywhere at the site of the licensed activity**"[(25)]. However, are acts of internal sabotage easily detectable or predictable?

The security obligations include "**instructing the workers on the physical security program at the site**". Again, the margin for a human error is high and the danger levels of internal sabotage cannot be avoided. To fulfill the security obligations there exists the "Nuclear Safety and Control Act"; managing "Access Control", barriers, competent staff, nuclear response force (on site and off site), uninterrupted water and power supply and designs of possible threats and risk assessment. The more these duties are the less safe the facility becomes.

Furthermore, serious accidents need immediate responses. In the cases of loss of coolant accidents (LOCA), for example, controlling reactivity by shutting the reactor down and injecting borated water as well as maintaining the reactor vessel's water inventory, cooling and evacuating residual power, … etc. If this is a complex procedure, the procedures of a core melt-down is far more complex[(26)]. Again, the more complex the reactions are the less safe the whole system becomes.

However complex these procedures may sound, the factors involved in a nuclear power plant site selection to constructions is very complex and can take decades to cover only few of those criteria. For example the "Monju Nuclear Power Plant" in Japan took 15 years to study the proposed site from the date of choosing the construction site in 1970 till the start of construction in 1985 – 1986.
From selection of the Monju site to construction of the nuclear power plant, there were 5 main stages:

1) Selection and Acquisition of a Site
2) Environmental Review
3) Designation as an Important Area
4) Regulations for Construction
    a. Safety Reviews for Permission of Construction
    b. Approval and Licensing of Design and Works
5) Preparation of Works and Construction[(27)]

There is also a criteria for selection of candidate sites in Japan, which are designed as follows:

1) Enough Cooling Water:
   Clean, Stable Supply (All Japanese NPPs are built on the coast lines).
2) Stable Ground:
   Existing of stable bedrock near the surface (No big active faults near the site).
3) Little Influence to Circumference:
   Avoiding placing NPP near cities from the viewpoint of Public Exposure and Evacuation Plan (Keep distance between the site and residential areas).
4) Enough Site Space:
   Enough space for construction and easy accessibility to the site.
5) Local Consent:
   In Japan, getting agreement from local residents is indispensable and is the most important and critical factor[28].

The Monju NPP achieved criticality in 1994. However in 1995 the plant was subjected to an accident, where sodium leaks caused a major fire that forced it to shut down. It started working again in 2010. Soon after, another accident forced another shot down right in the same year. As of June 2011, only one hour of generated electricity was produced by the reactor since 1994[29].

Nuclear liability and safety span long terms after construction, such liabilities include storage, treatment and disposal of radioactive waste generated at the operators' NPP, storage and management of nuclear fuel irradiated in the reactor of the operator's NPP ("spent fuel"), disposal of the spent fuel (SF) or residues resulting from spent fuel reprocessing. Last but not least, the operator is liable for decommissioning its nuclear facilities [30]. These different items are a risk to safety and security of the nuclear site.
Let us take the example of decommissioning:

> How many NPP's have already been out of business and still awaiting decommissioning?
>
> How many NPP's working life are being extended and at what risk?

This fear from accidents has led to the following outcome:

	Total operating	Construction starts	New Grid connection	Shutdown permanently	Under construction
2010	441	16[32]	5	138[33]	65[34]
2011	434[35]	4	5*	5	61[32]
2012	437	7**	3	3	67
2013	437[32]	15	4	2	68[32]

Table 3: World nuclear reactors statistics[31]

* (5 new grid connection) (Ningdle-1 and Shin-Wolsong-1 in China and Shin-Kori-2 in South Korea and Brudel 1 and 2 in Canada).
** China (4 reactors), South Korea (1 reactor), Russia (1 reactor), UAE (1 reactor).

The drop of NPP's under construction from 234 in 1979[36] to 68 as of January 1st 2014 establishes a big question over the future of nuclear power. The same conclusion can be drown from the reduction of total NPP's operating worldwide, from 441 in 2010 to 437 by the end of 2013. If we compare the number of plants connected to the grid to the shut down plants, we can see exactly similar numbers, except for 2013. Has the world recovered from Fukushima? I don't believe so as cheaper, safer and more sustainable, alternatives are available today.

	Operational Research Reactors	Shut down permanently	Temporary shut down	Decommissioned	Under construction	Planned
2012	247	150	15	304	4*	6**

Table 4: Research Reactors (RR) inventory

* 2 in France, 1 in Jordan (Sub-critical), 1 Russia.
** Argentina, Belgium, Brazil, Jordan, Netherland, Russia.

As for the research reactors, it is obvious that the need for them has diminished. The numbers of decommissioned RR exceeded operational ones in 2012 and only four reactors are under construction at present now.

	Spent fuel (t) HM	World accumulative spent fuel (t)	Stored at Reactors (t)	Reprocessed spent fuel (t)	World Reprocessing capacity[37]
2012	10,000	360500	250700	109800	4800 t

Table 5: The amount of nuclear spent fuel has dropped since Fukushima

t: tons

Spent fuel reprocessing is another hazard, as the world's capacity to reprocess is limited to 4800 tons annually since 2012, which means that the amount of spent fuel reprocessed is less than half the amount of spent fuel produced annually around the world. Hundreds of thousands of tons are still waiting to be reprocessed and are stored at NPP's worldwide which cause potential disasters if any of the plants faces and serious emergency.

To add to the dangers of nuclear power and to justify the paper's title predisposition that the nuclear energy is the energy of war; it is known that there are horizontal and vertical proliferation threats that are not usually added to sustainability issues and environmental degradation when nuclear issues and Uranium mining is under consideration [(38)].

According to the treaty on the non-proliferation of nuclear weapons, the horizontal proliferation is the transfer of present nuclear technologies to the parties which did not have it before. The vertical proliferation is the development of new nuclear weapon based on the higher fissile actinides [(39)].

To add further impediments to safety and security issues such as economic, cultural and political issues are of great influence. For example, the UAE Barakah NPP has experienced a big competition between the Russians and the South Koreans. The tender was pushed to its lowest bids by the South Koreans in order to win the contract. They eventually did win the tender, but what sort of backfiring might this have on the quality of works?

Culture of safety for a particular country or peoples, is important too and must not be overlooked, especially when employees in under developed countries tend to employ their relatives and give priority to family, tribe or sect rather to the ethics of work and according to a refined responsibility towards the whole nation and the world.

As to politics, it can be seen how in many parts of the world, particularly after 1989 breakdown of the Soviet Union, many states has been dissolved and has become a perpetual war zone, such as in many parts of the Arab World, Asia and Africa. Therefore, how safe can the nuclear industry be in the vicinity of those inflamed war zones? How safe would enriching Uranium and depleted fuel shipments be in and out of these regions? What responsibility and ethical burdens should exporters of nuclear technologies to under developed countries have on their conscious?

The Brennilis nuclear power plant real-life experience can summarize many of the issues discussed. This plant of 70 MW output was commissioned in 1967. In 1975 it was attacked by two explosions that temporarily closed the facility down, however it soon started working again. The same group (The liberation front of Brittany) attacked the plant again few years later by shooting at the power lines leaving the NPP. In 1985 it was shut down permanently.

The cost of decommissioning Brennilis NPP is currently estimated at 482 million Euros [40], and is not yet finished. This proves the numerous dangers and long term responsibility and burdens that accompany nuclear adventures. Hence, safety and security are relative in the nuclear industry. It might be true that with enhancing safety and tightening security accidents can be reduced, albeit they can never be avoided.

1-6 Sustainability of fuel and technology

Possible questions that ought to be asked concerning the nuclear fuel cycle are:

How feasible and sustainable is Uranium mining worldwide?
How long is Uranium going to last and at what environmental cost?
How long is the world going to tolerate its environmental pollution?
When is the world going to reach binding resolutions through UN bodies?
How much nuclear fuel is going to be retrieved from reprocessing nuclear waste and for what purpose?
What is the impact of the new nuclear fusion technology on all traditional mining facilities?

Country	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Kazakhstan	3719	4357	5279	6637	8521	14020	17803	19451
Canada	11597	11628	9862	9476	9000	10173	9783	9145
Australia	8982	9516	7593	8611	6430	7982	5900	9145
Niger	3282	3093	3434	3153	3032	3243	4198	4351
Namibia	3038	3147	3067	2879	4366	4626	4496	3258
Russia	3200	3431	3262	3413	3521	3564	3562	2993
Uzbekistan	2016	2300	2260	2320	2283	2657	2874	3000
USA	878	1039	1672	1654	1430	1453	1660	1537
Ukraine (est)	800	800	800	846	800	840	850	890
China (est)	750	750	750	712	769	1200	1350	1500
Malawi						104	670	846
South Africa	755	674	534	539	655	563	583	582
India (est)	230	230	177	270	271	290	400	400
Brazil	300	11	190	299	330	345	148	265
Czech Republic	412	408	359	306	263	258	254	229
Romania (est)	90	90	90	77	77	75	77	77
Germany	77	94	65	41	0	0	0	52
Pakistan (est)	45	45	45	45	45	50	45	45
France	7	7	5	4	5	8	7	6
Total world production	40178	41719	39444	41282	43798	51450	54660	54610
Tones U_3O_8 (demand)	47382	49199	46516	48683	51651	60675	64461	64402
Percentage of world demand		65%	63%	64%	68%	78%	78%	85%

Table 6: List of Uranium production and demand [41]
(est) is for established

It is clear that there are new discoveries of Uranium ore around the world, such as in Kazakhstan, Canada and in some other countries. However, there are similar but fiercer reductions in reserves and quality of ore, such as in Canada and South Africa. The table number 6 also shows the general impact of nuclear disasters on U_3O_8 production reflected by the decrease of the overall production after Fukushima in 2011 compared to previous years.

As far as Uranium production, the year 2011 is of particular concern; it is obvious that the demand exceeded the quantities offered from mines worldwide, that is why we can see in

Plate 11 prices of Uranium Oxide peaking during the oil crisis 2007 – 2008 when the demand on energy was at its peak.

Plate 11: U_3O_8 prices per pound (1995 – 2013) [42]

Plate 12: U_3O_8 prices per pound (2009 – 2014) [43]

However, another smaller peak was achieved just before Fukushima accident on March 11th 2011, then after that accident things went loose as the prices dropped to reach around $ 35.65 per pound on October 13th 2014, $ 37 in December 2014, almost a third of the prices in 2011 pre-Fukushima, as can be seen in plate 12.

1-6-1 How much Uranium is used annually around the world?

We can see from table 6 that in the year 2011 the amount of Uranium produced on a world scale was 54610 tones, which constituted 85% of the world's demand only. The rest was managed from nuclear warheads and reprocessed nuclear fuel. So, within this framework of consumption, how much longer would it last?

With time and across the continued mining of Uranium, the ore concentrations will gradually diminish, and eventually depleted, which, will make it more expensive and more polluting to the environment. Meanwhile, the world's reserves of nuclear weapons that were re-used as nuclear fuel through the deal, Megatons to Megawatts project (M2M) between Russia and the USA, for example, are going to be a more difficult source in the future due

to increased hostilities around the world. If the nuclear renaissance persists, the world's reserves of natural Uranium will not last more than 12.5 years [44], as some predictions put it.

Surprisingly enough, Uranium prices are falling dramatically. Possibly momentarily after the first shock of Fukushima dissipates into people's thirst to profit and to satisfy their needs and wants. It is bound to rise again as demand increases, particularly after Japan has decided to start its nuclear fleet once again after a suspended decision lasted for more than three years following the disaster. The Japanese decision will unfortunately have a drastic impact on the world's nuclear industry psychologically as well as tangibly and will convey a strong message that we are going on with nuclear, no matter what!*

Regardless of diminishing Uranium resources and concentrations, some argue that retrieving nuclear fuel from reprocessing facilities will provide a new source of nuclear fuel, particularly for the Mixed Oxide Cycle that uses retrieved U_{235} and plutonium. However, two basic counter-arguments would close the door in the face of those perspectives that are betting on the former argument. One can be deduced from table 7, whereas the quantities of nuclear fuel in the world are limited, not exceeding 2500 tons yearly at present, thus reducing worlds reprocessing capacity to almost half of that before Fukushima.

Location	Status	Capacity
France, La Hague	Operational	1700 tonnes / yr
UK,, Sellafield	Closed 2011	900 tonnes / yr
Russia, Moyak	Operational	400 tonnes / yr
Japan, Rokkasho	On hold	800 tonnes / yr
India (4 plants)	Operational	100 tonnes / yr each
China	Being planned	TBD
Total reprocessed		2500 t/yr

Table 7: Status of reprocessing facilities worldwide [45]

* The latest decision of Japanese parliament to change the constitution over the act of participating in war can be connected to the decision of going nuclear again, possibly to build a nuclear arsenal in the future.

The other counter-argument is based on the myth that nuclear warheads would be dismantled and its enrichment levels reduced to commercial levels (around 3.5 %).

To refute that allegation, we believe that the deal M2M (Megatons to Megawatts) between Russia and the USA has finished late 2013 and it has become clear now that the rising tension between Russia and the world over Crimea, Syria and Eastern Ukraine shall possibly incite further piling up of the nuclear arsenal again, particularly because Russia has huge reserves of gas and oil and also has an imperialist appetite to spread its influence around the world.

1-6-2 Fission to fusion

Fusion is the process that powers the Sun and the stars in the Universe. It is called 'fusion' because the energy is produced by fusing together light atoms, such as hydrogen, at an extremely high pressures and temperatures which exist at the centre of the Sun (approximately 15 million ºC). At the high temperatures experienced in the Sun, any gas becomes plasma, the fourth state of matter (solid, liquid and gas being the other three).

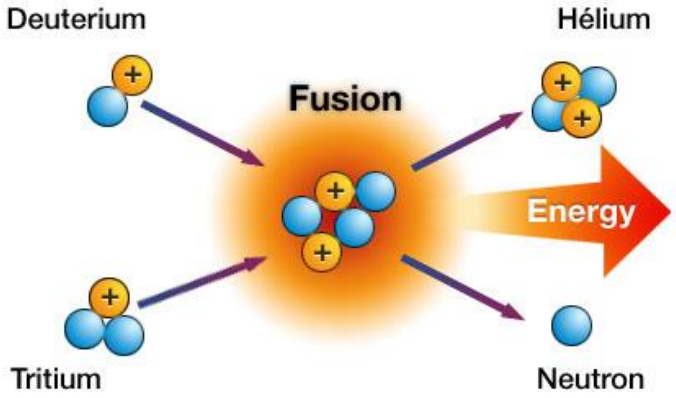

Plate 13: fusion reaction diagram

When two atoms, deuterium and tritium, fuse together, they form a helium nucleus as well as a neutron and a lot of energy. This is called nuclear fusion in contrast to nuclear fission where a heavy atom, such as Uranium 235, is bombarded by neutrons to cause fission as well as producing a lot of energy and radioactive waste too.

Fusion energy has huge potentials to provide much of the sustainable energy solution needed to Europe and the world. ITER, which means: "the way" in Latin, is an international collaboration of many countries on an experimental facility. It is the world's most important energy project that aims at demonstrating that fusion can be part of the solution to energy crisis by adding it to our energy mix in order to meet the global energy needs in a highly advanced and clean method.

How far has ITER progressed?
It is thought that the United States, although a part of the European based project of the fusion (Europe is responsible for nearly half of it's cost), is developing a small nuclear fusion reactor that is so small to fit in the back of a truck. However, it has the ability to produce the energy required to power a warship. The energy created through nuclear fusion can be up to four-times more powerful that the energy released by fission.

McGuire told Aviation Week recently with regards to the reactor's size; it is **"**Ten times smaller is the key". "The smaller size will allow us to design, build and test the CFR in less than a year". Next, the Lockheed division, the largest military contractor in the USA, wants to have a prototype almost ready to work within five years and after that, within ten years a commercial one will show up[(46)].

Also Russia is developing a new technology, a hybrid nuclear reactor which uses both technology of nuclear fusion and fission. The project is open for international collaboration, particularly from Chinese scientists.

The new approach has a number of benefits regarding safety, non-proliferation as well as regarding the cost of generated energy, which would render the fission technology obsolete in the near future.

In conclusion, a hybrid fusion-fission mixed technology reactor might be several times more efficient than what we call a traditional fission reactor.

Another benefit of the new hybrid design is that it is more environmentally friendly as it 'burns down' fissile materials thus leaving very little by-products. Therefore it will not produce much radioactive waste. Actually it can even treat the spent nuclear fuel produced from regular reactors [(47)]. This is the technology of the future that will render fission nuclear power stations worldwide "old fashion".

1-7 Nuclear Energy pollution and environmental degradation

It is commonly and wrongly argued that nuclear energy is the cleanest source of energy production available. Lamen and Smith respond by saying electricity production from Uranium ore of 0.1% concentration of U_3O_8 (1000 PPM) produces CO_2 slightly less than a natural gas turbine. However; if lower grades of Uranium ore are used (less than 1000

PPM) the nuclear industry would be polluting the environment far more than a traditional power generation that works on fossil fuels [48]. If a regress curve is postulated, we predict the concentration in 2014 to be below 500 ppm.

Plate 14: open cast Uranium mine

In plate 15, it can be seen that many countries in the world such as Namibia and South Africa produce U_3O_8 at less than 1000 PPM concentrations. If we exclude Canada where concentrations of very high qualities have been discovered lately, the average worldwide is now around 500 – 1300 PPM. In the USA, the average has dropped from 2800 PPM in Mid 20^{th} century to 700 – 1100 PPM in the nineties [49]. It is definitely lower nous in 2014.

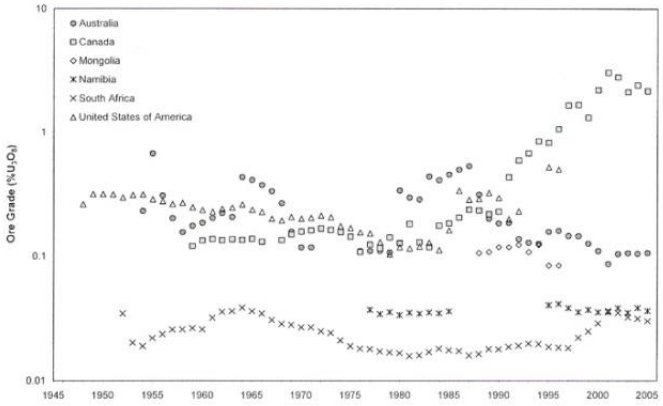

Figure 1 – Average Uranium Ore Grade in Milling Over Time

Plate 15: Concentration of U_3O_8 in different Uranium mines (50)

If we consider the steep decline of Uranium ore quality and our consciousness of the direct dangers of radioactivity, environmental issues and proliferation concerns that are growing worldwide, it would most likely reflect on future choices of energy technologies converging towards RE.

Adding to the above pollution of CO_2 a general term of "environmental degradation", which is used to denote the damage Uranium mines does to the environment and to denote also the amount of damage done by the nuclear industry during manufacturing the nuclear fuel, transportation risks of contamination, handling nuclear fuel at the nuclear station, using it to produce energy, consequently producing nuclear waste which is hazardous and requires cooling for many years before going through reprocessing and before eventual burial. Within that holistic perspective the nuclear industry becomes the most dangerous, hazardous and pollutant industry in the world; It is the energy of war and destruction.

Part 2: Renewable Energy: Socio-economics, politics and ethics

2-1 Energy of peace: A history of Renewable Energies.

For animate matter, the Sun has always been the source of life on Earth and has always been a source of inspiration for rational beings. Ancient civilizations understood the power of the Sun and its effect on their lives on Earth, concerning day and night, the seasons, heat, food, floods, … etc. They even argued the Sun as an essential part in their metaphysical after-life and considered their divine leaders as descendants from the Sun or the skies, such as the pharos of Egypt.

On the other hand, Passive Solar Systems were also used to utmost benefit in everyday needs, harvesting the Sun's heat in winter and shading it in Summer, as homes were built to make the most efficient use of the Sun, not only in orientation, but also in building dwellings underground or carved in rocks to use ground heat for thermal comfort, such as the ancient city of Petra in Jordan and other cities around the world in China, Persia, North Africa, and elsewhere,

Pythagoras and Aristarchus; both Greek scholars talked about a heliocentric model of our solar system long before Copernicus who published his findings in 1543. The Greeks and before them the phoneticians used the power of the Sun in sending messages by reflection and even tested that experimentally for military use by reflecting the rays through huge mirrors on enemy ships. However, the serious utilization of the Sun was not possible until after the scientific revolution when 360 mirrors were used in the eighteenth century to concentrate the Sun rays on a focal point which raised the focal spot to very high temperatures inciting further research and revealing great potentials of the Sun's energy.

Today very simple techniques can produce a Sun-cooker or a solar thermal water heater. Unfortunately not used wildly yet. Unfortunately, it has been for the abundance of fossil fuels and its cheap prices, until 2007 at least that made investment in some RE unfeasible.

In Jordan, the percentage of solar water heaters (SWH) installed in the country per household is believed to have decreased to 10% in 2011[(51)]. In neighboring countries like Cyprus the number of Solar Water Heaters increased to 80% of household in 2012. Many countries like Turkey and Greece are doing very well raising hopes for renewable energies great future.

With the improved technology of solar heater production moving into vacuum tubes, it has become more feasible and now requires less space and can function in cold weather too (vacuum tubes are more efficient than the flat plate SWH when clouds prevail during cold winter days).

Solar PV technology has become world number one in the production growth, as can be seen in plat 15:

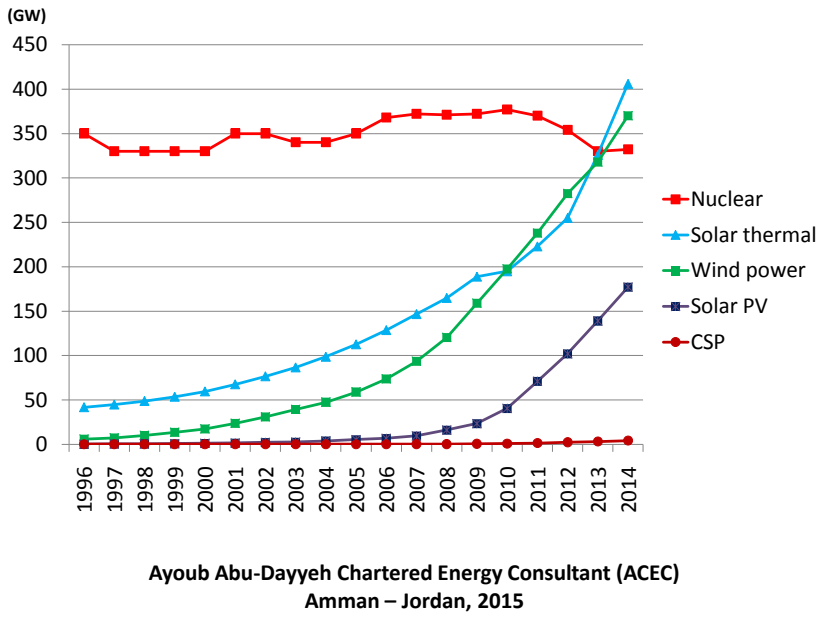

Plate 16: Energy Mix Growth Worldwide (GW)*

It can also be seen that by 2012 the three main sources of energy (Solar Thermal, Wind and Nuclear Energy) have produced approximately equal power, (406,370,332 GW), however, the fastest growing source is PV**.

Jordan has ratified the new renewable energy and energy efficiency law in 2012, thus allowing private homes to connect to the grid. During the following 2 years after ratifying the new RE law 2013 – 2014 almost 30MW of electricity was installed in less than 2 years.

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* World nuclear association reports (2006 – 2015). The nuclear data in GWe is not accurate in representing number of reactors operating due to improved performance for existing reactors, load factor and efficiency. Therefore nuclear load in MWe is correlated to 2011 level of 370 which is equivalent to 2630 Billion KWh of electricity.

Example: 2012 level = $\frac{2518\ \text{BKWh}}{2630\ (2011\ \text{level})} \times 370\ \text{MWe} = 354\ \text{MWe}$

** The world output of PV by the end of 2013 exceeded 130 GW; in 2013 alone 33 GW was produced: 10.6 GW in China, 9.7 GW in Japan, 6.2 GW in the USA (Ren 21, 2015 report).

This constitutes 1% of the total electrical load during peak hours in Jordan or 1.5% of the normal average load in the country. Therefore, an organized plan for solar electricity production can cover the future demand of the country at no extra cost because all mentioned production was private investments. JICA and the world bank have sponsored a long term study of the electricity load in Jordan so that it will help the country to manage its future electricity demand and probably connecting to Europe in the future across the Med-net (Mediterranean Net).

Wind power, however, was utilized since ancient times to drive ships; grind grain, olives and grapes. As seen in plate 16 wind power generated worldwide has reached 318 GW of energy in 2013, therefore exceeding all nuclear energy produced in the whole world*.

The cost of producing electricity from wind onshore is the cheapest source of energy at present as shall be seen in plate 16, but it is intermittent. However, with the energy stored in the national smart grid, synchronized with other RE sources, and as wind speeds becoming more predictable with scientific developments, hybrid systems are widespread now. The Unique German case of a wind-solar hybrid system that managed to produce 59% of Germany electricity needs on October 3rd 2013 as shall be discussed later.

The latter success might be the reason why we call RE the energy of the future and the energy of peace! The main reason why we call it the energy of peace is related to the idea that no country can block the Sun or the wind on another. The energy is dewy available, so why fight? Was it not the "oil" that attracted a coalition of 33 countries to invade Iraq in 2003?

* China alone produced 23.2 GW from wind in 2013, followed by Germany 5.3 GW, USA 4.9 GW, India 2.3 GW, Canada 1.9 GW and the UK 1.7 GW (Ren 21, 2015 report)

2-2 Feasibility and Job opportunities of renewable energy projects.

2-2-1 Feasibility

Wind power and solar thermal are the second and third fastest growing sources of energy worldwide. In 2013, wind energy production amounted to 318 GW, thus exceeding all nuclear power production capacities worldwide. Does this mean that nuclear power has a dim future?

With the post-Fukushima nuclear disaster, a new paradigm has developed in the nuclear industry. Extra safety precautions and worries about liability, an aging global nuclear power fleet and the privatization of utility companies since the dawn of the new millennium are all problems that must be confronted if the nuclear industry is to survive! It has become evident that nuclear energy is the most expensive source of energy, as can be seen in plate 17, which illustrates the price of investments in new European power stations.

Plate 17: Price of new electricity generation in European power stations [52]

To support the claim that nuclear energy is the most expensive, another German study has recently proven that if all costs related to the nuclear industry were reallocated to electricity consumers, such as: corruption, extra load management, liability, security risks, monopoly of enriched Uranium, environmental and water quality degradation, health hazards, the future generations' right to a clean and sustainable environment and resources, as well as the reprocessing and storage cost and hazards of nuclear waste, then the price of electricity would increase to reach a value of 2.36 Euros/KWh[53]. This is just far more expensive compared to other safer and more cleaner sources of energy that are outlined in plate 17, particularly gas and RE (Sun and Wind).

2-2-2 Job opportunity

Creation of jobs is essential too when considering any investment in the countries of the South as unemployment is very high there. In a country like Namibia, where uranium mines had been utilized for a long time, the percentage of unemployment reached 51.2% in 2008[(54)]. So, mining Uranium does not solve countries economical crisis.

If we consider the construction and operation of nuclear facilities, we may ask further questions:
Are they labor intensive? Energy source-jobs per terra watt hours of energy production are displayed in the following table:

Natural Gas	250 jobs / TWh
Coal	370 jobs / TWh
Nuclear	75 jobs / TWh
Wood	733 jobs / TWh
Hydro	250 jobs / TWh
Wind	918 - 2400 jobs / TWh
Photo-voltaic	29580 – 107000 jobs / TWh

Table 8: Jobs per Tera watt hours of electricity production [(55)]

It looks quite obvious that the nuclear industry is the poorest amongst all other sources concerning jobs per energy production. Hence, developing countries need to be motivated to resort to intensive labor energy sources, away from logging and deforestation, by promoting wind and solar energy which provide far more jobs than the nuclear industry or else.

Renewable and clean energy jobs are both decentralized, spread around the country, require no highly skilled labor and are safe and secure energy sources; decentralization and jobs are badly needed in the South as migration from rural areas to cities is intensifying under poor living and health conditions. Not to mention that much skilled labor had already migrated to the North.

2-3 Liability of accidents, Safety and Security

As for safety and security, we wonder! With the present reputation of the culture of safety and security in the South, as well as the poor human rights record such as that in China, Russia and India, were most of the NPP's are being built can developing countries minimize the risks of a nuclear disaster? Expert nuclear engineer David Lochbaum responds to our question: “It is not if we are going to have nuclear accidents but when” [(56)]!

If developing countries can afford nuclear accidents and can recover from such catastrophes, like what happened in Chernobyl – in the late USSR -and in Japan at Fukushima, developing countries of the South cannot do that for the reasons discussed earlier. However, in RE things are much different. Let us discuss the dangers of renewable energies to try to compare it with nuclear dangers.

2-3-1 Hydroelectric Energy

Hydroelectric energy is number 1 source of renewable energy in the world with a percentage share of the total electricity production of 16% worldwide; However, hydroelectric energy is the least growing source of energy, therefore new risks are not added to the energy mix that we are considering in this paper and thus it is useless to discuss for the purpose of this study.

2-3-2 Solar P.V

The production of solar power in the form of electricity has almost torched 300 MW in 2012, progressing at an amazing rate which makes this source the most promising in the next decade. What makes it even more promising is its capability to connect with wind energy in harmony. Germany has developed a smart grid and a hybrid system that allowed producing 59.1% of its electricity consumption at 2 p.m. on October 3rd 2013 from both wind and solar power, as can be seen in plate 18.

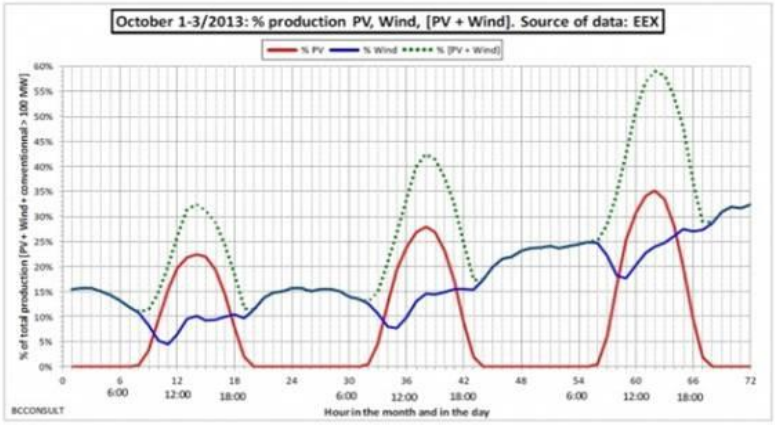

Plate 18: Hybrid energy system of wind and solar (57)

The production of PV cells, installation and connection to the grid are all potential dangers. Therefore safety measures and environmental concerns should be considered carefully. The process of manufacturing PV cells involves dealing with dangerous pyrophoric gas. Silane (SiH_4) is also a by-product of the industry that causes environmental hazards. The type and amount of energy consumed to produce these PV cells is questionable too, if produced from

coal for instance, like it is the case in China. In such a case it will be CO_2 intensive. However, science and technology are now producing safer alternatives with a more stable gas and energy sources are becoming cleaner [58].

Installation can be dangerous too, especially on pitched roofs. So is connecting to the grid, especially if it is a big project and when it needs special facilitation. In Jordan the so called "green corridor" is been implemented at present, almost finished in the south of the country (Maan-Qatrana). More work is needed on the northern eastern part to facilitate connecting electricity produced from solar and wind to the national grid.
A five square miles of land can produce 500 MW[59], meaning that all Jordan's future needs for the next 4 years (at 3.5 – 4% annual increase in demand) can be a similar project that will most probably be of private investment signing with the government a Power Purchase Agreement (PPA) for decades. In 2012 increase in demand averaged 4%, and then in 2013 it retreated to 3.5% [60].

Surely there are hazards, working in this industry but it is relatively extremely safe compared to the nuclear industry and provides all the time required for maintenance, cleaning … etc, especially during the night when the system is off-grid.

2-3-3 Solar thermal

The solar thermal industry is far safer than the PV industry in terms of material production. However, similar minor hazards can be raised from installation, but are as common as installing a satellite dish on the roof.

The solar thermal systems of concentrated solar power (CSP) are more serious and potentially dangerous because of the high temperatures reached at the focal tower. However, this industry is expected to flourish after introducing molten salt and other heat exchangers that allow storing heat during the night to ensure the continuity of electricity production all day long.
Efficiency and safety of installing these systems have been going uphill in the last few decades and require no further investigation.

2-3-4 Wind

The impact of wind turbines on human's health have started almost 80 years ago[61]; Although there are many allegations of potential damage to health, recent research for the European network on "Noise and Health" has announced in 2013 that noise impact on health lacks sufficient evidence. Air pollution and traffic noise are the prime environmental factors affecting public health in the EU and Norway[62]. However, high noise levels in urban areas proved to be an impediment to education[63], which doesn't imply that noise pollution of any source should not be underestimated.

In Jordan wind farms were installed in the years 1986 – 1987 at Ibrahimiyya and Hofa in the north of the country. They are still working now and contributing slightly less than 2 MW to the national grid. Nobody has complained of the noise or the aesthetics. Is it the "nocebo" or the "placebo" affects that control one's thought? Do negative thoughts engender negative outcomes, or is it the other way round?

Much research was done on the "nocebo" effect, in Sydney, Australia, proved a partial factor for the response [64]. Whatever the case might be, the rising interest in noise pollution produced by wind turbines is reflected in the many conferences commenced and dedicated to noise research (Noise-con) which was organized in conjunction with the Denver-dorado "International wind Turbine Noise conference". Some communities have voted to shut down turbines from 7 pm to 7 am, such as Falmouth [65].

Regardless of noise, does wind turbines take the beauty of the landscape or reduces property value, upsets mild life and kills birds? One ought to look at the issue from a holistic perspective by asking questions such as:

- Aren't these turbines far more environmentally friendly than burning coal or fossil fuel?
- Aren't these turbines far more environmentally friendly than motorways and car racing tracks?
- How much damage is done to the landscape when mining coal, gas, Uranium or oil?

Finally, we depend on the ever progressing technology to reduce noise and dangers. With improved mechanical parts in the turbine, the revolution of the blades are now far slower than earlier versions, therefore newer versions are quieter and more beautiful to the eye. With incentives given to investors in off-shore wind farms, the issue of noise pollution and aesthetics will be an issue of the past.

2-4 Safety and security of RE technology.

2-4-1 Hydroelectric Energy

Damage to Dams and water infrastructures have a long history since ancient times. In modern wars it can be a serious threat. However, examples of Iraq's Musel dam is interesting as it was not destroyed although occupied by ISIL (The Islamic state in Iraq and the Levant) fighters who are described as the fiercest guerillas in the world. Of course the answer lies in the scarcity of water in the area. In contrast Brennilis Nuclear Power station was attacked twice by French guerrillas from the province of Britannia that led to decommissioning it in 1985. In any case as this source of energy is not progressing worldwide we have no interest to continue the discussion over safety and security of hydroelectric energy.

2-4-2 Solar P.V

These systems of electricity production through photo Voltaics require neither serious safety nor serious security worries because it is wide spread around all over the world; on roofs, in deserts and elsewhere. Future technologies will soon replace P.V panels everywhere which will make the issue of safety and security trivial. Cells are being integrated now in building materials and soon our roads and building facades will be producing electricity.

However, CSP systems need more safety but this issue is confined on site and any damage is local and can in no circumstance cause a threat to a large area or a community in a similar manner to the potential damage of a nuclear accident, for instance.

2-5 Sustainability

Wind and Solar systems are modular, meaning we can add to them new sections by time without disturbing the whole system. They can be moved from one place to another if necessary. They can isolate large woods and forests by forming a service road to reduce the risk of fire. They can provide jobs to rural communities and improve their well-being, especially in developing countries.

Private homes are investing in these systems to produce their own consumption of electricity which would facilitate a more sustainable future for the owners and provide spare money on the long term to invest in other valuable things that can increase production or provide comfort and leisure.

Sustainability cannot be achieved without the support of environmental ethics. A branch of philosophy that is perceived as the practical dimension of ethics concerning environmental issues. It is also conceived by some as an “education for sustainability”, and “an important vehicle to transmit values, to change attitudes and to motivate commitment” [(66)]. Therefore,

sustainability is a crucial element in our moral decision over the choice of energy. While other traditional fuel sources are depleting the basic material for manufacturing PV cells is silica which is basically abundant and safe to handle.

2-6 Environmental Justice

When perceiving global environmental agendas, such as the "Ozone Layer" depletion and how it has been tackled successfully since the Montreal Protocol 1987, one wonders why has the international community succeeded in preserving the Ozone layer, through reducing and then eliminating the ozone depleting substances, such as chlorofluorocarbons, yet, the issue of Global Warming is still shifting from a discussion over reducing Green House Gases into adaptational measures, particularly after the Copenhagen Summit 2009 (Cop 15) till December 2014 (COP 20) at Lima-Peru?

Environmental Justice is part of social justice and has a substantial impact on our health, sustainability of resources and the integrity of the ecosystem in general, which consequently has impacts on the less privileged of the society, as well as on unfortunate nations and on future generations as well. The overall environmental policy is unfortunately marginally influenced by underprivileged persons and nations, and naturally uninfluenced by the latter in the absence of defenders of future generation's rights.

Nevertheless, in the process of checking the credibility of environmental justice in its idealist form, we ask: does it guarantee our right to participate in drafting environmental laws and regulations democratically, expanding the community involved, monitoring the application of laws and regulations and making sure that environmental risks are fairly distributed over the community?* These are some of the questions that ought to be addressed to respond to the discussion, yet, other question in the form of knowledge issues are formulated to guideline the discussion, such as:

> How is environmental justice connected to economic "progress" or "regress"?
> Who decides what percentage of growth (economically and demographically) should be targeted?
> How is it that economics, ecumenical and ecology come from the same Greek root (Oikos)?(67) Does this mean that all components of the society (Economics, politics, philosophy, …) are interrelated and intertwined together, as suggested by Antonio Gramsci?

Defining environmental Justice can be approached through explicating its opposite. The meaning of environmental injustice has been developing with time; it was firstly connected to race, gender and social class at different stages in history, depending on the ethical, economical, social and political paradigms prevailing.

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* Nuclear sites are usually chosen in the rural areas whereas urban areas get clean electricity and all the pollution happens further away in the country side, similar to what happened in Fukushima prefecture.

During the industrial revolution, waste was dumped near poor areas, or in neighborhoods where immigrants lived. Defenseless communities unwillingly invited breaches of environmental ethics, as serious chemical and radioactive waste was dumped in poor countries or in the open seas where defenseless island peoples and wild life has no rights and no means to defend themselves!
Environmental Racism was fought by the US Church of Christ, during the eighties of the twentieth century, but it wasn't till the early nineties that environmental law suits were accepted in the North American Juridical System. It wasn't till the year 1989 that Basel-Switzerland agreement over trans-border dangerous waste trafficking was passed [(68)].

On the other hand, if we go through successful cases of environmental justice we would wonder why the impact of Rachel Carson's books (*Silent Spring*, *The sea around us* and *The Edge of the Sea*) were successful compared to other cases of dramatic-failure to address environmental disasters, such as the chemical destruction of forests in Vietnam during the war, an issue which has rarely been addressed until now!

Another success story was the eco-justice movement which won in 1986 against Mc Donald's Styrofoam and Microsoft PVC plastic in 2006. So, can we thus infer that environmental justice is possible only in democratic, developed and rich countries, or there might exist other factors that deserve considering, such as environmental awareness?

If we mean by awareness the cognitive act of connecting environmental deterioration to historical, ethical, socio-economic, political and pragmatic circumstances; In this respect, can environmental justice be increasingly connected to environmental awareness, as been suggested by some researchers[(69)]?

It is believed that awareness, as a conscientious and cognitive act, is basically dependent on overcoming poverty levels, controlling birth rate, sustaining political stability … etc, which is rarely the case in poor countries. So, can we say that environmental justice is only possible in rich and democratic countries?

World economy growth in 2008 was 1.8 percent compared to growth of 3.8 percent in 2007[(70)]. It seems that the world economic crisis, since 2008, has shifted our stances over environmental issues from a plan of mitigation to another of adaptation. An action which illustrates how much influence economics has over politics and else.

Despite that multinational corporations control the political decision, people are rallying to defend their habitat, sometimes on personal initiatives. Environmental injustice felt by many has pushed people to start working, regardless of international support: The Chipko movement in India started early in the 1970`s, under the slogan: "what do the forests bear? Soil, water and pure air"! Small ecological farms started initiatives against globalized food industry; conserver versus consumer; ecology versus an industrial paradigm.

In Africa, Waugari Mathai, planted 20 million trees. Other initiatives around the world are equally important. But sustaining these projects would need decisions at the highest level; therefore, we believe that long-term success is highly unexpected.

Environmental injustice means poverty too, as the World Bank issued annual environmental degradations levels in percentage of the GDP; which is exceeding 3% in Jordan, and exceeding 5% in Egypt, for example. Although a country like Nigeria is an oil exporting country, oil pollution and environmental degradation has left 70% of the population living on less than one dollar per day [(71)].

The case in countries of the North is different. The worst environmental disaster in the United States is the oil spill in the Gulf of Mexico which started in April 2010, and ended in July 2010, it has left 200 million gallons of oil in the sea; coating migratory birds, polluting beaches and threatening bio-diversity … etc. The USA Justice department is likely to prosecute big companies for breaching the Clean Water Act and the Migratory Bird Treaty Act [(72)]; still, can environmental justice be achieved within the "democratic frames mentioned earlier"? We mean, is a sustainable and perpetual mode of environmental justice possible?

Even if they fine BP and other multinational corporations, the potentials of environmental disasters will still be there; the influence of big companies controls political decisions at the highest of levels.

The Eurocentric, or "Western-centric" perceptions of justice can be seen in the works of some political philosophers, such as John Rawls's book "A theory for Justice", written in 1971, where he entered the notion of obligation into the philosophical debate. Developing a method (Kantian – utilitarian) for moral evaluation of political, social and cultural institutions; John Rawls Justice is addressed as "fairness", eliminating all biases and prejudices! Is this true?

He classifies countries according to the law of peoples into Good and Bad, including countries which he calls "Kazanistan", an imaginary Moslem state [(73)]. This division between states is concealing the polarized relations that exist between North and South [(74)]. The dichotomy: north-south, good-bad, just states-unjust states, is endless. So, can we perceive political thinkers as a reflection to the ideology of the state?

Mining is another traditional source of pollution which is controlled by big cartels and has been causing environmental injustices in many countries worldwide. Mining Uranium and building nuclear facilities, either for nuclear fission, reprocessing waste, enrichment of Uranium, storing nuclear waste or else, is forcing people to leave their homes for safety reasons and other environmental concerns. The amount of pollution that accompany this industry is humongous, although some claim that it is a clean industry and go as far as considering it a remedy to Global warming, as the IAEA (International Atomic Energy

Association) Secretary General Mr. Amano suggested in a press conference in Amman in October 2011.

The fact is that one KWh of electricity produced from nuclear power produces 66 gms of CO_2 (mining, milling, enrichment, … etc) while an equal power generated from on-shore wind mills produce only 9.5 gms [(75)]. The future pollution from mining Uranium is even worse, as the quality of Uranium deposits in the world is worsening, while the technology of wind and other renewable sources of energy are improving. So, pollution is expected to be far less for renewable energy in the future, while pollution in the nuclear energy industry will be escalating in the near future [(76)]. Yet, some countries, unfortunately, are still insisting to promote nuclear energy worldwide!

Proposed nuclear waste dumps are usually chosen near the unprivileged of the nation. In Australia, during the Howard's government in 2007, the Muckaty Station in the Northern Territory, where unclear waste is to be dumped, is situated on land owned by the aboriginal Australians [(77)]. This project leads to further environmental degradation, more difficulties in reaching natural resources and exposes the population there to great health risks.

The Darlington Nuclear power facility in Ontario, Canada has been built in stages since 1981, finished in 1993 at a sky rocketing cost; it was ten billion dollars over budget[(78)]. So, it is not just Uranium deposits that are neither sustainable nor feasible, but also the cost of the nuclear industry. So, we can see how poorly justified and misleading the nuclear industry is! Yet, media still promotes the notion of nuclear renaissance at the expense of environmental justice!

The Chernobyl report on the nuclear disaster is another example of misinformation and media fraud, it was issued by the IAEA and WHO in 2005 in fifty pages; It claimed few casualties and minimal damage since the disaster in 1986. The second report was published in 2008 by the New York Academy of Science and listed almost one million casualties [(79)]. The media is still promoting the first report and discarding the second!

Although President Obama supported 8.3 billion dollars, in February 2010, in loan guarantees to construct two new nuclear plants in the State of Georgia, it is attracting tough opposition from environmental organizations on the bases of environmental injustice (safety, security, health, sustainability, and economic feasibility). Yet, deep down, it is mainly seen as a threat to the coal industry, and if the bill is going to be dropped the reasons would be not for environmental justice.

Discarding human rights for a clean, safe and sustainable environmental in such a manner requires a close look at the Earth Charter: principle l.a.:-
Recognize that all beings are interdependent and every form of life has value regardless of its worth to human being!

But, can we justify our interdependence? How dependent on others are we? How dependent are some nations on other stronger and richer nations? How dependent biodiversity has become on human beings for their survival?

We might further consult the General Assembly declaration on human rights 1948, article l: "*All humans are born free and equal in dignity and rights … etc*".
Can human dignity ever be achieved without environmental justice, which can balance the tension that exists between us and our ecosystem?
What happened to the notion of "The Limits to Growth" as put forward by the Club of Rome? Do we have to leave environmental degradation at the mercy of no limits for growth?

UNESCO declaration on the responsibilities of the present generation towards future generation (1997):
"*To ensure that future generation benefit from the richness of Earth's ecosystems, the present generations should strive for sustainable development and preserve living conditions, particularly the quality and integrity of the environment*".

Can we have a consensus over the same environmental issue without taking our private interests into consideration?(80) Meaning that we value more the materialistic outcome of things rather than its intrinsic values or its aesthetics, and without the consent of the majority or those who will belong to future generations!

In response to the latter dilemma, Deep Ecology questions the fundamental presuppositions of ethics (value priorities), religion and philosophy which underlies western societies economic agendas.

The socio-economic dimension is high-lightened here by Arne Naess(81), considering the members of the deep ecology movement as having things in common, such as: attitudes, beliefs, similar lifestyles and above all they tend to agree over many political issues.

Arne Naess and George Sessions have put forward a definition for deep ecology in 1984, which is basically the following:

1- All the richness and diversity in life form have intrinsic inherent values in themselves regardless of its usefulness to humans.
2- Human have no right to subjugate other life forms to their "wants", but can satisfy their vital needs in controlled human population growth.
3- Agreement on substantial measures necessary to mitigate the damage done to the ecosystem, controlling growth and raising awareness.

So far, we have seen little impact of deep ecology on environmental justices, may be due to its limited numbers of supporters. Meanwhile, a greater portion of people are supporting shallow ecological practices which resemble adapting to climate change (since Copenhagen COP15, at least) and adapting to environmental injustice rather than the opposite. This

stance leads us to an impasse, as lessons from the past can be taught and learnt! A real-life, situation is discussed to prove the point here.
The Easter Islands [82] example is appropriate here, being the most remote habitable island in the world, the island has given archeological evidence that forest destruction led to the loss of raw materials, wild life, rich soil and eventually the loss of crop yield. As a response to this environmental deterioration "ideology" took over! How did that happen?

The huge statutes built by the chiefs and priests were used to impress the masses and to claim their relationships to the gods, thus helped them to extract food surplus. When the environmental deterioration was so intense, the big monuments were toppled over and different clans fought each other fiercely, eventually reducing the population to few weak and desperate inhabitants at the time when they finally encountered the first Europeans in 1722[83].

A similar example comes from the Anasazi native people of America, who lived in the South West of the USA during the 11-12th century. They experienced deteriorating environmental degradation at the end of the 12th century which witnessed a global warming resulting in warfare and eventually cannibalism [84], thus annihilated each other.

The Maya people, also were weakened by climate change, deforestation, erosion and building monumental buildings instead of dealing with socio-economic and ethical practices in response to environmental problems, finally subdued in 1697 and were culturally vandalized by Bishop Diego de Landa through burning all Maya manuscripts in order to "eliminate Paganism"[85].

A contemporary version of population pressure is the genocide in Rwanda in 2004and the genocidal slaughters in Bangladesh 1971. Trujillo's atrocity against Haitians in the Dominican Republic is another example, as he ordered in 1937 a machete slaughter near the borders of 20,000 Haitians [86].

In conclusion, the concept of justice is relative and is thus defined according to the prevailing paradigm of that place at a specific time. Cases of environmental injustice discussed have shown the rift that lies between what we do and what we "ought to" do; Economics and power are the main salient factors regulating environmental justice. The ideologies that prevailed in the past and discarded environmental genocide are appearing today in the form of media ideological doctrines! So far, environmental ethics, the practical dimension of ethics, had limited influence over the immense environmental degradation levels prevailing in many parts of the world and falls short before making environmental justice possible!

If any success is to be achieved deep ecological perceptions must be incorporated in political decisions at the super-structure of the world's community; Recognizing the expansion of the moral community affected by ecological risks, minimizing risk for the

majority, distributing risk fairly over the ecosystem, involving the larger community in decision making and compensating those who suffer most[87]; Issues which remain standing for future discussions, particularly with dangerous sources of energy, such as the nuclear energy, the energy of war.

2-7 Conclusion

It is believed that background radiation instigated evolution of our species along millions of years passed; however, mutations induced by radioactivity from the nuclear industry produce species that cannot adapt, such as the genetically damaged children of Chernobyl and the Fukushima Butterflies [88] and other species of the rich biodiversity around us. Hitherto, we have proved that nuclear energy is neither safe, sustainable nor economic and eventually accumulates debts, poverty, water scarcity, potential threat, and enmity between nations as well as it enhances environmental and health degradation for millions of years.

We have also reached a conviction that sustainability presupposes peace. In contrast conflicts and wars start over natural, unsustainable and risky resources, such as the nuclear industry and fossil fuels. Both sources present an acute danger, not only to human life but also to the integrity of the environment and the eco-system at large.

Nuclear Energy advocates are thus anthropocentric in their perception to the world; we ought to change that into a biocentric or an ecocentric perception if we seek a sustainable future for life on Earth. Our moral duty cannot accept such a diabolic source of pollution that can be avoided by using safer and more sustainable available alternatives, such as renewable clean energy solutions: solar, wind, geothermal and ocean energies.

We believe that Sustainable Development is only possible through the Energy of Peace: Renewable Energy; the source of energy that no one would fight over and can eventually sustain Energy Equity and Environmental Justice. No one can shade the Sun or stop the wind or monopolize ocean tidal and wave energy.

Is it true that our moral decisions and ethical responsibilities can play a role in decision making over serious issues, such as nuclear power?

We believe it is possible to make a difference. Our example comes from Germany when the report of the Ethics Commission for a Safe Energy Supply in 2011 drew the future for nuclear-free Germany by 2022. Our inspiration comes also from H. Horsburgh while reflection on the possibility of nuclear annihilation: “only the non-violent can inherit the Earth …the violent can only deng them a world to inherit”[89]. We personally agree with Alan Carter [90] that the only ethics which can survive is Environmental Ethics.

If we thus agree that we did not inherit the world from our ancestors, but rather "we have borrowed it from our children", then we "ought to" resort to the precautionary Principle in our moral decisions, perhaps as defined by the United Nations:

The precautionary principle (United Nations Conference on Environment and Development 1992) holds forth that "a point can presumably be reached when human well-being and environmental health are put at risk by a large-scale human activity or man-made system over which humans have control. At such a point the problem could be identified, a course charted, and precautionary actions taken to ameliorate or prevent a potential threat to human and environmental health on behalf of current and future generations".

Since Copenhagen`s (COP 15) 2009 that witnessed a behind the stage deal over a policy of "mitigation", we ought to continue advocating for more stringent measures if Earth is to be saved the consequences of Global Warming. It is now verified that the point of no-return for Global Warming is 450 ppm CO_2 which is probably few decades away (we have passed 400 PPM lately) if something serious is not done right now, so why no serious action is under way at present, particularly by China and the USA who are producing almost 42% of the world's global emissions? Why, on the other hand, have we acted so swiftly when the Ozone Hole was discovered over the South Pole in 1985?

Surprisingly, only two years after the discovery of the Ozone Hole, the Montreal protocol was agreed in 1978, entered into force in 1989, amended in Helsinki 1989, 1990 in London, 1991 in Nairobi, 1992 in Copenhagen, 1993 in Bangkok, 1995 in Vienna, 1997 in Montreal, 1999 in Beijing and 2007 in Montreal. By the year 2000 the world can no longer producing harmful products to the Ozone layer, such as CFC_s, and consequently invented much less damaging replacements such as $HCFC_s$. By 2003 recovery of the Ozone was on its way! So, why were we so efficient in dealing with the Ozone issue while GHG's are still short of a world's consensus, although it is life threatening too? And why are we still marketing nuclear energy although it is the energy of war and destruction?

The answer to this question we leave open for further research!

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Corrections table

Page	Wrong	Correction
11	2012; now it is back …….. ** A lone	2012; it was back ……. ** A loan …….
36	have produced approximately equal power ** was produced:	have showed approximately equal power capacity ** was installed:
37	*China alone produced 23.2 ……	* China alone installed 23.2 ……

About FES Amman

The Friedrich-Ebert-Stiftung (FES) is a non-profit organization committed to the values of social democracy and is the oldest of Germany's political foundations. In Jordan, FES opened its office in 1986 and is accredited through a long-standing partnership with the Royal Scientific Society (RSS). The aims of the activities of the FES Amman are to promote democracy and political participation, to support progress towards social justice and gender equality as well as to contribute to ecological sustainability and peace and security in the region. FES Amman supports the building and strengthening of civil society and public institutions in Jordan and Iraq. FES Amman cooperates with a wide range of partner institutions from civil society and the political sphere to establish platforms for democratic dialogue, organize conferences, hold workshops and publish policy papers on current political questions.

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