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From Energy Mess to Energy Management: Jordan as a Case Study (2007-2020)

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Table of Contents:

List of Abbreviations:

British Petroleum (BP)

Build Own Operate (BOO)

Compact Fluorescent Lamps (CFL)

Electricity Regulatory Commission (ERC)

Energy and Mineral Resources Regulatory Commission (EMRC)

Gross Domestic Product (GDP)

Gulf Cooperation Council (GCC)

Islamic State of Iraq and the Levant (ISIL)

Japanese International Cooperation Agency (JICA)

Jordan Atomic Energy Commission (JAEC)

Jordan Nuclear Regulatory Commission (JNRC)

Jordan Petroleum Refinery Company (JPRC)

Light Emitting Diode (LED)

Liquid Natural Gas (LNG)

Member of Parliament (MP)

Memorandum of Understanding (MOU)

Ministry of Energy and Mineral Resources (MEMR)

National Electric Power Company (NEPCO)

Natural Resources Authority (NRA)

Particle per Million (PPM)

Photo Voltaics (PV)

Power Purchasing Agreement (PPA)

Quality Assurance Certificates (QAC)

Renewable Energy (RE)

Royal Scientific Society (RSS)

Solar Water Heaters (SWH)

1.0 Introduction

Energy policy in Jordan has been in disarray since the 2007-2008 energy crisis and ever since the Cabinet's endorsement of the 2007-2020 energy strategy in 2004. This paper shall be critically discussing the state of Jordan`s energy strategy 2007-2020 hoping to shed some light on the factors behind the disappointing outcomes of the recommendations of the energy strategy. In an ideal world, there would be some partial success stories. However, in the case of Jordan, it is more realistic to outline the impediments to success, which include poor methods of governance in terms of how power is exercised, and how decision-makers are held accountable.

By discussing some true success stories from around the world and comparing these to Jordan's experience, it could bolster hopes for future successes and open the way forward for better management of the energy crisis in Jordan. This could be done within the framework of a rational energy policy that is continuously updated through a system of trial and error. A good policy should stem from good governance and be based on both public-private partnership. It would also take into account the uniqueness of Jordanian energy endeavors, rather than copying foreign experiences per se.

This paper presents four sections on the energy problems in Jordan. The first section discusses the energy strategy from 2007-2020 in the oil, gas and renewable energy (RE) sectors as well as lays out a general strategy recommendations. The second section discusses some global success stories in RE and provides some background information that can be used as baseline criteria for practical achievements, which are outlined in the third section of the paper, this section focuses on the energy mess in Jordan, and is entitled: "Is an Optimistic Jordanian Perspective Possible?" The final section provides conclusions and recommendations.

1.1 Energy Strategy 2007-2020

The master plan for the energy sector was endorsed by the cabinet on December 7th, 2004. The energy strategy, however, was later released in two parts in December 2007. Adequate time has now passed to warrant a critical investigation of how many objectives have actually succeeded or are on route to being achieved, either by 2015 or 2020, as originally predicted in the different scenarios of the strategy. This applies particularly in regards to the energy mix, which consists of: oil imports, oil shale production, natural gas, nuclear and renewable energy.

The main concerns at the time of strategy design and initial implementation were to expand the grid to local communities, to develop electrical interconnection ties with the neighboring countries and to diversify energy sources, which were at the time mainly natural gas and heavy fuel. Although this paper will focus on the strategy in detail, it is important to bear in mind that the strategy was designed before the energy crisis of 2007-2008, and although the price of a barrel of oil did reach $147 in July 2008, nothing in the strategy changed to take into account the harder challenges that have occurred since then, particularly in terms of implementing energy efficiency and rationalization.

Therefore, the attempt will be undertaken to critically analyse how each source of energy has developed compared to the predictions in the 2004 plans, with an emphasis on how far Jordan has achieved in the realization of energy efficiency and rationalization as well as in the expansion and modernization of the petroleum refining industry.

A. Jordan's Oil Sector

In petroleum refining, the Jordan Petroleum Refinery Company (JPRC) has so far failed to expand refining facilities and upgrade the quality of its products, which are causing considerable pollution, endangering population health and creating property damage in vehicles and machinery. For

example, the amount of sulfur in diesel fuel in Jordan varies between 10000 and 12000 parts per million (ppm), whereas in the EU, standards from 2009 are a mere 10 ppm.[1] The Jordanian standards are set at a limit of 350 ppm, and were supposed to take effect as of May 2005, but have not yet been controlled or enforced.

Additionally, the recommended Aqaba– Zarqa pipeline and the rehabilitation of the Saudi– Jordan Tap Line, which would support the refining industry, have not advanced beyond the planning phase. The Iraqi– Jordan oil and gas pipeline project from Basra, although signed in 2014, seems to be postponed with the present political turmoil in Iraq. This shows that poor planning and political instability in the region are behind these setbacks, which will most likely persist for a long time.

Moreover, internal politics in Jordan have affected different energy deals with regards to the exploration of natural resources. The oil shale deal with the Estonians took six years of negotiations from the signing of the Memorandum of Understanding (MOU) in 2008. But the high turnover of government officials since that time, including ten different energy ministers and five different prime ministers, made it difficult to ratify this agreement. Eventually, the governmental deal reached its final stages and was officially signed on October 1st, 2014. Only time will tell if the Estonians will remain interested and can successfully gather enough financial backing to start producing, particularly as oil prices had been on the decline since then.

But there is some hope for optimism, as this deal offers a basic constant competitive price for forty years, set at 13.15 cents/KWh (US $), for at least 70% of the oil shale production.[2] However, the delays in finalizing the agreement, and the many long years of negotiations, stand in stark contrast to the natural gas deal made with Noble Energy, which was made in just a few weeks. This indicates that the government has other priorities and is not interested in adhering to a definite long-term energy strategy.

A speculative and holistic view on the energy strategy is that the government has been paving the way for the gas deal with Nobel Energy in order to avoid activities in the promising Jordanian oil and gas fields near the Iraqi and Syrian borders. These will be considered perpetual war zones for years to come, especially with the US announcement of a prolonged war on the Islamic State in Iraq and the Levant (ISIL).

B. Jordan's Gas Sector

The expectations for gas exploration in Jordan have diminished after British Petroleum (BP) left Jordan in 2013. [3] The late head of the energy committee in the Jordanian parliament believes that BP backed out not only on professional, but also political grounds.[4] It is not difficult to imagine a scenario where politicians seek to destroy public hopes for the potential of national oil and gas reserves (including fracking) in order to strike a quick deal with Noble Energy for Israeli gas, next door in the Mediterranean Sea.

Hopes of extracting 700 million cubic feet per day (mcf/d) of natural gas from the Risha field (which is almost twice the present amount of Jordan's daily consumption) have gradually died out. As much as 300 mcf/d was expected to supply Jordan as early as 2015[5] from this field. However, Jordanian Liquefied Natural Gas (LNG) imports from Egypt, which started in July 2003, have died out gradually since the Egyptian uprising in 2011. The result was a drop in the share of LNG electricity production from 80% in 2010 to 20% in 2012. Again, foul politics, mismanagement and instability were the main causes. How much and how many of these factors affected BP's decision to dump exploration in Jordan is not yet known.

C. Jordan's Renewable Energy (RE) Sector

Fears of the high cost of producing electricity from RE, particularly from Photo Voltaic (PV), have withered away since

the reduction of production prices worldwide in 2008. Also, fears of a lack of legislation have greatly diminished after the ratification of the 2012 Law number 13 of Renewable Energy and Energy Efficiency. The main objectives of this law are to increase the RE share in the primary mix, prompting investment, mitigating environmental pollution and rationalizing energy consumption, as well as improving energy efficiency and eventually achieving sustainable development (Article 3). A fund was established in order to bolster these goals (Article 12).

Although the solar thermal program in the 2007– 2020 energy strategy bluntly declared a strong determination to increase the percentage of installations from 15% to 25% of households by 2015 through the installation of 50,000 m^2 of flat plate solar heaters per year, [6] very little success has been achieved. It is rather believed that the percentage has decreased to 10% in 2011. [7] In comparison, neighboring countries like Cyprus installed 582.4 m^2 in solar collector areas per 1000 inhabitants in 2005. [8] The outcome was that the number of Solar Water Heaters (SWH) increased to 80% of household in Cyprus by 2012.

However, a new law has been put in force in Jordan, beginning in April 2013, as solar heaters became compulsory for flats with an area greater than 150 m^2. Commercial offices with less than 100 m^2 and private dwellings with less than 250 m^2 were exempted. Unfortunately, the percentage of homes that fall under the new law, which applies to newly built flats, does not exceed 20% in Amman, and represents less than 10% of future constructions for the whole country.

D. Energy Management and Policy

This section will try to present the most important, but not yet implemented recommendations for energy strategy. One recommendation was to establish a special oil shale unit within the Ministry of Energy and Mineral Resources (MEMR) or in the Royal Scientific Society (RSS). The overall master energy strategy correctly predicted the potential for oil shale

for Jordan, but unfortunately this unit has, until now, not yet been established.

A fund for RE and energy rationalization was also recommended in the energy strategy. This fund has been established, with a balance of around 25 million JD,[9] as announced by MEMR in a meeting at al-Rai Newspaper in Amman on March 13th, 2014. But the fund is not yet operational enough to serve its greater goals and purposes.

Furthermore, the strategy recommendation to create clear binding mechanisms for energy use rationalization, (e.g., by issuing Quality Assurance Certificates (QAC) for residential buildings starting in 2008) have not been realized. There has also not been a launching of broad awareness campaigns on energy efficiency and energy savings that should have started in 2008, with the aim of establishing audience service offices where the general public can seek advice. The final recommended action to rationalize the transport sector to save up to 20% of energy consumption through modernizing public transport, using hybrid cars, promoting eco-driving, car-pooling, telecommuting, etc.[10] has also not been implemented.

The only achievement to date is the reduction of taxes on hybrid cars which are currently only used in small numbers. When one of the late energy ministers announced that he was pushing for full exemption of taxes on hybrid cars, he was dismissed from office.

A further dramatic failure in energy management & policy was evident in last year's inefficiency to utilize the 5 billion dollar, five-year Gulf Development Fund, allocated in 2011 by the Gulf Cooperation Council (GCC) for both Jordan and Morocco. Most of the funds were used for infrastructure projects; mainly road works (18%). Proposals for projects to develop the economy to create more jobs and boost exports in industry and agriculture were poor as they fell short of the one billion dollars annual budget. The existing minister of planning said that the total use of the grant budget by the end of May 2013 didn't exceed $128 million [11] (which is less than 13% of the year's budget).

It is also regrettable that there was never an update to the old report on geothermal energy, which was submitted in early 2007 and then proved unfeasible. Oil prices were then almost half of what they are today, so a new study would be presently well-justified.

One more disappointment in the strategy is that 20 energy efficiency case-studies were produced, including some for industrial and commercial projects, which showed a great potential to reduce energy consumption by 20% with an investment of a mere 3 million JD, and a 21-month payback period.[12] No significant action has taken place to see that these investments are made.

The Energy Efficiency Label has only become compulsory as of July 1st, 2014, for electrical appliances such as air conditioners, dish washers, refrigerators, etc. Much work is still needed on pumps, cloth irons and other electrical appliances. However, it was supposed to have been functional in 2009, according to the strategy. [13]

Encouraging the use of Compact Fluorescent Lamps (CFL) and Light Emitting Diode (LED) bulbs only started in 2013 after imports of traditional incandescent bulbs were banned; a matter that proves how important policy making can be in the energy market.

Exaggerated electricity load predictions in the strategy also added to further negative impacts on the overall energy policy perspective. The following table shows the high predictions and the corresponding actual values:

Year	GWh predicted electricity	Actual	% prediction	% Actual	Actual peak MW	% actual	KWh / capita	Income / capita in $
2007	12830	***10553***	----	----	***2160***	----	2277	3023
2008	14480	***11509***	12.9	9.1	***2260***	***4.6***	2403	3797
2009	15822	***11956***	9.3	3.9	***2320***	***2.7***	2427	4027
2010	17156	***12843***	8.4	7.4	***2560***	***10.3***	2518	4371
2011	NA	***13535***	NA	5.4	***2680***	***4.7***	2167	4666
2012	NA	***14074***	NA	4.0	***2790***	***4.1***	2227	4909
2013	NA	***14564***	NA	3.5	***2995***	***7.3***	2220	5214
2015	24224	NA	7.3	NA	NA	NA	NA	NA
2020	32241	NA	5.7	NA	NA	NA	NA	NA

*NA: data not available

Table 1 (Predicted versus actual electricity loads for Jordan 2007-2020) [14]

It can be seen in Table 1 that the actual increase in consumption of electricity was on average 6.8% for the three years 2008, 2009 and 2010, compared to a predicted rate of 10.2%. The actual consumption was thus, on average, 33% less.

Exaggerating growth rates can be an impediment to attempts of scientific and rational energy management. In Table 1 it can be seen how the predicted numbers overestimated actual figures. This exaggeration of future electricity demand is similar to what happened in France, where it led to the extremely high share of nuclear electricity in the French grid, which is now being reduced gradually from 76% to 50% by 2025. [15] France has been lucky finding markets

for its excess electricity in the EU and also lucky to have so far avoided a major nuclear accident. (16)

A further quick review of Table 1 shows how predictions for electricity demand for six consequent years (2008-2013) have proven to be exaggerated. Considering a 33% reduction in predicted peak load, this would put the grid capacity in Jordan at 3350 MW in 2020 rather than at the 5000 MW level. This was deceitfully used by JAEC as an excuse to justify each nuclear load unit of 1100 MW not exceeding 20% of the national grid capacity. In case of a black out, the equivalent of this amount has to be ready for immediate power generation at the event of any problem or during refuling nuclear fuel at the nuclear power station. This adds further capital costs which are never accounted for in the nuclear budget, as produced by the Worley Parsons feasibility study of the Jordan Nuclear Power Plant Project issued on September 28th, 2012.

Therefore, it is vital to reconsider regression in electricity consumption and growth in future strategies as a viable probability. This avoids falling into a “load management” pitfall that can be costly for the Jordanian economy and its social stability, which is already quite critical, being in an area close to a "perpetual war zone" since the invasion of Iraq in 2003. It is also rather controversial to talk of a plan to study the kingdom’s electricity sector for the next 15 years (Sponsored by JICA) as the energy strategy is currently at a standstill.

1.2 Global Success Stories in Renewables

This section establishes (in Table 2) a comparison amongst Jordan (as seen earlier in table 1) and the top five countries in the EU, in terms of its RE share of the total energy mix, electricity consumption per capita (2009-2011) and income per capita (2009-2012).

Country	% Share in 2012[19]	KWh / capita: 2009[18]	KWh / capita: 2010[18]	KWh / capita: 2011[18]	Income /capita: 2009[17] US$	Income /capita: 2010[17] US$	Income /capita: 2011[17] US$	Income /capita: 2012[17] US$
Sweden	51	14143	14934	14030	43640	49377	56724	55039
Latvia	35.8	3027	3230	3264	12082	11447	13827	13947
Finland	34.3	15242	16483	15738	44838	44134	48695	45649
Austria	32.1	7955	8321	8374	45872	45017	49485	46792
Denmark	26	6220	6327	6122	56227	56411	59912	56364

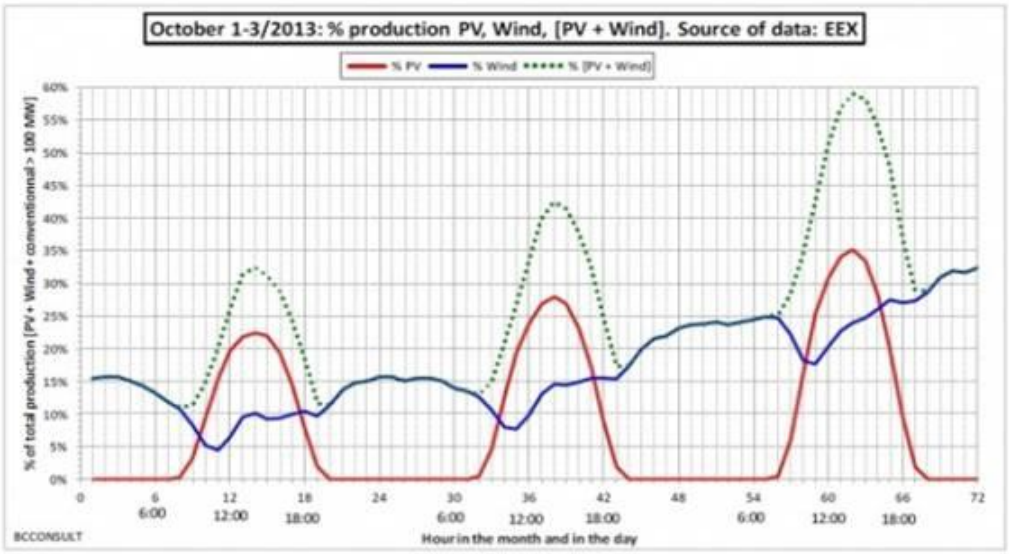
Table 2: RE share in total energy mix targets in 2012 (EU 28)

From the above table and Figure 1, we can conclude the following:

1) The development of the share of RE in Denmark between 2006-2009 will be taken as an example and be compared to the predicted share of RE in Jordan in 2020 to see how actual achieving our targets are? Consider the case of Denmark below:
   - 2006 actual RE share is 16%.[19]
   - 2012 share increased to 26%[19] (1.67% annual increase).
   - 2020 prediction is 30%,[20] which is a very conservative prediction compared to the exaggerated case in Jordan (1% in 2007, 1% in 2013, 7% predicted for 2015)!
2) Sweden and Denmark have shown a considerable drop of per capita electricity consumption between 2009 and 2011. Finland witnessed the same drop between 2010 and 2011. Austria and Latvia were almost the same. This suggests that energy efficiency and energy saving strategies are on the right track and are reasonably functional in these countries.
3) All countries showed an increase in income of their inhabitants per capita in GDP, which reflects a healthy economy.

4) The renewable energy share of the total energy mix fluctuated between 26-51% in 2012. In fact, Sweden achieved its 2020 predicted share in 2012. The EU, on the other hand, achieved 14.1% of its cumulative share by 2012. [21]
   Although Norway achieved 64.5% RE in 2012, while aiming for 67.5% in 2020, the rapid growth from 2004 to 2012 was topped by Sweden (38.7 – 51%), followed by Denmark (14.5 – 26%), then Austria (22.7 – 32.1%), Greece (7.2 – 15.1%) and Italy (5.7 – 13.5%).[22]
5) Germany has developed a smart grid and a hybrid system that allowed for producing 59.1% of its electricity consumption at 2 p.m. on October 3rd 2013 from both wind and solar power.

Figure 1: Hybrid energy system of wind and solar [23]



To compare these success stories with the Jordanian case, we present the following corresponding arguments:

1) The gap is still very wide for Jordan between the existing RE share of 1% in early 2013 (expected to reach 2% by the end of 2014 from private two-way

metering PV installations) and the predicted 10% in 2020 (even if the wind projects of Tafilah and elsewhere see the light of day before that date, and even if the 200 MW PV projects of batch one operate on time). Therefore, a similar success story is unlikely to be achieved by 2020 unless the policy of hindering RE projects changes.

2) From Table 1: Although the price of petrol jumped in 2007-2008 to unprecedented levels, the consumption of electricity kept increasing from 2007 to 2010; the reason is probably related to the continuing subsidies and dependency on the Egyptian gas during that period which created favorable prices. In 2011, consumption per capita decreased, then increased slightly again. The increase from 2012 onwards is partly due to the influx of Syrian refugees into Jordan and is not related to the natural growth trend. Therefore, political and security issues play an important role in Jordan's energy policy, inciting the urgent need for continuous strategy updates.

3) Jordan's annual income per capita increased by reasonable levels over the past several years, but on average it is still less than 10% of that of the five EU nations that were chosen as successful examples. Therefore, it can be deduced that energy strategies should not copy identical success stories from the West, but seek to improvise national plans that best suit the under-developed economy, stressed labor conditions, security issues, corruption, culture of safety and uneven distribution of wealth.

4) Great potentials for RE in Jordan exist with solar energy radiation of 5-6 KWh/m^2 and mean daily sunshine between 8.4 – 9.4 hours. [24]It is irrational to turn away from solar energy as a substantial source of peak load electricity potential. As for thermal solar potentials, Israel now has solar water heaters in 85% of households after passing a law in Knesset in 1980.[25]This is equivalent to 3% of the primary national energy consumption in Israel.[26] If this can be compared to Jordan, it translates to 138 million JD in 2012, when the primary national

energy consumption in Jordan reached JD 4.6 billion.[27]

5) Great potentials for a hybrid system of wind and solar in Jordan exist as wind capacity can be predicted with almost 90% probability one day ahead.[28] This encourages smart grid design. However, some work is still needed on the grid and the Green Corridor which facilitates the safe transmission of renewable energy generation into the national grid. Much work must also be done on the method of agreement on purchasing electricity. The Power Purchasing Agreements (PPA) are forcing the **National Electric Power Company** (NEPCO) to buy electricity from private producers with a risk of not being able to market it at times of low demand. Therefore, a possible solution might be to allow the three main electricity distributors to buy the electricity directly from the producers at market prices and according to demand.

1. 3 Is an Optimistic Jordanian Perspective Possible?

Is our claim that Jordan has made a mess of its 2007-2020 energy strategy justified? Here we shall track the achievements of energy mix scenarios that were set to be implemented by 2020 in the energy strategy 2007— 2020. [29] The ranges for each commodity from the different scenarios are as follows:

LNG: 20% - 45%
RE: 10%
Oil shale: 8% - 14%
Oil by-products: 25% - 59%
Imported electricity: 1%

How successful was the implementation of this strategy on the ground?

1) **LNG** predictions are not at all in line within the remaining time frame. BP has already left the country and there are no hints of gas fracking or further gas exploration in the promising areas or elsewhere. The remaining alternative is to import gas through the

floating LNG terminal at Aqaba, which is due to finish in 2015, as well as importing Israeli gas from the Mediterranean in the coming years.

2) **RE** has a predicted share of 7% of energy mix in 2015, which does not seem possible. The only currently available plan is for a wind project in Tafileh, which would produce 117 MW and has started already. It is encouraging to hear of an expansion of the project, but the target of 10% RE in 2020 is still very unrealistic. It is not clear so far why the solar projects in the south are facing difficulties. However, some of the 200 MW (batch one) of PV from private investors, which was signed this year 2014, might be finalized by 2015. But this would still not meet the 7% target for 2015. If the GCC fund is properly utilized and potential investors in RE, such as MASDAR, are involved, the target of 10% by 2020 can be met. A choice that can be achieved. Therefore, the energy strategy ought to be updated regularly if the target of a 20% share of RE in the overall energy mix is to be met by 2020. This would then match the minimum target aspired by the EU27.

3) **Oil shale** prospects for 2015 cannot be met. It seems inevitable that Jordan will still be 95 – 96% dependent on imports (oil and gas) in 2015. If the energy mess persists, the country will still be 90% dependent on foreign resources by 2020, because nuclear energy can never be online by then as expected. JAEC unofficially announced a new date of 2023-2025[30] for the start of nuclear capacity, which is expected to be delayed even further over the course of time. However, oil shale might be producing 550 MW of electricity and 38000 barrels of oil by 2018/19, providing that everything goes well after the signing of the agreement with the Estonians on the first of October 2014 (for example: funding, security, etc.).

To produce a realistic picture of the challenges that Jordan faces, several energy management and policy making

impediments should be addressed. For example, issues concerning the structure of governance should be tackled. It is of utmost importance that the most qualified are appointed in key positions of Energy management in Jordan. Hence, less bureaucracy and corruption is needed in the field of Jordanian energy policies. This aspiration is dependent on the vision that a competent cabinet elected from the major political parties in parliament and is accountable for its acts. Only then would it be possible to plan for a sustainable future. Democracy will assure that the decisions of the majority are instituted and those responsible for failure and corruption will be held responsible. Therefore not only reforms in the field of energy politics have to be undertaken but also political reforms (electoral law, for example) in order to strengthen the position of the Parliament and to hold the government accountable.

Although the 2007-2020 strategy recommended the establishment of new sections or units of expertise, such as a specialized team for solar, wind, oil shale, etc., almost the same team for RE in MEMR still persists, both in number and capabilities. Furthermore, instead of making independent regulatory groups, exactly the opposite has occurred, and there has been a merging of commissions. For example, 2014 witnessed the combination of the Jordan Nuclear Regulatory Commission (JNRC), the Natural Resources Authority (NRA), and the Electricity Regulatory Commission (ERC). How can this centralized attitude open any prospects for optimism concerning accountable and transparent oil, gas and clean energy policy?

If any progress is to be made in the area of natural energy resources in Jordan, it is obvious that more space and more freedom in policy making must be facilitated. The only extra privileges currently granted are for the Jordan Atomic Energy Commission (JAEC), which is directly connected to the PM office, whose decisions are unilateral, regardless of public and experts opinion. The only body that supervises JAEC activities is the JNRC, which was forced in 2014 into a trinity with ERC and NRA under the name: Energy and Mineral Regulatory Commission (EMRC).

Impediments for the RE market are mounting after the ratification of a RE law in 2012. Although the first batch of 12 investors, signed in March of 2014, created projects amounting to 200 MW of electricity generation through solar projects, the second batch was limited to a minimum of 50 MW each. The third batch that had applied earlier for investment was dismissed and a new invitation for 100 MW was announced in July 2014 on the basis of a Build Own Operate (BOO) project model.[31] Soon after, this last batch was cancelled. This hesitation and turbulence in decision making, as well as the reduction in solar purchasing unit prices from 120 to 100 Fills/KWh, has shaken trust between the government and investors. A more stabilized policy over a longer period of time would be much more encouraging for investors.

Table 3 shows the average cost of electricity per KWh in Jordan between 2005 and 2013, according to NEPCO annual reports:

Year	Average cost of KWh sold (Fils)	GDP (Million J.D)	Energy bill % of GDP
2005	46.93	9100	19.5
2009	54.46	17816	10.9
2010	68.27	18762	13.9
2011	129.88	20476	19.6
2012	145.69	21965	21.1
2013	145.30	23851	17.1

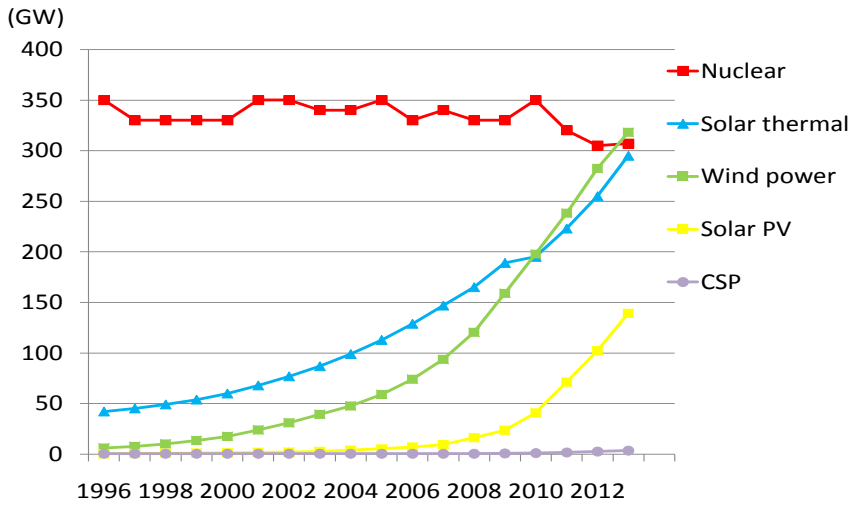
Table 3: Cost of producing electricity in Jordan (including energy source)[32]

It is obvious that energy bills had a spike in terms of GDP in 2005 (19.5% of GDP), and not only in 2011 and 2012 (19.6% and 21.1%, respectively) due to the Egyptian gas deal. There must be other reasons for this increase. It can also be inferred from the table that the cost of wind energy, which is

priced at 80 Fills per KWh, is competitive to the cost of other types of energy production since 2011. However, an offer from oil shale investors at 13.15 US cents/KWh (9.34Fils) for 40 years at a constant price is also competitive. This would have the result of bolstering the Jordanian economy and maintaining production from industry and business at competitive and sustainable prices.

The most optimistic perspective on future renewable energy potentials worldwide can be seen in Figure 2; the fastest exponentially growing market in the world is the solar PV market, amounting to 139 GW in 2013, adding 36.3% to 2012 production.

Figure 2: Energy Mix Growth Worldwide (GW)



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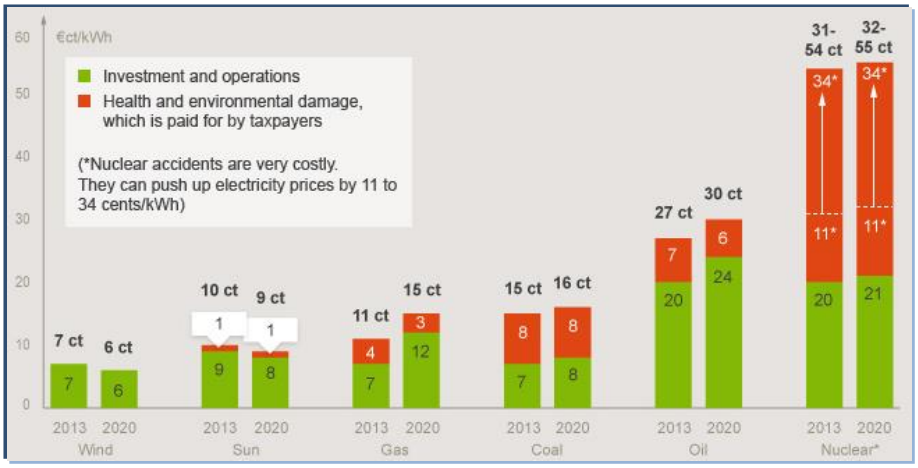
Wind power and solar thermal are the second and third fastest growing sources of produced energy worldwide, after PV electricity production situated on top. In 2012, wind energy production amounted to 318 GW, thus exceeding all nuclear power production capacities worldwide. Does this mean that nuclear 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. It has become evident that nuclear energy is the most expensive source of energy, as can be seen in Figure 3, which illustrates the price of investments in new European power stations.

Figure 3: Price of new electricity generation in European power stations [33]



In supporting this claim, a further study shows 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 of nuclear waste, then the price of electricity would increase to reach a maximum value of 2.36 €/KWh. [34] This is just plain expensive compared to other safer and cleaner sources that are outlined in Figure 3, particularly gas and RE.

1.4 Conclusion and Recommendations

Jordan's energy strategy should be updated and revised every three to five years. Strategy updates are especially useful in under-developed countries such as Jordan, because the impacts of internal and external influences are much greater than in developing countries.

Issues of short-sighted politics, dependency, and impediments to research & technology transfer all contribute to energy planning instability. However, the impact of these factors on the energy strategy would be much less dramatic if Jordan would step towards energy independence. This could be done by accessing local oil shale and gas & renewable energies, as opposed to importing Egyptian & Israeli gas and heavy crude oil from Saudi Arabia and Iraq.

There is great potential for RE resources such as wind and solar in Jordan. With just small capital investments in energy efficiency and rationalization, savings could quickly reach an average of up to 20% for some sectors. With the further implementation of solar water pumps, additional savings in electricity consumption could be achieved. Water pumping electricity bills were in fact already at 13.69% of total electricity consumption in 2012.

Furthermore, managing electricity peak loads during the hottest days of the year in the summer months of July and August can cover at least 50% of the extended load from renewable energy. In 2013, the peak load reached 3120 MW, meaning that at least 1000 MW can be covered by solar at noon, when the solar intensity is at its highest levels. With smart grids, which manage today's hybrid systems of different clean energy sources, this is possible as the grid itself has become the power storage facility.

If incentives were put for installing solar water heaters and PV cells or partly funded for the public, the energy mess would be a story of the past. However, who would compensate the losses incurred to electricity producers and distributors for

providing base load power supply? Similar setbacks could create responses similar to the cancelling of the third stage of RE tenders in August 2014; it seems as an outcome to government loss of consumers of high tariff bills!

Unfortunately, the hard lessons of the last decade have not been learned concerning depending on imported sources of energy, as the government is still stubborn about producing nuclear electricity at a preliminary load of 2200 MW with imported fuel. This is planned as a first stage for 2020 presuming that nuclear share will not exceed 40% of the expected alleged 5000MW grid load. Furthermore, there are high risks of importing nuclear fuel, as enriched Uranium has been delayed to many nuclear plants in the world, including such countries as India and the Philippines. Therefore, the dependency on imported nuclear fuel will always be a political risk and a perpetual threat to energy sustainability in Jordan and will require a continuous back-up supply of electricity from traditional means of production.

The energy rationalization policy has also failed in terms of establishing specialized units, making use of funds, or even finding a proper mechanism for applying building codes, such as Quality Assurance Certificates (QAC). The only partial success stories have been the introduction of energy efficient light bulbs, the endorsement of the RE law in 2012 and the policy on the first batch of energy efficiency labeling, which came into force on July 1st, 2014. Amendments and revisions are needed for updating instructions on best practices and need to be flexible in accordance to the ever changing needs of the market.

Another key reason for the energy mess was the exaggeration of the electricity load to justify adding nuclear power to the system. This was done at the painful cost of "load mismanagement" and a corresponding high capital investment with subsequent negative impacts on investments in other sectors of the economy. Finally, if any substantial success is to be predicted for the future with a fair degree of optimism, a new strategy has to be implemented based on the latter

recommendations and on public-private partnership in the framework of further democratizing Jordan.

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