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NUCLEAR ENERGY PERSPECTIVES IN MENA COUNTRIES

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The expanding market for nuclear equipment and services in support of the construction of new Nuclear Power Plants (NPPs) in the Middle East and North Africa (MENA) region is growing. To meet increasing energy demands, the last decade has seen countries in MENA turn to alternative energy sources such as nuclear power and renewable energy. The interest in nuclear energy has intensified in the last few years despite issues raised following the accident at the Fukushima Daiichi NPP in Japan. There are a number of key challenges facing countries in the MENA region that are driving plans towards nuclear power generation. In particular countries in the region face: increasing energy demands due to population and economy growth, energy independence, reduction of reliance on fossil fuels, increasing revenue on fossil fuel exports and reduction of carbon emissions. As a direct result of these challenges there are significant plans in place to deliver considerable nuclear generation capacity in the region by 2030. Case studies include Algeria, Egypt, Jordan, Saudi Arabia, Turkey and United Arab Emirates.

Keywords: *Energy scenarios, Nuclear energy, MENA countries.*

INTRODUCTION

World demand for energy is set to increase significantly in the coming decades, spurred by economic and demographic growth, especially in developing countries [1-3]. Unless current policies are changed, this demand for energy will be met mainly by burning fossil fuel, at the cost of escalating emissions of carbon dioxide and the associated risk of global warming. To cope with this risk switch to cleanly-generated electricity is needed. In the decade preceding the Fukushima Daiichi accident on March 2011 in Japan, nuclear energy had been considered as a key electricity generation technology in the world mix of energy to support the transition of fossil-based energy systems to low-carbon systems. Without it most of the world would have to rely almost entirely on fossil fuels for base-load electricity. In 2010, nuclear power provided over 13% of the world's electricity, almost 24% of electricity in OECD countries, and 35% in the EU [4]. However, the future of nuclear power was put under question after the Fukushima accident. Since that, several energy scenarios have been proposed with a significant development of nuclear energy to meet energy and environmental goals, albeit at a somewhat slower rate than previously projected. The development aimed at strengthening nuclear safety criteria to meet low-risk beyond-design severe accident scenarios. Reinforcing nuclear safety and transparency along with setting up and maintenance of efficient governance will obviously strengthen public acceptance of nuclear power. Clearly, nuclear energy will continue to have its share in the future energy mix as the energy policies of many countries already show [5].

STATUS OF GLOBAL ENERGY AND ELECTRICITY

Global energy and electricity demands are set to grow for decades. A growing world population and economic development predict faster grow rates for electricity than for primary energy demand, with most growth in developing countries. The UN population projections estimate population growth from 6.8 million people in 2010 to 8.365 billion at 2025 and 10.633 million in 2050 [2]. The World Bank projects average annual growth of the world economy of 3.1 % between 2009 and 2015, and 2.5 % between 2015 and 2030 with faster growth in developing countries [3].

In 2011, world energy production / consumption in 2011 totaled 12.550 / 12.275 million toe with nuclear share 599 million toe (4.77 / 4.88 %). The world electricity generation, according to IAEA estimates, increased from 25.2 PWh in 2011 and is projected to reach 38.6 PWh in 2035 (a 45% increase). Implications of the Fukushima accident favored the low nuclear scenario with nuclear power playing a smaller role in the global energy balance. In this scenario the total amount of nuclear power capacity increases from 369 GWe in 2011 to 563 GWe in 2030. That would produce 4.72 PWh, 12.2% of the world total. Renewables are likely to become the world's second largest source of power generation by 2015, with share of electricity generation growing from 20% in 2010 (including hydro) to 31% by 2035 [6-9].

At the same time, a large number of countries, including developing countries wishing to launch nuclear power programs, have confirmed their intention to rely on nuclear energy to meet electricity needs and objectives to reduce carbon emissions [6].

THE NUCLEAR ENERGY OPTION

Nuclear power generation provides ¬7% of world total energy supply and ¬ 13.2% of generated electricity. This indicates the significant role nuclear energy plays as compared to conventional means. Reasons behind world interest in nuclear power may be summarized as: growing energy demand, increasing energy costs, lack of conventional energy resources, increasing dependence on imported fuel, scarcity of water resources and degradation of environmental conditions due to increasing consumption of fossil fuel resources.

Significant rise in nuclear electricity took place during the period 1979-1986 with slowdown noticed after the Three-Mile Island accident in 1979 in USA and the Chernobyl accident in 1986 in the Soviet Union. With improvements in safety tools and culture, increase of plant availability and economy, nuclear power plants became increasingly competitive with other means of electricity generation. Now worldwide operate 435 nuclear power reactors generating 370 GW of electricity. Almost half of the world’s power reactors are in the U.S. (104 units/101.5 GWe), France (58 units/63.1 GWe), and Japan (50 units/44.2 GWe). In Africa only South African Republic has two operating power reactors providing 1.8 GWe. In the Middle-East, only one NPP with 950 MWe is operational in the Islamic Republic of Iran since 2010, and another one with design 1400 MWe is under construction in the United Arab Emirates [8,9].

Contrary to oil and gas reserves which are considered depleting resources, nuclear fuel has extended life-time. With appropriate nuclear fuel cycle technology, the life time of nuclear fuel may extend to several thousands of years. According to current estimates the life extension of crude oil is estimated at 130-150 years, of gas – at 210-250 y and of coal and lignite – at 350-450 y. Nuclear fuels are much more abundant, both for fission (uranium and thorium) and fusion (deuterium). Moreover, nuclear power is characterized by its good safety record accounting for only two accidents with death casualties during more than 13500

reactor-years of operation: Chernobyl (USSR) in April 1986 and Fukushima Daiichi (Japan) in March 2011 [8-10].

Table 1. Nuclear Power Units in Commercial Operation, 2011

Reactor	Main Countries	Num.	GWe	Fuel	Coolant	Moderator
PWR	US, France, Japan, Russia	272	250.3	enriched UO2	water	water
BWR	US, Japan, Sweden	84	77.7	enriched UO2	water	water
PHWR (CANDU)	Canada, India	47	23.1	natural UO2	heavy water	heavy water
RBMK	Russia	15	10.2	enriched UO2	water	graphite
Gas cooled (Magnox & AGR)	UK	15	8.1	natural U (metal), enriched UO2	CO2	graphite
FBR	Russia, China	2	0.6	PuO2 and UO2	liquid sodium	none
	TOTAL	**435**	**370.0**			

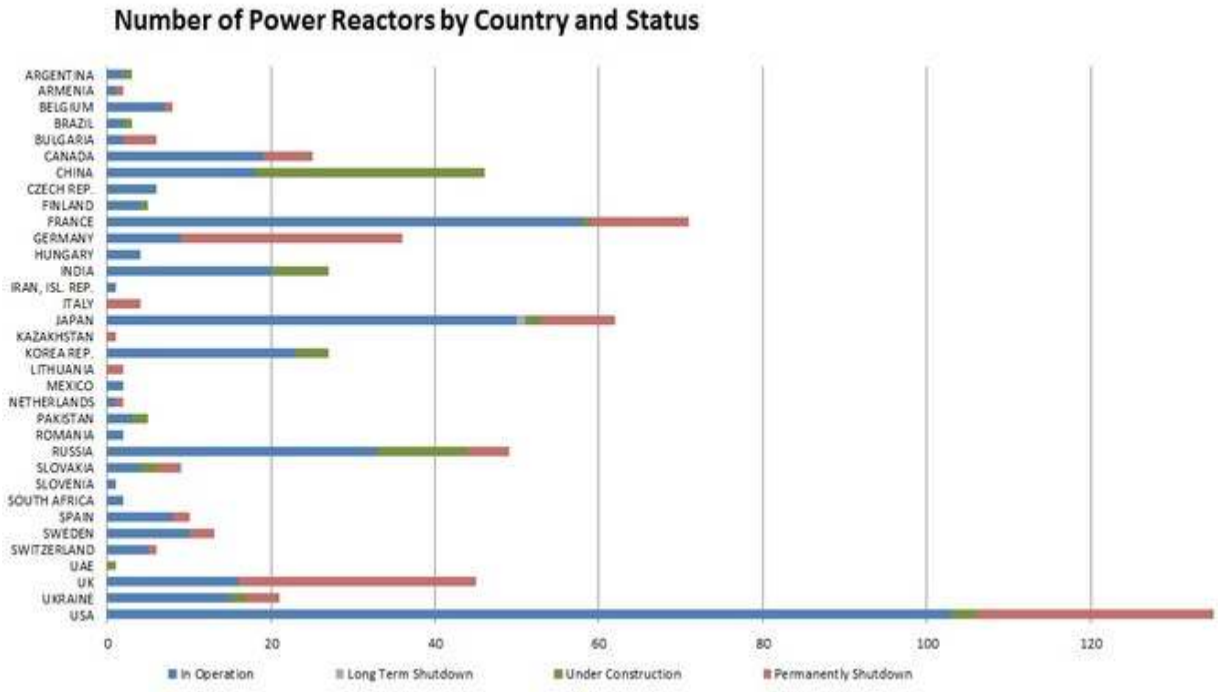

Figure 1. Status of Nuclear Power 2012-2020

Future of Nuclear Power till 2030

According to available 2012 statistics no appreciable change has been noticed in world energy policy after the Fukushima accident. However, upgrade of security standards and more strict design changes and improved safety measures are envisaged. Worldwide, 14 countries are constructing 63 nuclear power units, 29 countries are planning to construct 161 more nuclear power units and 37 countries are considering whether to construct 334 more nuclear power units. With 224 units planned to be operational by 2030, world nuclear capacity will increase to 610 GWe, a 65% increase. The 224 units are needed to maintain nuclear energy's 13% share of the energy mix at that time [7,11].

ENERGY SHIFT IN MENA

Depleting reserves and growing domestic hunger for energy means that countries of Middle East and North Africa must move from dependency on fossil fuels to renewables such as solar, wind, along nuclear energy [12,13].

Table 2. Alternatives for Sustainable Energy in MENA Countries

Oil/Gas:	High Cost Escalation - Growing domestic needs will compete with exports Climate vs. Cost (CO2-Sequestration adds 2 - 3 ct/kWh)
Coal:	Less Cost Escalation than Oil & Gas - Primary source depending on imported coal - New source will require infrastructure and investment - Climate vs. Cost (CO2-Sequestration adds 2 - 3 ct/kWh)
Nuclear:	Require Higher Initial Capital Share - Primary source depending on imported nuclear fuel - New Source will require infrastructure and investment - Security vs. Cost (Nuclear waste disposal, etc.)
Solar/Wind:	Cost De-Escalation - Low power density source, no base load electricity - New Source will require infrastructure and investment - Environment friendly source

NUCLEAR BUILD IN MENA COUNTRIES

Approximately $400 billion worth of nuclear projects have been planned in the MENA region. Egypt has a long story with nuclear ambitions since 1964. A 2nd bid was canceled in 1986 on the tail of the Chernobyl accident. Its 3rd bid on 2010 was frozen in view of economic difficulties following the 25 January 2011 revolution. UAE bidding on its first reactor since 2009, projects that nuclear energy will produce nearly a quarter of the country's electricity needs, and a further 12 units will generate over $60 billion in new contracts over the next decade. Turkey has contracted on 2010 to construct its 1st NPP comprising 4 reactor units totaling 4800 MWe. Jordan has plans for at least one 1000 MWe reactor by 2019. Saudi Arabia is looking to build 16 reactors by 2030 with a budget of $100 billion. The remaining countries have near-term plans or a more long-term interest, as they closely follow the region's activities [12,13].

1. EGYPT

Egypt has diversified experience with the operation and maintenance of particle accelerators and research reactors that went back to 1959 and 1961. It has long term experience with nuclear material exploration and mining. Nuclear government bodies are the Atomic Energy Authority, Nuclear Materials Authority, Nuclear Power Plants Authority and Nuclear and Radiation Regulatory Authority. Major nuclear facilities are ETRR-1 (2 MW Russian tank-type reactor), ETRR-2 (22 MW Argentinean pool-type reactor), ICF (20 MeV Russian AVF cyclotron), ITF (3 MV AEG Cocroft-Walton tandem accelerator) [14-16].

Egypt Nuclear Timeline

Egypt interest in peaceful uses of Nuclear Energy started following country's participation in the 1st UN Conference on Peaceful Uses of Atomic Energy, Geneva 1954. In 1955 the national Atomic Energy Committee was established. A comprehensive man power development program started in various applications of atomic energy by sending senior and junior graduates to developed countries: Germany, France, UK, USA and USSR. In 1957 the Atomic Energy Establishment (AEE) was formed. A Soviet tank-type 2 MW research reactor started operation in 1961. In 1962 a Nuclear Power Project was established under the umbrella of AEE, followed by an international bidding for the construction of a 150 PWR in 1964 at the Burg El-Arab site (on the South Mediterranean coast). The project was stopped by the 1967- 1973 wars with Israel. In 1974 the Egypt entered into discussions with USA on bilateral nuclear cooperation, followed by a limited international bidding for NPP (2) in the same 1974. To concentrate national efforts the Nuclear Power Plants Authority (NPPA) was established in 1976 under the umbrella of the Ministry of Electricity and Energy (MEE). El-Dabaa site (150 km west of Alexandria) was chosen in 1980 to house 4 NPP units. In 1982 a nuclear regulatory body was formed within AEA (formerly AEE). In 1983 an international bidding was issued for the construction of two 900 MWe PWR reactors. The whole process halted following the fears arose after the Chernobyl disaster in April 1986. The revival of the NPP program was initiated in 2006 and a contract for 10 years consulting services was singed with Worley Parsons in 2008. To fulfill increased safety measures the national Nuclear and Radiation Safety Law was issued in 2010, followed by the establishment of Nuclear and Radiation Regulatory Authority (NRRA).

A new situation evolved with the 25 January 2011 Revolution and the Fukushima disaster in March 2011.

2. UNITED ARAB EMIRATES

The UAE has the fifth largest proven oil reserves in the Middle East. It is one of the most booming economies in the region. UAE officials acknowledge that diesel fuel and crude oil could be used to produce electricity in the future. However, they urged the loss of export revenue and the environmental effects of fossil fuels make this option unattractive. These assumptions led the UAE in 2007 to conclude that nuclear power generation is a commercially competitive option to generate electricity. Thus, the UAE envisions producing six to seven percent of its future energy from renewable sources in tandem with natural gas, fossil fuels, and nuclear energy from twelve reactor units [17-19].

US-UAE Nuclear Agreement

On January 2009 an initial U.S.-UAE 123 agreement was signed with Bosh administration that gave the UAE prior approval to use USA nuclear technology, send its spent nuclear fuel to the United Kingdom or France for reprocessing. The agreement also allowed the United States to terminate the deal and required the return of any nuclear material or equipment if the UAE were found to have acquired sensitive nuclear facilities related to reprocessing and enrichment. In April 2009 a revised agreement was signed with Obama administration that explicitly prohibits the UAE from possessing enrichment and reprocessing facilities within its territory within the framework of strengthening the nonproliferation provisions under NPT.

UAE – S. Korea Nuclear Deal

A long-term cooperation in the civilian nuclear field with South Korea was established in December 2009, when Emirates Nuclear Energy Corporation (ENEC) awarded a contract to set up four nuclear power plants in Abu Dhabi to a consortium led by Korea Electric Power Corporation (KEPCO). As per the contract, KEPCO team will design, build and operate four civilian nuclear power plants with the capacity of 1,400 megawatt (MWe) for each plant. The value of the contract for building, operating and procuring nuclear fuel for the four plants is fixed at AED 75 billion (US $ 20 billion) throughout the whole plant life. By the terms of the agreement the Korean investors will have an equity interest in a joint venture that will operate and own the plants. The deal marks the first time South Korea exports its nuclear reactors.

The Barakah Site

The Barakah site is located on the Arabian Gulf in the Western Region of Abu Dhabi. It was selected as the preferred site for the NPP plant following a comprehensive analysis of multiple locations across the UAE. Studies have shown the site area to have very low probability of earthquakes suggesting it to be tectonically inactive for nearly 100 million years. The site is planned to have a total of four reactors. Construction of Barakah Unit 1 will take five years, with the plant expected to become operational in 2017, with one additional reactor becoming operational each year up to 2020. With four reactor units operational by 2020, UAE electricity generation is predicted to gain 5.6 GWe of nuclear energy, and the country to save the up to 12 million tonnes of CO_2 emissions each year.

3. TURKEY

Turkey presently has no nuclear power plants in operation. However, in August 2006, the Turkish Government announced its plan to have three nuclear power plants with total capacity of 4,500 MWe, operating by 2012–2015 to meet the rapidly increasing demand for electricity and support the country's economic development. In May 2007, a new bill concerning construction and operation of nuclear power plants and the sale of their electricity was passed by the parliament. It also addresses waste management and decommissioning, providing for a National Radioactive Waste Account and a Decommissioning Account, which generators will pay into progressively. In May 2010, Turkey and the Russian Federation signed an agreement for the construction and operation of the first nuclear power plant at the Akkuyu site in southern Turkey, as a BOO (build-own-operate) project. The first of Akkuyu's four 1,200 MWe VVER units, with a total capacity of 4800 MWe, is scheduled to start construction in 2013 and be commissioned in 2021. The second nuclear power plant will be

built at the Sinop site on the Black Sea, while the third project is still under discussion [16,20-22].

Akkuyu NPP Management, Funding & Financing

The Akkuyu NPP construction and operation was negotiated under intergovernmental Turkey-Russia agreement statements: Russian Party will establish a joint stock "Project Company" in Turkey initially with 100% share. Russian Party's share will never be below 51% at any time. The Project Company will be the owner of NPP. General Contractor will be JSC "Atomstroyexport" (ASE). Russian Party shall provide funding for ASE for the construction of NPPs. In accordance with Project Protocol Agreement, The Turkish Electricity Trade and Contract Corporation (TETAS) has guaranteed the purchase of 70% power generated from the first two Akkuyu units and 30% from the third and fourth units over a 15-year power purchase agreement at an average price of 12.35 US cents per kWh excluding VAT.

Table 3. Levelised Generation Cost Turkey-specific Agreement Price

Technology	Levelised Generation Cost Assumptions (US ¢ / kWh)		Akkuyu Agreement 2020-2035 Average Purchase Price (US ¢ / kWh)	
	2006 nominal	2010 real	2010 real	2027 nominal
AGR	5.33	5.71	Low (4.5% discount rate):	
AP-1000	4.09	4.38	5.84	
EPWR	4.88	5.23	Mid (7% disc. rate):	12.35
GTMH	9.58	10.27	3.91	
PBR	6.93	7.43	High (10% disc. rate):	
PWR	5.18	5.55	2.44	

Human Resources

Turkey has limited nuclear power reactor expertise, but has in place a plan to train a new generation of nuclear plant professionals with the assistance of Russia. Nearly 50 college students have already studied in Russia and an additional 75 including high school students will be sent to the country during the 2012-2013 school year. Turkey plans to send up to 600 students to study nuclear energy under a scholarship program.

The TAEK

While there are no commercial nuclear plants yet, Turkey is no stranger to nuclear technology. The Turkish Atomic Energy Authority (TAEK) was established in 1956 when the country first sought to build a research reactor. It operates one research reactor, located at

Istanbul Technical University. TAEK has constructed in 2011 and commissioned in 2012 a proton accelerator facility based on Cyclone -30 cyclotron for research and RI production at Sarayköy Nuclear Research and Training Center in Ankara. The TAEK has nuclear and radiation regulatory functions. It operates the national Radiological Monitoring System Network consisting of ~102 stations distributed all over the country [23].

4. ALGERIA

Algeria, home to the world's tenth largest uranium reserves, has only recently expressed interest in the development of a civilian nuclear power program. In 2007, Algeria signed preliminary nuclear cooperation agreements with:

- Russia (in January, on training nuclear technicians and constructing nuclear power plants in Algeria);
- The United States (in June, to explore nuclear energy options);
- France (in December, establishing a framework for future cooperation on nuclear energy, possibly including construction of nuclear power plants).
- Algeria Minister of Energy and Mining has also met with nuclear officials in Iran to discuss prospects for collaboration between the two nations.

Nuclear power ambitions are under re-consideration after the Fukushima disaster in 2011. According to official statements, any decision on nuclear power will only be taken when all the necessary guarantees are met of safety for people and the environment, not underestimating the seismic risk due to the nature of Algerian geology [24,25].

Algeria Nuclear Infrastructure

At present Algeria doesn't have NPP's, the country operates however the following nuclear installations:

- Nur reactor: 1MW MTR-type light water moderated pool reactor devoted to training and research. First operation started in 1989.
- Es-Salem reactor: 15 MW heavy water moderated tank-type reactor devoted to materials testing, radioisotopes production and training of reactor operators. First operation started in 1992.
- Nuclear Fuel Fabrication Unit: started operation in 1999 and is aimed at the development of rod and plate type nuclear fuel elements.

Algeria NPP Plans

For the NPP option, preliminary studies indicated the need to put in operation a first NPP (≈1000-1200 MWe) by 2022 and a second one by 2027-2030. It is expected that 14% of the national electric generating capacity, will be nuclear by 2030.

5. SAUDI ARABIA

Saudi Arabia was the world's largest producer and exporter of total petroleum liquids in 2010, and the world's second largest crude oil producer behind Russia. SA is one of the world's largest energy producers, pumping approximately 10.782 million barrels per day (1.7142×10^6 m^3/d) of petroleum. SA has one of the largest oil reserves in the world. (Second to Venezuela). Saudi Arabia's economy is petroleum-based; Oil actually accounts for 90% of the country's exports and nearly 75% of government revenues. The oil industry produces

about 45% of Saudi Arabia's gross domestic product, against 40% from the private sector. Saudi Arabia is a member of the G20 countries with per capita GDP of $20,700. However, the economy is still very dependent on oil in spite of a diversification effort, in particular in the petrochemical sector. During the 2012 United Nations Climate Change Conference in held in Qatar, Saudi-Arabia announced its target to receive 30% of its electricity demand from solar power with 41 GW of solar capacity by 2032. At the same time, SA authorities announced interest to invest in 16 new nuclear reactors in the next 20 years [16,26].

SA Nuclear Ambitions

According to a Citigroup report published in September 2012, Saudi Arabia is due to run out of crude oil for export by 2030. Depleting reserves are due to growing energy demands, both domestic and international, combined with rising oil prices. Saudi electricity demand is predicted to increase from 75 GWe by 2018 to more than 120 GWe by 2030. According to SA officials this growth can't be sustained by fossil fuel alone and also maintain the income stream the nation depends on from oil exports. Hence serious changes have to be implemented. Nuclear reactors are an obvious choice for sustainable growth scenario.

In April 2010, Saudi Arabia established the King Abdullah City for Atomic and Renewable Energy (KA-CARE) whose primary role is to develop alternative sustainable development, primarily nuclear power programs. The Riyadh-based center will promote research, make deals in the region and internationally, and oversee activities related to the peaceful use of nuclear energy. Saudi Arabia plans to build 16 nuclear reactors over the next 20 years spending an estimated $7 billion on each plant. The $112 billion investment, which includes capacity to become a regional exporter of electricity, will provide 20% of the country's electricity for industrial and residential use and for desalinization of sea water. In this respect, MOU had been signed with a number of countries as USA, UK, France, South Korea and Japan.

6. JORDAN

Jordan suffers from lack of fossil fuel reserves. 99% of Jordan's electricity is generated from either oil or gas, which is in turn 96% imported. Energy import costs country about one fifth of its GDP. In 2009 Jordan generated 14.3 billion kWh, mostly from natural gas, and imported 0.4 billion kWh of electricity for its six million population. In 2012, due to gas supply constraints from Egypt, its electricity supply was 25% from natural gas, 32% from heavy fuel oil, 32% from diesel, and 11% was imported.

Jordan has regional grid connection of 500 MWe with Egypt, 300 MWe with Syria, and it is increasing links with Israel and Palestine. Jordan is expected to need 3600 MWe of generated capacity by 2015, 5000 MWe by 2020 and 8000 MWe by 2030. About 6800 MWe of new generating capacity is needed to satisfy the demand by 2030. Jordan plans to have one third of this projected capacity as nuclear [27-30].

Jordan Nuclear Option

In 2007 the Jordanian government announced its intention to build one nuclear power plant by 2019 and a number of others by 2030. The objective was to provide a sustainable domestic energy supply and relieve the burden of reliance on external energy sources. This burden has led to a massive strain on the government budget as well as domestic discontent,

due to rising living costs which has negatively affected regime stability - this latter point is especially important in light of the current geopolitical changes sweeping across the region.

Jordan Nuclear Strategic Goals

Jordan's nuclear power program aims at:

- Increase of energy independence
- Provide electricity to the country at a reasonable price
- Ensure additional income and balancing loads by exporting electricity to the neighboring countries (Egypt, Saudi Arabia, Iraq, Syria and Palestine)
- Utilize/ Leverage domestic uranium reserves
- Provide opportunity to develop nuclear capabilities, including participation in project development, design, construction, and plant operation
- Multiplicative effect on local economy via infrastructure upgrades, job creation, provision of services, and education of workforce
- Reduce CO_2 emissions, by switching to minimum CO_2-intensive electricity production
- Support major infrastructure projects, such as Red Sea – Dead Sea Canal project.

CONCLUSION

The civilian use of nuclear energy is experiencing a world-wide renaissance, with more than 490 new reactors currently being planned or proposed globally. Nuclear energy is a proven and shared technology, with some 440 currently operating NPPs in the world, and more than 13,500 reactor years experience. Low operating cost and CO_2 emissions are among the main advantages driving this growth.

MENA countries are on the cross roads with energy options. Oil and gas reserves are depleting. New primary energy resources are to be searched. The drivers for nuclear power development are numerous, and include the diversification and conservation of energy resources, energy security, regional integration, desalination needs, and the desire not to lag behind new technologies. Rich oil/gas producers want to catch the moment and use the available surplus funds to build advanced energy complexes that serve coming generations for decades ahead.

In the region, Egypt, Jordan and Turkey are the most progressed countries when it comes to diversifying the electricity generation portfolio with means of nuclear energy. This is dictated by the absence (Turkey, Jordan) or eventual depletion (Egypt) of other primary sources needed to support sustainable development.

REFERENCES

[1] IAEA, Energy, "Electricity and Nuclear Power Estimates for the Period up to 2050", Reference Data Series No. 1, 2012 Edition, International Atomic Energy Agency, Vienna, 2012.

[2] UN, "World Population to 2300", United Nations Department of Economic and Social Affairs, Population Division, www.un.org/esa/, 2011.

[3] WB, "Prospects for the Global Economy", World Bank, www.worldbank.org , 2011.

[4] WNA, "World Energy Needs and Nuclear Power", World Nuclear Association, www.world-nuclear.org, July 2012.

[5] IEA, "World Energy Outlook 2012", International Energy Agency, Paris, www.iea.org, 2012.
[6] NEA, "The Role of Nuclear Energy in a Low-carbon Energy Future", NEA No. 6887, Nuclear Energy Agency, www.oecd-nea.org, 2012.
[7] IAEA, "International Status and Prospects for Nuclear Power 2012", Report by the Director General, GOV/INF/2012/12-GC(56)/INF/6, IAEA, Vienna, 2012.
[8] IAEA, "Nuclear Technology Review 2012", ntr2012, IAEA, Vienna, 2012.
[9] NEA, "Nuclear Energy Today 2nd Edition", NEA No. 6885, OECD 2012.
[10] WEC, "World Energy Perspective: Nuclear Energy One Yea after Fukushima", World Energy Council, London, www.worldenergy.org , 2011.
[11] Mycle Shneider, "The Status of Nuclear Power in the World Before and After Fukushima", Greens-EFA Conference, European Parliament, Brussels, 7 March 2012.
[12] Adnan Shehab-Eldin, "The Future of Nuclear Renaissance following Fukushima: Focus on MENA", Forum on Nuclear Power and Renewable: Implications on Oil, Gas and carbon Contents, Oil & Money 2011, London, 12 Oct. 2011.
[13] Lindsay Windsor and Karol Kessler, "Technical and Political Assessment of Peaceful Nuclear Power Program Prospects in North Africa and the Middle East", Pacific Northwest Center for Global Security, Sept. 2007.
[14] EIA, "Country Analysis Briefs Egypt", www.eia.gov, Last Updated 8 July 2011.
[15] Egyptian and International Mass Media, 2008-2012.
[16] Nuclear Power in Turkey, Egypt and Saudi Arabia - how cost effective?, Presented at Non-proliferation Policy Education Center, Prague, 10 March 2008.
[17] EIA, "Country Analysis Briefs, United Arab Emirates", Last Updated Jan. 2011.
[18] WNA, "Nuclear Power in the United Arab Emirates", Last Updated Dec. 2012
[19] ENEC, "UAE Civilian Nuclear Energy Program", Emirates Nuclear Energy Corporation", www.enec.gov.ae, 10 Feb. 2013.
[20] WNA, "Nuclear Power in Turkey", viewed at , Last Updated 21 Dec. 2012.
[21] Serhat Kose, "Recent Status of Nuclear Program in Turkey", Workshop on Introduction of Nuclear Power Programmes: Management and Evaluation of a National Nuclear Infrastructure, IAEA, Vienna, 8-11 Feb. 2011.
[22] Sinan Ulgen, "The Turkish Model for Transition to Nuclear Energy", Center for Economics and Foreign Policy Studies (EDAM), Turkey, 2011.
[23] TAEK, Turkish Atomic Energy Commission, www.taek.guv.tr/en/, Jan. 2013.
[24] EIA, "Algeria Energy Analysis", Energy Information Administration, Last updated 8 March 2012.
[25] Kamal Sidi Ali, "Introduction of Nuclear Power Plants in Algeria", Presented at TH/W3, 24-27 Jan. 2012.
[26] EIA, "Saudi Arabia Energy Analysis", www.eia.doe.gov, Last Updated Jan. 2011.
[27] WNA, "Nuclear Power in Jordan", WNA inf138, Updated Oct. 2012.
[28] NTI, "Jordan Country Profiles", www.nti.org, Last Updated Aug. 2012.
[29] Imad El-Anis, "The Political Economy of Energy Security and Nuclear Energy in Jordan", Central European Journal for International and Security Studies (CEJISS), Vol. 6, Issue 1, 2012.
[30] Kamal J. Araj, "Case Study: Programme for Nuclear Energy Development in Jordan", International Workshop on Long-range Nuclear Energy Planning and Strategy Development, IAEA, Vienna, 14-17 Jan. 2010.