C

Laith ALRahahleh

The current situation of the renewable energy in Jordan

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Executive summary

The Hashemite Kingdom of Jordan tells a fascinating and complex story about small-sized country with plenty of economic opportunities. Jordan's population is about 9798000 million capita, where 90% of the total population are permanently resided inside the main cities, namely; Amman, Zarqa and Irbid. The population's pyramid reflects the youthfulness of the people, where approximately 60% of the total population are between (15-64) years. This implies that the country has a real promising demographic opportunity, which so far has not been fully utilized. The constitution also strongly stipulates that all Jordanians must be treated equally without any discrimination on grounds of their race, language and religion, subsequently; the country has become an impressive model for the religious coexistence and tolerance worldwide.

Fostering the economic growth, achieve fiscal and monetary stability; enhance businesses and investment environment and raise its competitiveness, all together, have been at the top's priorities of the Jordanian governments. Thus, substantial measures and programs have been introduced, which aimed to restructure and revitalize the Jordanian's economy. In spite of the instability in the region, the country's economy has achieved consistent GDP growth averaging 5.4% over the last decade, and the GDP per Capita has increased from 1512 J.D up to 3670 J.D in 2014. Jordan is an active member in 8 FTAs (Free Trade agreements) and more than 55 bilateral investment treaties; therefore, the country has become one of the most competitive economy in the Middle East.

The region's instability have indicated that the economy is highly vulnerable towards the external shocks and disturbances, and there is an urgent need to increase its economy resilience. Fully dependence on imported fossil fuels to serve the growing demand for electricity, water and transportation, industrial and nonindustrial consumers have direct fiscal, climate and environmental impacts. For instance, both the National Electric and

Power Company (NEPCO) and Jordan Water Authority (JWA) caused about 25% of the total country's debt by the end of 2017.

Regarding the renewable energy, Jordan holds a pioneering position in the MENA region on renewable energy, however, not yet these resources well utilized. Therefore, in order to reduce its dependence on the imported energy and minimize the energy's burden, the Jordan National Energy strategy (2007-2020) has been launched. These strategies included clear political supports for renewable energy based-projects, which would help moving from fossil-based into Green-based economy. The National Energy Strategy (2007-2020) aims to raise the share of the renewable energy in the primary energy mix up 1850 MW (corresponds to 10% of total's energy mix). So far, approximately 747 MW of energy was generated from renewable sources, mainly from solar and wind sources. However, more efforts are needed to fulfill the National Energy Strategy and Jordan's vision 2025 (10% and 11% the share of the renewable energy by 2020 and 2025). The Direct Proposals Scheme (DPS) is among the most common schemes applied in Jordan, where the government seeks the most competitive prices through public auctions. Up to date, three DPSs rounds were announced with total capacity of 900 MW. The first round (200 MW) has been commissioned and connected to the National Grid. In addition to that, there is still several projects in the planned phase and it will be announced upon completion the required steps.

The Jordan's vision 2025, National Green Growth Plan NGGP and Jordan's Nationally Determined Contribution (NDC) on Climate Change outline that climate actions are an important parts of sustainable solution to addressing the country's remarkable fiscal, economic and climate vulnerabilities. The aforementioned policies and documents have created strong linkages between climate changes and national development priorities to create economic opportunities through pursuing Green Economy pathway.

A green Growth philosophy is to create more jobs, increase the per capita income and make the country resilient to the unexpected shocks and instability in the region. A country for everyone provides decent work and living conditions based on environmentally sustainable economic growth model.

In 2017, the Jordan Green Growth Plan (JGGP) was launched and focused on six key sectors; namely; energy, water, waste, transport, tourism and agriculture sectors. The Green Growth Plan has identified three clusters: a green growth corridor, smart urban transformation and rural resilience. These three clusters represent the convergence between climate action, sustainable local development and macroeconomic considerations.

Introduction

GEOGRAPHY AND CLIMATE

The Hashemite Kingdom of Jordan is a Southwest Asian country, located at the heart of the Middle East, with 80 Km far to the east of the Mediterranean Sea. Jordan is bordered by Syria from the north, Iraq from the Northeast, Saudi Arabia from the East, South, and Israel and Palestine from the West. The total area of the country is approximately 90,000 Km2 (35,480 sq. mi), and Amman is the country's political and economic capital. The country is divided into; plateau area (a high flat plain), which ranges between 700 m and 1200 m above sea level (ASL), Jordan Rift Valley (JRV) and mountainous ranges (The highest peak is located is in southern part of Jordan at Jabal Umm ALdami with 1854 m above sea level). The JRV, where the Dead Sea is located, is a part of Great Rift Valley, runs from the Yarmouk

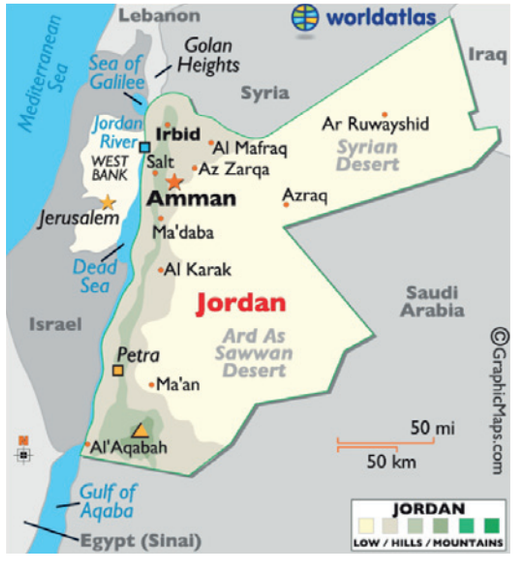


Figure 1. Jordan's map.

River in the north to Al-Aqaba in the south, with approximately 380 km long. The Dead Sea occupies the deepest depression on the land surface, and it locates at approximately 410 meters below Sea level. The Gulf of Aqaba and the Dead Sea together have given the country a coastline of 26 km (16 mi).

Climatically, the country is classified as arid and semi-arid region; with an annual precipitation of less than 200 mm a year over more than two-thirds of the entire territory. The peak temperature reaches during August, whereas, the coolest month is usually in January. The snow occurs few times mainly on mountainous cities, and seldom occurs on the plateau and Jordan rift valley. The Western part of Jordan (mountainous ranges) characterize by the Mediterranean climate type; hot and dry summers and wet and cold winters. The annual precipitation varies from 300 mm in the South (ALKarak and Tafiela mountains) to more than 500 mm in the most North (Ajloun and Irbid mountains).

In spite of that, most of the Eastern part receives less than 120 mm of rainfall a year and it is considered as a dry desert. Meanwhile, Jordan Rift Valley creates a very narrow semitropical climate zone that receives more than 300 mm rain a year in the most north, and less than 120 mm in the south. As result of this tremendous variation in the topography and climate features, around 19 different plant ecosystems and more than 2500 of vascular plants have been recorded, belonging to approximately 152 families, which representing 1% of the total world's flora.

Historically, forests in Jordan covered large proportion of the total's mass land. However, illegal cutting, over grazing, droughts and heat waves had negatively affected the vitality and distribution of the natural forests. Nowadays, forests are very limited, poorly productive, sparse and unmanaged covering less than 1% of the total's territory, where Pine, Oak and Juniper are the main species. It distributes naturally on Mountains, where the annual precipitation is more than 300 mm/a, especially in norther part of the country.

POPULATION

Jordan's population is represented approximately 0.13% of the total world's population. The demographic characteristics of the Jordanian people have been largely affected by the regional instability circumstances since 1948 (Palestine, Iraq and lately Syria). By the end of 2017, approximately 2,792,221 million refugees from different nationalities have been officially entered the Jordanian borders. According to the population and housing census 2016, Jordan's population is about 9798000 million capita (47.1 % Female, and 52.9%), of which around 90% of the total population permanently live inside cities and 10% live inside rural areas (country side). The population density varies from 1157.7 person/km2 in Irbid city to 4.5 person/km2 in Maan city (least populated city) (table 1). The Jordanian population pyramid (structure) reflects the youthfulness of the population, around 12.75% of the population is under 4 years old, and almost 24.57% is under 14 years old, 3.23% of the population is over 65 years old, and 60% of the population is between 15-64 years, representing the dominant group. This last age group represents the demographic opportunity, which provides an economic development opportunity as this group is the one entering the workforce and contributing to economic growth.

POLITICAL AND LEGAL ENVIRONMENT

The Jordan's constitution stipulates clearly that the people of Jordan form a part of the Arab Nation, and its system of government is parliamentary with a hereditary monarchy. Islam religion is the official religion of the State and the Arabic language is the official language. The constitution has been passed through several constitutional amendments aiming to create more stable political environment. For instance, in 2015, the parliament passed constitutional amendments that have given the King Abdullah II Bin Hussein the power to hire and fire the heads of the army and the intelligence services, as well as to appoint his own successor and crown prince. Proudly to say that Jordan is considered an impressive example of religious coexistence as the constitution strongly stipulates that all Jordanian citizens must be treated equally without any discrimination on grounds of their race, language and religion.

There is three categories of courts: civil, religious, and special courts. All Judicial review of legislative acts occurs in a special High Tribunal (lower and higher house). Religious courts have both primary and appellate courts and deal only with matters involving civil law such as marriage, divorce, inheritance and child custody. Administratively, the country is divided into twelve (12) governorates, each one headed by a governor appointed by the King. Regarding to the political pluralism, more than 50 political parties have been legally registered representing a wide range of different political ideologies ranging from the extreme left (Jordanian Communist Party) to the extreme right (Islamic Action Front).

ECONOMY

The Jordanian economy is market-oriented economy, where it relies on foreign trade for its energy and natural resource requirements. The economic system is based on free enterprise and personal initiative. During the last decades, substantial measures and programs have been introduced to restructure and revitalize the Jordanian's economy. As results of adopting the liberal market approach, Jordan is member in 8 FTAs (Free Trade Agreements) and more than 55 Bilateral Investment Treaties, therefore, the country has become one of the most competitive Middle Eastern economies. Up to date, Jordan also has invested significant resources in infrastructure facilities serving the citizens create remarkable achievements, maintained stability and attracted foreign and local investments.

The country's economy has achieved consistent GDP growth averaging 5.4% over the last decade (International Monetary Fund 2016). However, by the end of 2016, the growth in the GDP declined to 2%, compared to 2.4% in 2015, which is still consider below the MENA region average of 2.7% (figure 2).

Table 1. The total Jordan's population and its distribution over the twelve governorates.

Governorate	Population	%	Female	%	Male	%
Amman	4119500	42.0	1907800	19.5	2211700	22.6
Balqa	505400	5.2	234000	2.4	271400	2.8
Zarqa	1403000	14.3	661200	6.7	741800	7.6
Madaba	194500	2.0	91700	0.9	102800	1.0
Irbid	1819600	18.6	879400	9.0	940200	9.6
Mafraq	565300	5.8	273800	2.8	291500	3.0
Jarash	243700	2.5	117000	1.2	126700	1.3
Ajloun	181000	1.8	87800	0.9	93200	1.0
Karak	325500	3.3	155500	1.6	170000	1.7
Tafiela	99000	1.0	47200	0.5	51800	0.5
Ma'an	148100	1.5	70600	0.7	77500	0.8
Aqaba	193400	2.0	84000	0.9	109400	1.1
Total	**9798000**	**100**	**4610000**	**47.1**	**5188000**	**52.9**

(Source: Department of the Statistics, DOS Jordan, 2016)

The finance and insurance services, transport, storage and communications and real estate together contributed the highest share in the GDP during 2016. The reasons behind the declining in the growth of GDP are mainly the closure of Iraqi and Syrian borders, lower tourism and weak performance in mining and quarrying sector amid regional instability (Jordan has hosted around 660,000 Syrian refugees).

The total amount of foreign reserves at Jordan Central Bank by the end of 2016 was comfortable at USD 14.5 billion, including gold and special drawing rights (SDRs) (USD 12.9 billion of foreign currencies, USD 1.5 billion of gold, and 95.6 million of SDRs). This would reflect the attractiveness of the Jordanian dinar as a saving tool, and confidence in the Jordanian economy. The GDP per Capita has also increased from 1512 J.D in 2004 up to 3670 J.D in 2014, and the deficit in the trade balance has reduced from 7,486, 6 to 6, 761, 5 J.D in 2012 and 2016, respectively.

The Government has adopted a Jordan Economic Growth Plan JEGP to effectively tackle the slowing economy growth and the unemployment rate. The JEGP aims to double the economy growth over 2012-2018. The JEGP identifies a green growth corridor, smart urban transformation and rural resilience as main drivers with special focused on six sectors, namely; the energy, water, tourism, agriculture and transport. Doubling the economic growth would require an increase in the of the growth rate at least by 5%, equivalents to 1.8 US dollar annually. The JEGP applies the Holistic approach to identify the reforms need for 19 sectors. The JEGP aims to double the economic growth, reducing the debt burden, creating more jobs and increasing the income level.

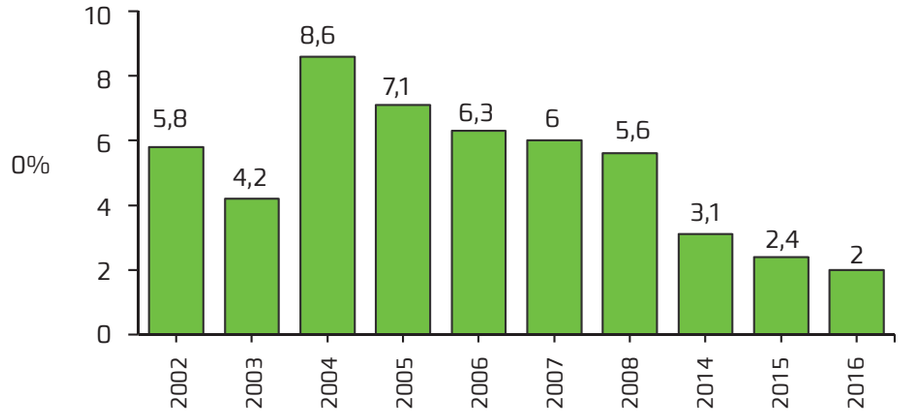


Figure 2. The growth in the GDP during the period of 2002-2016

WORKFORCE PARTICIPATION

Jordan with its large pool of high intellectual and professional expertise is considered as a major supplier of brainpower to neighboring MENA countries, and especially Gulf Countries. Jordan's human resources offer a range of distinct regional services in the engineering, medical, and educational sectors. It considers one of the highest country in the world in terms of number of Physicians and Engineers per Capita. In 2014, the total number of Jordanians work in Saudi Arabia, UAE and Kuwait were 235,000, 170,000, and 70,000, respectively. By the end of 2016, the amount of remittances from Jordanians experts into Jordan amounted 20% of the GDP.

However, the unemployment rate was 15.3 % by the end of 2016, because of incapability of the national economy to create sufficient job opportunities to absorb job seekers, as well as the gap between the educational system outcomes and market need. Further, the distribution based on the age category showed that the highest unemployment rate was among the age group (15-19) years. While, the unemployment rate declined among older age groups to reach 1.5 percent for age category that is above 65 years. The Jordan's vision 2025 stated that a new development model must be built aiming to simulate the current economy growth and create more decent jobs simultaneously with encourage youths workforce to fully participate in the development process. Accordance to the Vision 2025, the unemployment and poverty rate must reduce to 9.17 and 8%, compared to the current level of 15.3 and 10%, respectively.

WATER SECURITY

Jordan suffers from the imbalance between water demand and available water resources. Therefore, the water issue recognises as central to a nexus of social, economic and political issues that affect agriculture, energy, cities, trade, finance and national security. The geographical location, climatic conditions, especially the variability in rainfall and geopolitical situation have made the country one the poorest countries in the world in term of water availability. The water sector is characterized by severe water scarcity, with an increasing demand due to high population growth, hosting millions of refugees and economic development needs. The public expenditure on the water sector ranges between 2-4% of the total GDP, and the total subsidy amounted 180 million US dollar in 2015. An official reports mentioned that the financial returns only covers two third of service costs, and the sector losses have increased by 1% of the GDP. However, the gap between expenditure and revenues is significant and growing dramatically.

In 2017, the share of renewable water resources per capita was less than 100 m3/capita, which is still beyond far the global threshold of 500 m3/capita. The total used amount of water in 2017 was 972 MCM, of which (26.6%) derived from the surface water, and 60.6 % and 12.8% derived from groundwater and treated wastewater, respectively (See table 2). The water consumption increased by 16.8% in 2015, compared with 2014.

By the end of 2025, water demand in Jordan is projected to increase up to 26%, compared with the current level (See figure 1). However, this deficit is expected to reduce to 6% if the Red Sea-Dead Sea Project will be implemented on time. So far, there is strong evidences that Jordan has made strategic advances towards achieving the MDGs regarding water sanitation. The proportion of the population with safe sanitation exceeds 93% (63% coverage by sewer system and 30% by other safe sanitation methods), which is considered very high among other countries. The treated wastewater is mainly used in the agriculture sector (91% of its treated wastewater) to reallocate fresh water for domestic purposes. In spite of the aforementioned challenges, many new policies and efficiency improvements measures have been undertaken to increase, conserve, reuse and recycle all available freshwater. For instance, the Disi-Amman conveyance project became operational in summer 2013 aiming to mobilize new water sources into Amman and Aqaba city. Furthermore, it is planned to bridge the remaining gap between demand and supply through increased use of non-conventional water including reclaimed water and desalinated seawater to be provided by the Red Sea-Dead Sea Project (RSDSP) in the near future. At the same time, efforts are being made to optimize the use of existing resources by reducing physical and commercial losses.

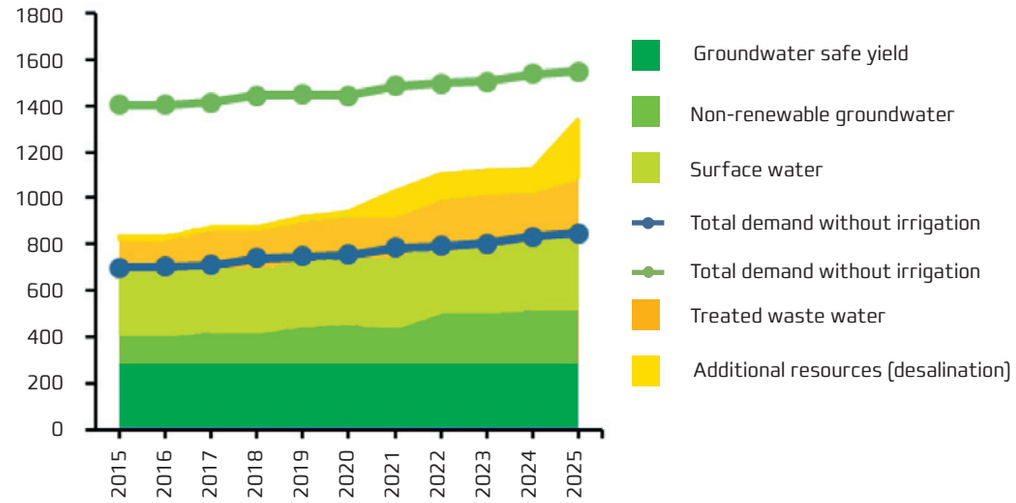


Figure 3. Development of water resources and the projected demand in million cubic meter per a yea MCM/ year over 11 consecutive years (2015-2025)

Table 2. National water supply by sectors in 2014

Source	Domestic (MCM/a)	Industrial (MCM/a)	Irrigation (MCM/a)	Total (MCM/a)	Share %
Surface water	103.8	4.8	150	259	26.6
Groundwater	325	32.2	231.3	589	60.6
Treated wastewater	0	1.7	123.3	125	12.8
Total used	**429**	**39**	**505**	**973**	**100**

(Source: Ministry of Water and Irrigation, Water Budget 2014)

AGRICULTURE

At the time of Jordan's independence (25th May 1946), the Agriculture sector contributed substantially to the national economy. However, its contribution has been reduced clearly, which mainly induced by several reasons such as the country's climate, geopolitical conflicts and climate change. Farming system remained economically important and playing crucial role in the country's stability. In 2016, the cultivated areas by field and vegetables crops and bearing trees have increased substantially by 42%, compared to 2007. The share of the agriculture sector was 3.8% in 2016, compared to growth rate of 5% in 2015. However, the growth in the agriculture sector was partly induced by the increased volume of agricultural investments, which reflected by the growth in the credit facilities provided to this sector. By the end of 2016, the volume of the agriculture investment increased by 40%, compared

to 2015. Furthermore, the amount of allocated loans provided by the Agricultural Credit Corporation (ACC), increased by 13.5 %, compared to 2015. The number of registered agriculture companies increased from 720 in 2015 to 820 in 2016. A key issue is that the agriculture sector consumes about 65% (505 MCM/a) of the available water resources (973 MCM/a), but, it produces 19% of the country's food requirements and employs only 1.8% of Jordan's workforce. The Employment Strategy acknowledged the need for the agriculture sector to become more resource efficient. In addition to these challenges, the conflicts in Syria and Iraq have negatively affected Jordan's cross-border trade of agricultural products. The influx of Syrian refugees is placing a significant additional burden on the limited food resources. Notwithstanding, the sector remains a key part of Jordan's plans and the Jordan's Vision 2025 targeting an increase in the rate of agricultural exports from 18% in 2014 to 24% in 2025.

TOURISM

The tourism sector considers as the main driver of sustainable economic development, and also considers as the second fastest growing sector being the largest export sector and a major employer. In 2016, tourism sector contributed by 10.5% of the country's GDP, and employs approximately 50 thousands employees (Table 3). Recently, several development projects in some key tourist attractions, mainly in Aqaba and Dead Sea have been established aiming in marketing Jordan as a tourist destination and raise its competitiveness within the region. Even though the regional instability, the number of tourists arrived Jordan in 2016 was 4.2 million with receipt of 2886 million USD (JCB 2016). As results of these projects, Jordan ranked in position 35 out of 140 countries in the WEF tourism Global Index. The Jordan National Tourism Strategy 2010-2015 vision aims to make Jordan a distinctive destination with diverse visitor experiences that will enrich the lives of Jordanians and their guests. The strategy, aims at improving quality of services and diversifying products and facilities to conform to international criteria and increase number of tourists visiting tourism sites. In addition to its historical sites, Jordan offers a unique place for the medical and religious tourism. More than 250,000 patients from different nationalities have been visited the Jordanian Hospitals during 2016 making the country one the second region's medical treatment hub. Tourism has been identified as a key growth industry for Jordan, with vision 2025 targeting an expansion of tourism from providing 8% of employment in Jordan to 16%.

Table 3. Main indicators for the tourism sector (2013-2016)

Main indicators	2013	2014	2015	2016
Number of Arrivals (millions)	5.4	5.3	4.8	4.8
Share in the GDP (%)	12.3	12.2	10.8	10.5
Value added (JD millions)	1.461.5	1.553.3	1.443.1	1.435.5
Number of Hotels	519	536	558	573
Number of rooms (Thousands)	26.4	27.1	27.7	28.2
Employees in Hotels (Thousands)	18.3	18.6	19.1	19.3
Employees in Tourism sector (thousands)	48.1	48.6	49.1	50.4

(Source: Jordan Central Bank 2016)

Energy Sector

ENERGY SECURITY

Jordan imports about 95% of its energy requirements, mainly includes crude oil, oil by-products and natural gas. The indigenous resources cover only 5% of total's energy requirements, and renewable resources (mainly Solar and Wind) contribute marginally. Traditionally, Jordan used to depend overwhelmingly on imported oil from Iraq with preferable prices. However, invasion of Iraq in 2003 and its associated consequences had forced the Government to search for new partners elsewhere to meet its energy needs. In addition to that, by the end of 2014, the imported natural gas from Egypt totally halted as result of continuous bombing of the Arab gas pipeline. This dilemma have made the energy security a questionable issue. The increase in the population, industrial development and growing of the national economy have also led to increase in annual demand for power by 5.5%-6.5%. The influx of Syrian refugees into Jordan has increased dramatically the demand for primary energy, which affected negatively the amount of consumption per Capita.

For instance, the total primary energy demand in 2016 was 9500 T.T.O.E (thousand tons oil equivalent), compared to 8229 T.T.O.E in 2015 (table 4). The primary energy consumption per Capita in 2016 increased up to 969 kgoe (kilograms oil equivalent), compared to 933 kgoe in 2015 (figure 4). The total generated and imported electrical energy amounted to 20064 GWh in 2016, compared to 19613 GWh in 2015 representing an annual growth of 2.3%. The total generation capacity of the Jordanian power plants amounted 4419 MW, where the renewable energy projects only produced 499 MW. Additionally, approximately 89.5% of total's electricity generation produced using the imported Liquefied Natural Gas (LNG) from Qatar and Egypt.

The national electricity grid for transmission and distribution of electricity has expanded to serve the country's governorates and most of the rural and remote areas. In 2013, the percentage of the population with affordable electricity supply reached 99.9%, which consider very high coverage even compared with the well-advanced economies.

Table 4. Primary energy and energy consumption from (2012-2016)

Year	Total Primary Energy demand T.T.O.E	Growth rate %	Primary Energy per Capita (kgoe)
2012	8206	10	4.8
2013	8157	0.6	10.8
2014	8461	3.7	1.443.1
2015	8927	5.5	558
2016	9500	6.4	27.7

THE JORDAN NATIONAL ENERGY STRATEGY (2007-2020)

The region's instability have indicated that the Jordanian economy is highly vulnerable towards the external shocks and disturbances. Aiming to minimize the energy's burden on the economic and social development and achieve energy security, the Jordan National Energy strategy (2007-2020) and the national vision and strategy 2025 have been adopted. These strategies included clear political supports for renewable energy based-projects facilitating way towards the green economy. A green Growth philosophy is to create more jobs, increase the per capita income and make the country resilient to the unexpected shocks and instability in the region. A country for everyone provides decent work and living conditions based on environmentally sustainable economic growth model.

The National Energy Strategy and vision 2025 aim to raise the share of the renewable energy in the primary energy mix up to 10 and 11% by the end of 2020 and 2025, respectively, which corresponds to 1850 MW, where 1200, 600 are expected to generate from wind and solar energy, and around 50 MW from waste-energy projects (figure 4). The implementation of the National Energy Strategy (2007-2020) requires a gradually removal of subsidies on oil and oil-by products, adoption of the country's first National Energy Efficiency Action Plan (NEEAP), introduce and implement net-metering and wheeling schemes and the formulation of minimum energy performance standards for household appliances. In addition, upgrading the current capacity of the National grid to be able to accommodate the extra green energy derived from new green-based energy projects (Green Corridor).

The strategy includes other recommendations on energy conservation such as grant exemptions to energy-saving vehicles, exemption of solar water heaters from sales tax, implementation of building code regulations that conserve energy and the creation of national award for rationalization of energy consumption. The biggest accomplish to the

renewable energy sector was when the Renewable Energy and Efficiency Law (REEEL) was successfully approved in 2012 and updated in 2015. REEEL requires the national utility company (NEPCO) to purchase electricity from renewable energy projects and for the government to cover the cost of grid connection (Green Corridor). On the top of that, the grand achievement was the establishment of "the Renewable Energy and Energy Efficiency Fund" (REEEF) to supporting projects and initiatives that aim to reduce energy consumption and/or utilize renewable energy sources. This Funded by state and international donor agencies such as the French Development Agency and the World Bank, private investors, both domestic and international, are eligible apply for loans and grants to finance small and medium-scale projects that rely on renewable energy or are designed to increase the country's energy efficiency.

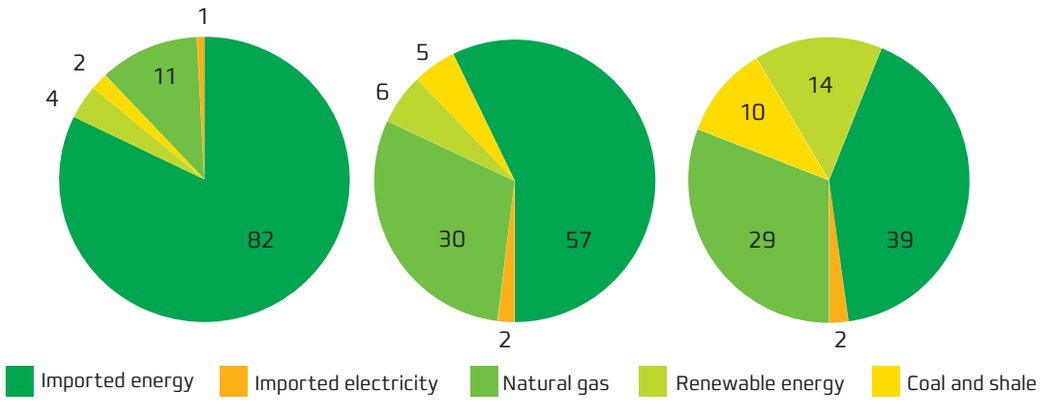


Figure 4. The share of renewable energy in the primary energy mix based on the National Energy Strategy (2077-2020)

The National Energy Strategy (2007-2020) forecasts approximately $18 billion of new private and public investment in domestic power projects to boost domestic energy generation to 40% by 2020. The plan is notable for its emphasis on private investment in the energy sector and includes a variety of incentives for potential investors, including a 100% exemption from income tax for 10 years (Figure 5).

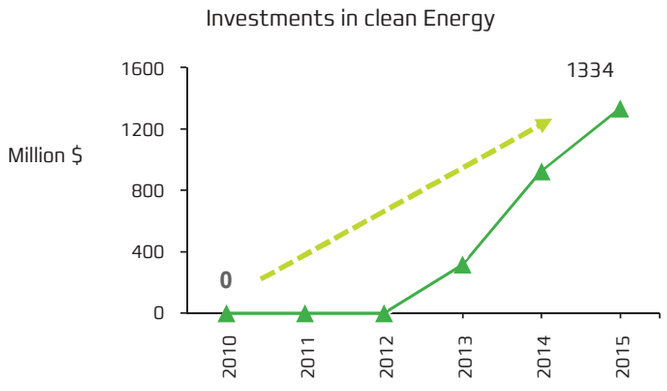
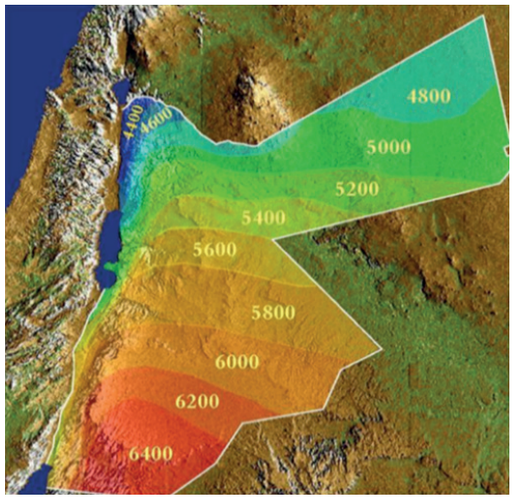


Figure 5. Investments in clean energy from 2010-2015

Renewable Energy sources

SOLAR ENERGY

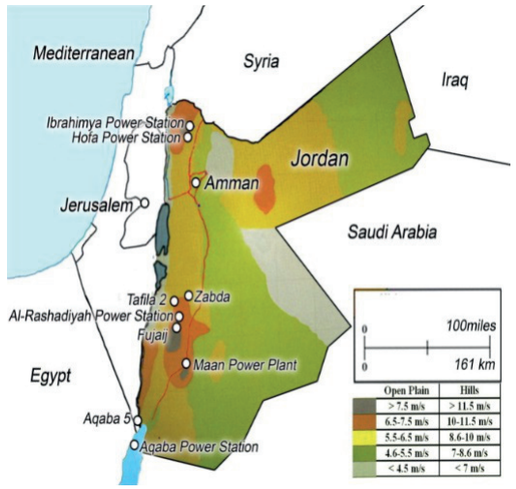


Jordan locates on the earth's sun-belt area with one of the highest figures in the world (on average from 5 to 7 KWh/m2). This amount corresponds to approximately 1400-2300 Kwh/m2. The country has approximately 330 days of sunshine per year with relatively moderate temperatures and low dust and humidity levels, which made the conditions relatively suitable for the commercial purpose. Nowadays, in rural and remote areas, the decentralized photovoltaic units are widely used for lighting, water pumping and other social services (Approximately 1000 KW of peak capacity). In addition, about 12% of all households in 2012 were equipped with solar water heating systems, with total energy production of 380 GWh yearly and 61,218 toe saving in the energy. According to the National Energy Strategy (2007-2020), around 24% of total households are expected to be equipped with solar water heating system by the year 2020. This would save around 122436 toe of the primary energy saving. During 2016, several projects of the direct

offer were completed with total capacity of 400 MW. In addition to that, the Power Purchase Agreement PPA were signed between the National Electric Power Company NEPCO and Baynouna Company to develop a PV project with total capacity of 200 MW. The government is hoping to construct the first Concentrated Solar Power (CSP) demonstration project in the short to medium term and is considering Aqaba and the south-eastern region for this purpose. It is also planning to have a solar desalination plant. According to the national strategy, the planned installed capacity will amount to 300 MW – 600 MW (CSP, PV and hybrid power plants) by 2020.

WIND ENERGY

Jordan has significant wind energy resources that could be potentially exploited for power generation. The country's Wind Atlas shows that wind speed in Jordan varies from 7.5 (m/s), especially in the northern and western regions to 11.5 (m/s) in hilly areas. There is therefore potential for several hundreds of megawatts of wind power installations around the Kingdom. According to a study carried out by the Ministry of Energy and Minerals Resources and the Royal Scientific Society, approximately 16% of the total's country mass lands are suitable for wind power production, with total technical potential of 3.6 GW. Two wind pilot projects exist in the county with a capacity of 1.5 MW. They have been running since early 1990. Recently, Jordan wind and AL-Hussein wind project in Maan area were completed and inaugurated, with total capacity of 117 and 88 MW, respectively. In addition to that, 6 Purchase Power Agreement (PPAs) were singed in 2016, with total capacity of 420 MW, where it is expected to be operated between 2010-1019.



BIOMASS

Jordan has potential to utilize biogas from solid waste for electricity generation. Millions of metric tons of MSW are generated in Jordan every year. The growing of industrialization, high growth rate and massive fluxes of refugees have increased the daily production of MSW. Previous study indicated that around 50% of MSW is food waste and 35% is packaging waste and these would be potentially available for recovery. Most of MSW ends up at dump sites and landfills. Up to date, there is 18 official disposal sites operating by different municipalities, in addition to Great Amman Municipality GAM and Aqaba Special Economic Zone Authority. Out of these sites, only one of them is considered as an engineered sanitary landfill (AL-Ghabawi Landfill).

The latter one is operated by Great Amman Municipality (GAM), and consists of 9 cells with total area of 200 ha. GAM has developed a Master Plan, which provided a framework for infrastructure, planning and zoning, transportation and service provisioning. In 2015, a new National Strategy for MSW had been launched. The strategy recommended some incentive oriented programs and awareness campaigns to enhance the public engagement in the Strategy. The Jordan Biogas Company, which funded by the UNDP in 1998, which owned by Great Amman Municipality (GAM) and the National Electricity Power Company (NEPCO). The aim is to generate an electricity from the treated organic waste in AL-Russaifeh landfill. The project is registered as CDM (Cleaning Developing Mechanism) project, and in 2007, it signed the Emission Reduction Purchasing Agreement ERPA with The Finnish Government. During the period of 2000-2011, around 19 thousand tons of solid waste and 44 thousand m3 of liquid waste have been treated, with total amount of 78 GW generated electricity.

HYDROPOWER

Hydropower resources are very limited in Jordan. The country's only hydropower plant is the King Talal Dam with 7 MW installed power capacity, which generates 25 GWh of electricity annually. Hydropower turbines with total rated capacity of 6 MW were also installed at Aqaba Power Station using the available head of returning cooling seawater. Various studies show an additional hydro resource potential of 400-800 MW could be exploited from the 400-meter elevation difference between Red and Dead Seas through the proposed Red-Dead Sea Canal project.

Green Growth

Even though Jordan is a very small country in terms of its size, however, it underpins by range of economic non-utilize opportunities. For instance, Jordan is the most safety country in the region, pioneer position on renewable energy, member of several bilateral agreements and has substantial demographic opportunities, where around 50% of its population are under than 24 age. A major challenge for the Jordanian government has been always is how to simulate the economic growth and create more jobs simultaneously with preserve all environmental components. Fully dependence on imported fossil fuels to serve the growing demand for electricity, water and transportation, industrial and nonindustrial consumers has direct fiscal, climate and environmental impact. By the end of 2017, both the National Electric and Power Plant and Jordan water authority caused about 25% of the total country's debt. This situation had caused structural transformations in the energy and water sectors. These transformations had aimed to enhance fiscal resilience through policies and investments to promote clean technologies, energy efficiency and resource conservation in energy, water, transport and industrial sectors.

The Jordan's vision 2025, National Green Growth Plan NGGP and Jordan's Nationally Determined Contribution (NDC) on Climate Change outline that climate actions are an important parts of sustainable solution to addressing the country's remarkable fiscal, economic and climate vulnerabilities. The aforementioned policies and documents have created strong linkages between climate changes and national development priorities to create economic opportunities through pursuing Green Economy pathway. Based on the definition formulated by the World Bank, the green growth is growth that is efficient in its use of natural resources, clean in its minimization of pollution and environmental impacts, and resilient in its consideration of physical disasters and natural hazards in the face of a changing climate.

In 2017, the Jordan Green Growth Plan was launched and focuses on six key sectors; namely; energy, water, waste, transport, tourism and agriculture sectors. The Green Growth Plan has identified three clusters: a green growth corridor, smart urban transformation and rural resilience. These three clusters represent the convergence between climate action, sustainable local development and macroeconomic considerations. The Smart Urban cluster would include implementation of project and policy interventions such as public transport, waste management and clean energy service sand building, vehicle and appliance standards. These interventions would not only improve the quality of service delivery and the financial sustainability of utilities/service providers. The following table (Table 5) describes some examples for the green growth projects needed in Jordan based on the cross benefit Analysis CBAs.

Table 5. The green growth projects needed in Jordan based on the cross benefit Analysis CBAs

Green Growth Intervention	Project scale	Financing needs
Utility scale solar and wind projects	Typical Project scale: $80-200 million	• Large project debt and equity Finance • Loan Guarantees
Electric Vehicles with solar PV project(EVs)	Typical Project scale: >$100 million Infrastructure	• PPPs (Public Private Partnership) for EV charging stations & PV.
Renewable desalination	Typical Project scale: >$350 million	• Large project debt and equity Finance • Loan Guarantees
Recycling	Project scale: >$150 million	• Public or grant financing
Waste-to-energy / wastewater Wadi al Arab wastewater biogas	Typical Project scale: >$28 million (S) for programme of numerous plant	• Debt and equity Finance option • Grant funding for individual plants
Green spaces Public park	Typical Project scale: >$28 million (S) for programme of numerous plant	• Public or donor funding
Freight rail Jordan freight rail	Project scale: >$4 billion	• PPP's

(Source: National Green Growth Plan, 2017)

Possibilities of developing business cases for green growth

POTENTIAL PROCUREMENT APPROACHES FOR SOLAR PV POWERING WATER DESALINATION AND PUMPING

The MWI plans to increase desalination and treatment of non-renewable groundwater sources, which are remote from Amman, in order to meet the urgent water crisis facing Jordan. Solar PV installations will substitute the highly GHG emissions-intensive grid electricity needed to power the pumping and desalination processes. Large-scale solar PV power plants are typically developed with a long-term Power Purchase Agreement (PPA). These agreements provide the basis for the other contracts needed for the project developer to deliver the capacity – the Engineering, Procurement and Construction (EPC) and Operation and Maintenance (O&M) contracts. The Ministry of Energy and Mineral Resources (MEMR) has recent experience of tendering solar PV through competitive tenders, and would be the logical off-taker for the renewable energy for desalination project. As outlined in the financial assessment below, in 2015 MEMR procured 200MW of solar PV capacity through the second round of direct proposals, achieving very low electricity tariffs compared to the grid production cost and the tariffs offered in the first round of direct proposals.

Once the project concept for the desalination facility has been developed further by the MWI and key technical details (water production volume, energy requirements, and project location) have been clarified, project developers can identify viable sites and capacity factors, and begin the prefeasibility and feasibility studies. These project-specific details will shape the form of the financial and commercial models and the PPA and other contracts.

After the power requirements of the pumping and desalination facilities are determined, NEPCO can arrange a competitive tender by project developers to deliver the required capacity to the grid. Once the winners have been selected and the tariffs, grid connection agreements and PPAs are in place, the project developers can arrange project financing and procure EPC and O&M services with back to back contracts, allowing the construction, commissioning and operation of the installations to commence.

POTENTIAL PROCUREMENT APPROACHES FOR ELECTRIC VEHICLES IN AMMAN

The Ministry of Environment and other key stakeholders currently propose that the Electric Vehicles in Amman project be undertaken as a "public-private joint venture", with the private sector partner taking responsibility for the financing, construction, operation and maintenance of the charging point network. The Greater Amman Municipality will provide land for the charging points and assist the consortium to identify land for the solar PV installation. The Ministry of Environment, Ministry of Energy and Mineral Resources and the Energy and Minerals Regulatory Commission will support the drafting of the necessary legislation and regulations for licensing charging points. As regards the latter, the Ministry of Environment has recently published the Directive for Licensing Vehicle Charging Stations.

The All Cell consortium has requested that the Government grant a grace period during which they will install, own and operate the network of charging stations. However, the details of a concession / grace period have not yet been finalised. At present there do not appear to be other consortia expressing interest in constructing and maintaining the network. However, the Government may wish to consider introducing a competitive tendering approach (either now or at the end of a grace period with the private sector Joint Venture (JV) partner) which will enable it to ensure that the charging network is delivering value for money to the public. As noted in the strategic case, realising net benefits from the use of the EV charging network depends on both private EV take-up and competitive infrastructure costing. Competitive tendering processes for a fixed-term concession to construct operate and maintain the network of charging stations would enable the Government to test whether the proposed capital expenditures are spent in the best interests of the public.

Finance the Green Growth in Jordan

Green Growth is now an established framework for sustainable development; through the integration of environmental, social and economic objectives within the National Green Growth Plan (NGGP). However, the Green growth will not success unless the finance issue is well addressed. The financing of a sustainable development plan should not rely heavily on donor finance and government grants. The core of a green growth ambition is to achieve a sustainable green economy including all aspects (social, environmental and economic). Therefore, the ultimate aim should be to grow private sector participation in commercially attractive green infrastructure projects in Jordan.

Financing Mechanisms

INTERNATIONAL FUNDING SOURCES

International aid, development banks and other sources have provided a major source of financing for green growth projects. According to the OECD DAC 2014, the largest funders for projects that address climate change include the EBRD, Government of Germany, the International Finance Corporation and the EU. A majority of this funding is committed to priority sectors such as Water and Energy and to government and civil society activities. Jordan receives financial assistance from various tailored green funds. For example, the Jordan Sustainable Finance Facility (JorSEFF) has been recently established with initial amount of €34.5 million.

DEVELOPMENT BANKS

Development banks providing financing to Jordan for the purposes of green economy initiatives include, the Agence Française de Development (AFD), KfW, the United Nations Development Programme (UNDP), the European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC), the European Union (EU), the Kuwait Fund for Arab Economic Development and others. These are commonly coordinated through the Ministry of Planning and International Corporation MOPIC who plays a key role in Donor coordination and project engagement.

DIRECT AIDS

Direct aid plays crucial part in Jordan's green economy sector, including financing from the Abu Dhabi Fund for Economic Development. In addition, the US provides a wide range of financial aid to Jordan, such as economic assistance from USAID (approximately $1 billion per year) and Millennium Challenge Account (approximately $275 million).

COMMERCIAL / PRIVATE FINANCING

Jordan has also been the recipient of direct financial investment and debt finance from the international commercial banking sector. Some of the recent renewables projects, including the Adenium Energy PV plants in Maan, and the Falcon Maan for Solar Energy PV project included private financing as part of a consortium of investors. Nearly all renewable energy projects in Jordan have required some form of financing or underwriting from key international development banks or grants. Development assistance is provided primarily through concessional loans, co-financing or equity investments into green growth projects. Furthermore, the JREEEF has been set up to channel a range of funding, including international aid and development funds, to renewable and energy efficiency projects.

THE JORDAN RENEWABLE ENERGY AND ENERGY EFFICIENCY FUND (JREEEF)

JREEEF established in 2012 by the Mistry of Energy and Mineral Resources (MEMR) as a result of approving the Renewable Energy and Energy Efficiency Law. Current fund size: JOD 25 million Funding sources: Jordanian government, international aid agencies, grants. It was set up to help facilitate the scaling-up of Renewable Energy and Energy Efficiency (RE & EE) to meet the energy needs, in accordance with the National Energy Strategy and National Energy Efficiency Action Plan. FREEEF's vision is to make the country a regional leader in sustainable energy implementation. It is also active in attracting donor financing and other support for its operations, including banks, aid programmes, donors, and loan guarantee facilities to help finance or co-finance programmes implemented by beneficiaries.

JORDAN ENVIRONMENT PROTECTION FUND (JEF)

The Ministry of Environment established The JEF in 2006. The Fund intended to provide financial support for projects in the context of environmental protection and preservation. The JEF fund receives financing from multiple sources such as Aid, donations and grants provided to the Fund from public institutions and civil bodies and private, Arab, regional and international bodies, Fines and compensation referred to the Environmental Law 66. The following table (Table 6) describes some selected global green funds.

Table 7. Examples of selected global green funds

Name	Type	Country/ Region	Fund size	Brief description
Green Climate Fund GCF	Fund	Global	10.3 billion	Assist developing countries in adaptation and mitigation practices to counter climate change
Breakthrough Energy Coalition	Fund	Global	20 billion	Support Renewable energy projects
Goldman Sachs Renewable Energy Investment	Fund	Global	40 billion	Support renewable energy projects

(Source: National Green Growth Plan, 2017)

Renewable Energy Projects in Jordan

Up to date, the share of the renewable energy in the total primary energy is approximately 8%, of which; 550 MW derived from solar and 197 MW from wind. The most common schemes for the renewable energy projects is the Direct Proposals (DPSs), where the Government seeks the most competitive submitted prices through auctioning process after selecting the most qualified companies. So far, three rounds have tendered. The first round direct proposal target was to generate 203 MW of electricity from renewable sources (Table 7). These projects already have signed a Power Purchase Agreement PPAs with the National Electric Power Company NEPCO. The third direct submission proposal aimed to generate 300 MW (200 MW solar and 100 MW wind energy), of which 100 MW will be allocated for the small and medium enterprises SMEs to enhance their competitiveness capacity. I addition to that, several projects are still in the planned phases and they will be announced upon completing the all required steps.

Table 8. Direct Proposal Schemes DPSs (First Round)

Name of the company	Location	Capacity (MW)	Cost million J.D
Shamsuna Power Company	Aqaba	10 PV	18
Jordan Solar One (Evolution Solar)	Hosha/ Mafraq	20/PV	52
Arabia One For Clean energy Investments	Maan Development Area (MDA)	10/PV	17.5
Shams Ma'an Power Generation	Ma'an	50	117
Catalyst Private Equity	MDA	20	32
EJRE Projects	MDA	20	33
Clean Energy Concepts	MDA	10	16.5
SunEdison Italia	MDA	20	40
Bright Power Group	MDA	10	18
Martifer Solar, S.A	MDA	10	18
Scatec Solar	Ma'an	10	19
Greenland Alternative Energy	MDA	10	19
Total		**120 MW**	**400 million J.D**

WASTE TO ENERGY PROJECTS

Millions of metric tons of MSW are generated in Jordan every year. The growing of industrialization, high growth rate and massive fluxes of refugees have increased the daily production of MSW. Previous study indicated that around 50% of MSW is food waste and 35% is packaging waste and these would be potentially available for recovery. Most of MSW ends up at dumpsites and landfills. Up to date, there is 18 official disposal sites operating by different municipalities, in addition to Great Amman Municipality GAM and Aqaba Special Economic Zone Authority. Out of these sites, only one of them is considered as an engineered sanitary landfill (AL-Ghabawi Landfill). The latter one is operated by Great Amman Municipality (GAM), and consists of 9 cells with total area of 200 ha. GAM has developed a Master Plan, which provided a framework for infrastructure, planning and zoning, transportation and service provisioning. In 2015, a new National Strategy for MSW had been launched. The strategy recommended some incentive oriented programs and awareness campaigns to enhance the public engagement in the Strategy.

The fees system of MSW in Jordan:

- A fixed annual lump-sum fee (JOD 20 per household) that is paid in monthly instalments plus JOD 0.005 per KWh (for every KWh above 200 KWh consumption per month), levied with the monthly electricity bill and is applicable for households in Amman municipality.

- A fixed annual lump-sum fee (JOD 24, 15, or 8 per household depending on municipality class) that is paid in monthly instalments levied with the monthly electricity bill and is applicable for households in municipalities except Amman municipality.

GHABAWI LANDFILL GAS TO ENERGY PROJECT

Generation of electricity by burning methane from Al Ghabawi solid waste landfill, the first of its kind project in Jordan. The generated electricity will be used to power the landfill, while the remainder will be sent back to the national grid.

Table 9. General information about Ghabawi Landfill (Gas to Energy)

Financing	3 million $ senior loan, to be co-financed by a $5 million loan funded by the Green Energy Special Fund ("GESF") administered by the European Bank
Value	30.2 million $ of which a $10 million contribution from Greater Amman Municipality (GAM)
Status	In progress on the projects' second phase (the drilling of wells to collect methane). The facility will start burning methane by end 2017. GAM will soon begin implementing the third phase during which the municipality will install generators and integrated systems for generating electricity by burning methane. Upon completion of the 3rd phase, 5 MW per hour is expected to be generated by late 2018.

(Source: Rahim et al. 2017. Energy Prospects in Jordan.)

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