



Ministry of Water & Irrigation  
وزارة المياه والري

## Energy Efficiency and Renewable Energy Policy for the Jordanian Water Sector

2015

## Background

To accommodate its development targets and to promote sustainability, Jordan, a growing economy of high potential, is working towards building modern infrastructure, mainly for water and energy. The efforts of the Jordanian Government are embedded in a comprehensive strategy of improving the organizational and financial structures of its bodies. The optimization of energy use in the water sector serves the objective of financial restructuring through improving cost recovery, tapping alternative energy sources, and decreasing inefficiencies.

This policy puts into effect the mandate of the Ministry of Water and Irrigation (MWI) to improve the performance of the water sector through

1. Improving the energy efficiency in water facilities in order to decrease the specific power consumption for water supply, and
2. Introducing renewable energy technologies to protect the environment and reduce energy price volatilities in the water sector.

The energy targets of MWI for the year 2025 are specifically

1. Reducing the overall energy consumption in public water facilities by 15%, and
2. Increasing the share of renewable energy to 10% of the overall power supply.

To achieve these targets, an action plan with priorities is to be devised through setting three main milestones within this policy for the years 2017, 2021 and 2025.

### Current Energy Use in the Jordanian Water Sector

The Hashemite Kingdom of Jordan faces challenges regarding the availability and the utilization of its natural resources. These challenges are generated by the scarcity of both, water and fossil energy resources, and their increasing demand. Jordan's climate is arid to semi-arid with low rainfall and high evaporation rates. About 94% of Jordan's territory receives less than 200 mm of rainfall per year. Jordan imports around 97% of its fossil fuel from abroad, mainly for power generation and transportation. According to data of the Ministry of Energy and Natural Resources (MEMR), 17% of the Kingdom's GDP of 2013 were spent on energy<sup>1</sup>.

Recurring political crises in the region has forced a large number of dislocated people of region, currently mainly from Syria, to seek refuge in Jordan. This causes recurrent sudden increases in demand for water supply and wastewater as well as for energy. This in, turn disrupts a systematic and smooth implementation of existing water management plans and are extremely difficult and costly to accommodate where infrastructures are not in place.

Rapid natural population growth adds to the significant increase in the demand for water and electrical power and poses additional pressures on water, wastewater, and power supply systems.

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<sup>1</sup> MEMR Annual Report 2013 page 15. In 2013, US\$ 4.076 Billion amounted the national energy bill out of US \$23.852 Billion total GDP.

Electrical power generation in Jordan relies predominantly on fossil fuels with significant impact on the environment through harmful greenhouse gases (GHG) such as CO<sub>2</sub> and NO<sub>x</sub>. Power generation in 2013 amounted to around 17,261 GWh, which corresponds with more than 12.5 million tons of CO<sub>2</sub> emissions<sup>2</sup>. This suggests a reorientation towards renewable energy and clean power generation systems to protect Jordan's natural environment. Because of wind and solar energy sources abundance in Jordan, such reorientation will in the long-term reduce power generation costs and improve the country's energy security.

Today, photovoltaic technology can produce solar power at a fixed rate of 0.10 JOD/kWh calculated for a 20 years project<sup>3</sup>. This rate is lower than the cost of power produced with conventional methods. Photovoltaic power supply systems represent an opportunity for the water sector to significantly decrease operational expenses and to mitigate the effects of energy price volatility, which largely depend on fluctuating fossil fuel prices.

Water supply in Jordan relies mainly on resources, which are located at a considerable distance to agglomerations. Consequently, the water sector involves an energy extensive operation by deploying large water pumping, boosting and treatment and distribution facilities. According to the 2013 Annual Report of the Ministry of Energy and Mineral Resources (MEMR), power requirements only for water pumping in 2013 amounted to about **14%** of the total power production of Jordan with a total amount of **1424** GWh. The specific energy consumption for the same year was 7.2 kWh/m<sup>3</sup> (billed) for the Water Authority of Jordan (WAJ), mainly for municipal water supply and wastewater, and 0.46 kWh/m<sup>3</sup> (billed) for the Jordan Valley Authority (JVA), mainly for irrigation and industrial use in the Jordan Valley. The weighted average consumption for the public sector water facilities is 4.2 kWh/m<sup>3</sup>. Given that the water sector is highly subsidized, the total energy bill paid by MWI (including JVA and WAJ) in 2013 was JOD 100 million, which is equivalent to an average specific power cost of 0.069 JOD/kWh. However, this figure does not reflect the actual power costs paid by the Government. The actual power expenses amount to 0.189 JOD/kWh approximately<sup>4</sup>. This result in an actual energy bill of the year for the water sector JOD 270 million paid by the Government with a subsidized amount of JOD 170 million. Subsidies pose a major additional obstacle to more efficient power consumption as they do not generate incentives for power saving. A more transparent accounting system to avoid double counting is required as well as creating a coherent one-subsidy point along the service chain to eliminate hidden subsidies.

The future expected power requirements of the utility water sector from 2013 to 2025 are illustrated in the graph below. The projected values until 2025 are calculated based on the water demand values released by MWI in 2013 using current specific energy supply requirements of 7.2 kWh/m<sup>3</sup>(billed) for WAJ and 0.46 kWh/m<sup>3</sup>(billed) for JVA. Assuming that current operational patterns are sustained, real power costs only for water pumping amount to JOD 640 million.

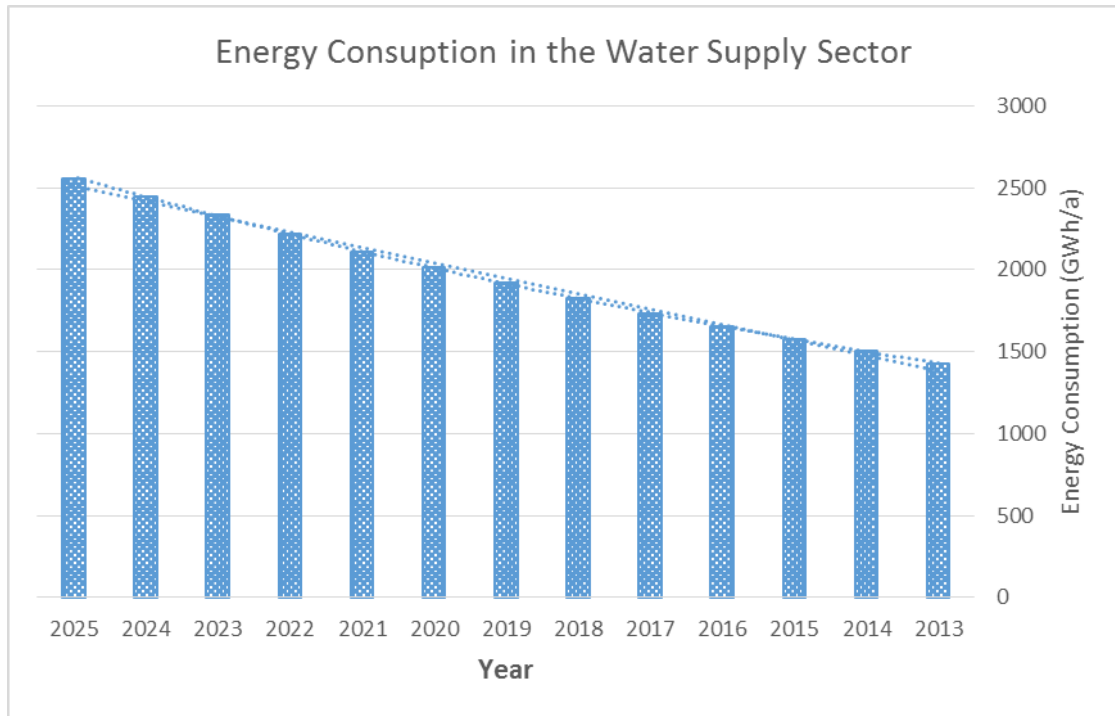
Since the consumption of JVA constitutes a small portion compared to that of WAJ, the focus will mainly be on improving the energy consumption of WAJ facilities, while maintaining data for JVA facilities.

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<sup>2</sup> MEMR 2013 Annual Report calculated for 0.728 kg CO<sub>2</sub> emitted for each kWh produced.

<sup>3</sup> This is the value of the recent feed-in-tariff set by MEMR. It represents the market value of photovoltaic power. However, actual photovoltaic power generation costs are generally lower than this value.

<sup>4</sup> The Energy Situation in Jordan, Ministry of Planning and International Cooperation, Mojaheed Elsagheer, July 2013.



For Jordan, initiatives to encourage efficient use of scarce natural resources will significantly contribute to reduce financial pressures. Accordingly, the substantial energy saving potentials in the water sector represent an opportunity to achieve sustainability objectives, not only on ministerial level but also on ministries’ institutions level.

Improving the efficiency of energy use in the water sector and introducing renewable energy technologies to the sector shall lead to a reduction in water supply costs and avoid unnecessary losses in the sector. Achieving such results shall contribute to the sector optimization and hence to solving serious challenges for Jordan’s sustainable development caused by the various pressures on its limited resources and their inefficient management.

### Participating Institutions

Participating institutions for implementing this policy are:

- Ministry of Water and Irrigation (MWI): Policy formulation, coordination, monitoring and evaluation.
- Ministry of Energy and Mineral Resources (MEMR): licensing and issuing permits.
- Ministry of Planning and International Cooperation (MoPIC): Funding.
- Ministry of Finance (MoF): Financial regulation.
- Ministry of Environment (MoE): Environmental protection and ecological aspects.
- Jordanian Water Authority of Jordan (WAJ): Implementation.
- Jordan Valley Authority (JVA): Implementation.
- Water companies: Implementation and participation.
- Private sector: Participation.

## Introduction

This policy is intended to serve as a tool for implementing an ambitious national program to promote energy efficiency and renewable energy usage in the water sector. Adherence to the policy guidelines is expected to boost Jordan's energy autonomy by improving cost recovery, ensuring a more productive use of energy, and reducing CO<sub>2</sub> emissions. It shall enhance the ability for strategic planning of the water sector, thus contributing to the sustainable development and the welfare of our society.

The purpose of this policy is to improve the energy efficiency in the Jordanian water sector, to reduce water supply costs and accordingly to contribute to the growth of the Jordanian economy. Furthermore, this policy directs the utilization of renewable energy technologies for power supply at the water facilities, and consequently, reduces the volatility of the energy prices that are typically linked to the fossil fuel prices.

By implementing this policy, the burden on the already overstretched electricity generation sector as well as the energy costs for the water sector shall be reduced. There will be a significant contribution to climate change mitigation efforts through targeted investment such as the use of carbon efficient technologies.

### Policy targets until 2025

- 15% reduction in the specific energy consumption of billed water corresponding to a 0.46 kg reduction of CO<sub>2</sub> emissions for the production per each billed cubic meter of water.
- Raise the share of renewable energy resources in power consumption to 10% corresponding to a total saving of 0.26 kg of CO<sub>2</sub> emissions per each billed cubic meter of water.

The targets established above represent a conservative scenario for policy implementation. A more optimistic yet feasible scenario is presented also in this policy. The two scenarios are presented in the table below.

According to MWI<sup>5</sup>, the total billed water supply to all users in 2013 was 341.1 million cubic meter (MCM) (188.1 MCM for municipal and 153 MCM for irrigation purposes) associated with a total electrical power demand of 1424 GWh (1354 GWh for municipal and 70 GWh for irrigation). The specific energy consumption for water supply in 2013 was of 7.2 kWh/m<sup>3</sup> billed for WAJ and 0.46 kWh/m<sup>3</sup> (billed) for JVA. The water demand is assumed to have an annual growth rate of 5%, which is equivalent to 415 MCM in 2017, 504 MCM in 2021 and 613 MCM in 2025. The corresponding energy consumption values for current water supply patterns and) after implementing energy efficiency and renewable energy measures; are listed in the table below together with the corresponding CO<sub>2</sub> emission values for all target years.

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<sup>5</sup> Water Budget Report for 2013, Table 9, page 13. The total water quantity including the Disi project is 418.5 MCM.

	Operator	Baseline 2013	2017 (MS1)		2021 (MS2)		2025 (Target)	
			Base case	Optimistic	Base case	Optimistic	Base case	Optimistic
Total water supply to final consumer (MCM)	WAJ	188	229		278		338	
	JVA	153	186		226		275	
	WAJ+JVA	341	415		504		613	
% Reduction of energy consumption per m <sup>3</sup> billed (Target)		100%	94.75%	92.73%	89.50%	86.40%	85.00%	80.00%
Energy consumption per m <sup>3</sup> billed (Target)		0%	5.25%	7.27%	10.50%	13.60%	15%	20%
Reduction of energy consumption per m <sup>3</sup> billed (kWh/m <sup>3</sup> billed)	WAJ	7.20	6.82	6.68	6.44	6.22	6.12	5.76
	JVA	0.46	0.44	0.43	0.41	0.40	0.39	0.37
	WAJ+JVA	4.175	3.96	3.87	3.74	3.61	3.55	3.34
Renewable Energy Share for specific power need per m <sup>3</sup> billed		0%	2%	2%	6%	7%	10%	12%
CO <sub>2</sub> Reduced value due to Energy Efficiency (kg/m <sup>3</sup> billed)	WAJ+JVA	0	0.16	0.22	0.32	0.41	0.46	0.61
CO <sub>2</sub> Reduction due to Renewable Energy (kg/m <sup>3</sup> billed)	WAJ+JVA	0	0.06	0.06	0.16	0.18	0.26	0.29
Total CO <sub>2</sub> Reduction due to EE and RE (kg/m <sup>3</sup> billed)	WAJ+JVA	0	0.22	0.28	0.48	0.60	0.71	0.90
Power demand BAU* (GWh)	WAJ	1,354	1,646		2,001		2,432	
	JVA	70	86		104		127	
	WAJ+JVA	1,425	1,732		2,105		2,559	
Power demand EE and RE measures (GWh)	WAJ+JVA	1,425	1,640	1,605	1,883	1,818	2,175	2,047
Total CO <sub>2</sub> emissions in BAU (tons/year)	WAJ+JVA	1,037,182	1,260,719		1,532,376		1,862,704	
Total CO <sub>2</sub> emissions after EE and RE measures (tons/year)	WAJ+JVA	1,037,182	1,194,021	1,168,566	1,370,768	1,323,289	1,583,163	1,490,035
Total CO <sub>2</sub> emissions Savings (tons/year)	WAJ+JVA	0	66,697	92,153	161,608	209,087	279,542	372,669

Note: Water demand annual growth rate = 5%

\*BAU: Business as Usual

## **The Policy Pillars:**

### **1. Optimization and rehabilitation of water infrastructure**

The water supply infrastructure consists of well fields, pumping stations, main transmission lines, water and wastewater treatment plants, water distribution and wastewater collection networks. In the rehabilitation phase, depending on their state, power needs and operational efficiencies, different water facilities should be rehabilitated according to a priority plan. Rehabilitation works of water pumping facilities shall lead to reduction of power demand for pumping and pressure drop in the network, and should achieve better water planning. These actions include mainly:

- Replacement and/or repair of malfunctioned or damaged equipment.
- Replacement and/or repair of broken and/or leaking parts and pipes.
- Deployment of hydraulic modelling techniques in the water distribution network to employ gravity for water distribution to consumers.
- Proper maintenance of the facility buildings.

The continued optimization and rehabilitation works shall ensure the sustainability of the operation and maintenance of the water supply facilities. According to this policy, the following plans shall be implemented to this objective:

- Improving and extending the SCADA system coverage to include all water facilities, thereby enhancing water demand management, optimizing equipment utilization and improving the water supply system.
- Preparation of routines of, preventive and corrective maintenance plans for water facilities to improve their operational efficiency.
- Human factor plays significant role in promoting energy efficiency in the water sector. Therefore, highly qualified O&M personnel shall be trained to operate technologically advanced control systems for the water system.
- Adequate capacity-building programs shall be designed to prepare operation and maintenance personnel at various water facilities to perform various tasks at different levels (highly qualified and ordinary workers) in accordance with best operational and maintenance (O&M) practices.
- Operational plan for the transportation fleet in the water sector shall be implemented to control vehicle usage thereby reducing fossil fuels consumption and avoiding inefficient use and abuse of vehicles.
- Engagement of the private sector mainly through *Energy Performance Contracts* between energy service companies and the water authorities, i.e. WAJ and JVA. This will help allocating risks and ensuring the quality of the product at fixed costs. The Private sector roles are seen in:
  - Improving energy efficiency through systematic rehabilitation,
  - Operation and maintenance works, and

- Investing and bringing in new technologies that will bring-in future benefits.
- A Health and Safety (H&S) plan should be prepared to ensure the safety of workers at the various facilities.
- A security strategy should be developed and plans prepared to secure facilities and to protect the whole system from vandalism specially theft of water and equipment.

## ***2. Introduction of economic feasible and environment friendly power generation system based on renewable energy resources***

The water sector promotes the introduction of renewable energy technologies into the sector within the framework of the national energy strategy to diversify energy resources and to reduce reliance on energy imports. In this context, the following policy statements are valid; the water sector provides:

- Direct investments in renewable energy by the sector to supply a share of 10% of its power requirements from renewable energy systems by 2025,
- Implementation of photovoltaic (PV) technology to supply the largest share of power to the water sector. Net-metering and wheeling mechanisms can be used.
- Establishment of hydropower stations at water dams and canals which have the potential of supplying power at an economic rate.
- Utilization of sludge from wastewater treatment as biological power source to cover part of the energy needs of wastewater treatment facilities, and
- Introduction of wind energy farms and other renewable technologies such as concentrating solar power (CSP) to supply power at economic rates.

The water sector, among all other power-consuming sectors in the country, will directly benefit from the implementation of the national energy strategy, which states that renewable energy shall contribute with a rate of 7% to the overall energy mix by 2015 and 10% by 2020. The introduction of renewable energy technologies into the water sector shall lead to the following results:

- Supply of power at stable and low rates leading to reducing energy prices volatility.
- Reduction of the sector dependence on fossil fuels.
- Reduction of water-pumping costs.
- Enabling long term planning of water supply.
- Reducing CO<sub>2</sub> emissions that makes it not only an economic attractive option but a high ecological value option, too.

### **Enclosure: EE & RE Policy Action Plan (2015-2025)**

To achieve the targets an action plan has been prepared based on the main milestones set in this policy for the years 2017, 2021 and 2025. The plan is developed based on the expected savings achieved by implementing each action, i.e. rehabilitation of facilities. Thus, water facilities with highest power saving potential, for instance, shall be given the highest priority. Existing finances and funds shall be taken into consideration in the plan in order to render its implementation feasible.