

# **Jordanian-German Cooperation**

**Ministry of Water and Irrigation (MoWI)  
Water Authority of Jordan (WAJ)**

## **Energy Efficiency Program**

### **Project Preparatory Report** Final Version

**Prepared for:**  
**KfW Development Bank**

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## CURRENCY EQUIVALENT (February 2010)

|               |   |                      |
|---------------|---|----------------------|
| Currency Unit | : | Jordanian Dinar (JD) |
| 1 EUR         | : | 0,99 JD              |
| 1 EUR         | : | 1,40 US\$            |
| 1 JD          | : | 1.39 US\$            |

## LIST OF ABBREVIATIONS

|                  |   |
|------------------|---|
| AS               | Activated sludge  |
| BGR              | German Federal Institute for Geosciences and Natural Resources  |
| BMU              | Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit |
| BMZ              | German Ministry of Economic Co-operation and Development        |
| BCT              | BCT Technology Enterprises GmbH                                 |
| BOD <sub>5</sub> | Biological Oxygen Demand  |
| BOT              | Build-Operate-Transfer  |
| BP               | Business Plan   |
| CAPEX            | Capital Expenditures  |
| CDM              | Clean Development Mechanism                                     |
| CERs             | Certified emission reduction                                    |
| CIP              | Capital Investment Plan   |
| CM               | Complementary Measures  |
| DN               | Diameter nominal  |
| DP               | Development Partners  |
| DUC              | Dynamic Unit Costs  |
| EEP              | Energy Efficiency Program                                       |
| EIB              | European Investment Bank  |
| ESPC             | Energy Saving Performance Contract                              |
| EU               | European Union  |
| EUR              | Euro (European currency)  |
| FC               | Financial Co-operation  |
| FS               | Feasibility Study   |
| GHG              | Greenhouse Gas  |

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|           |   |
|-----------|---|
| GoJ       | Government of Jordan  |
| GTZ       | German Agency for Technical Cooperation   |
| IEES      | Improvement Energy Efficiency Study (GTZ / Dorsch-Consulaqua; 9.2009)   |
| IRR       | Internal Rate of Return   |
| ISO       | International Standard Organisation   |
| JD        | Jordanian Dinar   |
| JVA       | Jordan Valley Authority   |
| JV        | Joint Venture   |
| kV        | kilovolt  |
| kW        | kilowatt  |
| KfW       | Kreditanstalt für Wiederaufbau (German Agency for Financial Cooperation)  |
| l/c/d     | litre per capita per day  |
| MCC       | Millenium Challenge Corporation   |
| MCM       | Million m <sup>3</sup> of Water   |
| MEMR      | Ministry of Mineral Resources   |
| Miyahuna  | Jordan Water Company  |
| MIS       | Management Information System   |
| MoA       | Ministry of Agriculture   |
| MoWI      | Ministry for Water and Irrigation   |
| MoM       | Minutes of Meeting  |
| NGWA      | Northern Governorates water Administration  |
| NPV       | Net Present Value   |
| NRW       | Non-Revenue Water   |
| NWMP      | National Water Master Plan  |
| O&M       | Operation and Maintenance   |
| OPEX      | Operating Expenditures  |
| PMU       | Project Management Unit   |
| PO        | Private Operator  |
| PPP       | Public Private Partnership  |
| PSP       | Private Sector Participation  |
| R&M       | Repair and Maintenance  |
| SAMRA Co. | SAMRA Wastewater Treatment Plant Co. (BOT Operator of the New Samra WWTP and the Conveyor System; MORANTI / SUEZ Environment) |
| TOE(toe)  | Tonne of oil equivalent   |
| UFW       | Unaccounted-for-Water   |
| UNDP      | United Nations Development Programme  |
| UNFCCC    | Jordan's Second Communication to the United Nations Framework Convention on Climate Change (UNFCCC) 2009                      |
| USAID     | United States Agency for International Development  |
| US\$      | US-Dollar   |
| WAJ       | Water Authority of Jordan   |
| WB        | World Bank  |
| WS        | Water Supply  |
| WTP       | Water Treatment Plant   |
| WW        | Wastewater  |
| WWTP      | Wastewater Treatment Plant  |

## **1 Introduction**

### **1.1 Generalities**

The Water Authority of Jordan (WAJ) is the largest single consumer of electricity in Jordan. The current energy consumption of WAJ for water supply and wastewater services amounts to about 14 % of the total energy demand in the country and the corresponding expenses represent by far the largest portion of recurrent operating costs for WAJ and the Jordan Water Company, Miyahuna.

As outlined in “Jordan’s Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC, 2009)”, the Jordanian Government gives high priority to implementing enhanced measures for gaining energy efficiency in all relevant sectors. In particular, the Ministry of Water and Irrigation has identified energy saving for water pumping and other water sector related activities as a priority goal for the future. Hence, WAJ, representing the MoWI, has asked Kreditanstalt für Wiederaufbau (KfW) to commission a short-term-expert in order to help WAJ to prepare a potential future program in this regard.

The expert’s defined particular scope of work under the assignment comprises:

- Analysis of existing results regarding the energy efficiency of water and wastewater infrastructure in Jordan;
- Elaboration of potential project concepts; and
- Discussing possible program set-ups with the relevant Jordanian institutions and other participating international stakeholders in the water sector.

The results and impact of on-going subject related projects to be considered by the expert for the elaboration of the Program Preparatory Report are as follows: (i) Improvement of the Energy Efficiency of WAJ (financed by the BMU, implemented through GTZ; “Assessment of Pump Efficiency, Pump Operation and Energy Saving Potential, 9/2009, Dorsch / Consulaqua”); (ii) Operations and Management Support to WAJ in the Middle Governorates (financed by BMZ, implemented through GTZ); (iii) Accompanying Measures for the Water Loss Reduction Project in the Northern Governorates (financed through KfW); (iv) Accompanying Measures for the Karak Water Loss Reduction Project (financed through KfW); and (v) Consultancy Services for the Preparation of Feasibility Studies for the Zarqa Governorate (financed through Millenium Challenge Corporation / MCC).

### **1.2 Problem Analysis**

Jordan suffers from a severe shortage of water. The country’s water strategy for the period 2008 – 2022 states that Jordan is one of the four driest countries in the world. The annual per capita water availability has declined from 3,600 m<sup>3</sup>/year in the year 1946 to only 145 m<sup>3</sup>/year in the year 2008, which is far below the international water poverty line of 500 m<sup>3</sup>/year. Jordan’s water is derived from both surface and underground sources. Developed surface water in Jordan is estimated at 295 MCM in 2007 at approximately 37% of

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Jordan's total water supply. The contribution of the groundwater is estimated at 54% and other sources include treated wastewater which is used for irrigation in addition to desalinated water from some springs. Moreover, it is expected that the climate change will significantly affect the availability of water resources as a result of decrease in precipitation and projected changes in its spatial and temporal distribution. The scarcity of water in Jordan is the single most important constraint to the country's growth and development because water is not only considered a factor for food production but a very crucial factor for health, survival and social and economical development. In order to counterbalance the negative impact of climate change on water, the Jordanian Government has initiated programs on water loss reduction, water conservation and groundwater monitoring and re-use of treated wastewater for agricultural purposes. The present Water Strategy of Jordan, entitled "Water for Life", approved in May, 2009, mainly focuses on effective water demand management, water resources development and effective water supply operations. This latter also indicates an efficient and systematic reduction of energy cost.

Jordan has extremely limited primary energy resources and is forced to depend to a large extent on the imported petroleum, petroleum products and natural gas from neighbouring Arab countries. Primary energy consumption reached 7,2 million toe in the year 2006, compared with 5,1 million in the year 2001. The electricity consumption in Jordan in the year 2006 was 9,579 GWh compared to 6,392 GWh in the year 2001 which reflects a quite remarkable average annual growth rate of about 7.7% in the recent past. Energy contributes about 74% of Jordan's total Greenhouse Gas emissions (GHG), followed by waste (13.5%), industrial processes (7.9%) land use (3.7% and agriculture (0.9%). The current breakdown of Jordan's total emissions on a GHG basis is as follows: Carbon dioxide (CO<sub>2</sub>) is 84.6%, Methane (CH<sub>4</sub>) is 13.6% and Nitrous oxide (N<sub>2</sub>O) is 1.7%.

Responding to the major challenge facing Jordan's sustainable development, energy security, the Ministry of Mineral Resources (MEMR) has developed in 2004 an integrated and comprehensive energy master plan for the development of the energy sector over the next 20 years. The objectives of the defined development strategy concentrate on: (i) Modernisation of the national energy sector; (ii) Restructuring of the energy sector to provide the needed energy, particularly under consideration of alternative and renewable energy resources; and (iii) Promotion of private sector participation. On the supply side the main focus for enhancing energy efficiency concentrates on the increase of natural gas as a major source of primary energy for electricity production and the use of combined cycle technology. Key barriers to energy efficiency for the demand-side are: (i) Lack of knowledge by energy users of the benefits of energy efficiency; (ii) Lack of expertise to develop energy efficiency projects; (iii) High initial implementation costs; (iv) Low and partially subsidised tariffs for energy; and (v) Lack of suitable financing mechanisms and of a consistent institutional framework for the development of energy efficiency and renewable energy projects by the private sector. MEMR studies anticipate that approximately 20% of the energy consumption can be saved from the total projected energy consumed in the year 2020, if systematic energy efficiency programs are to be implemented in the country.

Mitigation scenarios for CO<sub>2</sub> emission reduction projects in Jordan, using the net present value method, were analysed for the following areas: (i) Primary energy; (ii) renewable

energy; (iii) energy efficiency; (iv) waste; and (v) agriculture. The results of the mitigation analysis based on unit abatement cost clearly reveal that the most feasible options for CO<sub>2</sub> reduction are energy efficiency projects, followed by fuel switch for energy generation. The abatement unit cost for landfill gas collection, domestic wastewater and renewable energy projects are less feasible. However, the marginality of such projects can be enhanced under Clean Development Mechanism (CDM) through Certified Emission Reduction (CERs) sales revenues.

Consequently, it can be concluded that the planned Energy Efficiency Program (EEP) for WAJ complies with the GOJ's objectives and strategic planning for improved energy generation, utilisation and sustainable GHG reduction.

### **1.3 Project Goal and Indicators**

The main goal of the program will be the systematic and state of the art improvement of energy efficiency in domestic water supply infrastructure in Jordan, comprising optimised groundwater extraction infrastructure, pumping and booster stations and desalination water treatment facilities. The foremost focus of financing under this program is dedicated towards M&E equipment and installations, hydraulic and measuring / automation devices and SCADA systems for remote control, monitoring and documentation. However, for achieving set targets for some of the identified potential projects, supplementary physical investments will be needed for specific system improvements, comprising the enlargement of storage capacities and the restructuring and / or replacement of pumping and transmission mains.

In order to ensure the sustainability of the undertaking and to guarantee a continuous high level of operation efficiency in the long-term perspective, special attention will have to be employed for the planning and implementation of adequate future institutional concepts comprising Energy Savings Performance Contracting (ESPC) and / or performance based O&M Contracting. The preparation of program / project specific assessment studies and baseline concepts, energy auditing, drafting of PSP related contract documents, definition of performance indicators, conceptual design works, tendering of ESPC contracts and construction supervision will be financed through KfW financed consulting contracts whereas the costs related to direct and continuous advisory services to WAJ/PMU, training of staff and any required external technical and financial advisory services during program implementation and the ESPC service period shall be financed from the supporting Accompanying Measures (AM) budget.

The Samra WWTP BOT Project, which started full operation in 2008 is an excellent example of private sector participation in the Jordanian water sector and provides a good basis for implementing similar approaches of PSP under the planned EEP, which comprises competitive bidding and payment for design, supply and installation during the project implementation phases and balanced remuneration of basic fees, recurrent O&M costs and performance related incentive payments during the fixed service period. The benefits associated with PSP / ESPC arrangements are related to: (i) Reduction of energy consumption and therefore decrease of operating costs; (ii) Transfer of technical and financial risk to ESC for the contract period; (iii) Improvement of operational performance;

(iv) Long-term planning approach for energy use; (v) Know-how transfer; (vi) Eco-efficient side effects; and (vii) Access to external private funding (considered to be quite limited at the start of such a program and under still prevailing financial crisis conditions). Indicators measuring the success of the EEP will comprise and be directly related to: (i) Quality of design, supply and installation of facilities; (ii) Maintaining the performance standards and operation quality of the equipment and installations over time; (iii) Quality of the service contractors O&M personnel; and (iv) Working condition of the installations at the end of the service contract period (residual value of assets).

The energy consumption of WAJ in 2007 amounted to about 0,979 GWh and the current emission of GHG per kWh is equivalent to about 0.728 kg CO<sub>2</sub>. Only about 5% of WAJs energy was used for wastewater pumping and treatment and this leads to the assumption that the potential of GHG reduction in the domestic water supply sector in Jordan amounts to about 150,000 t/CO<sub>2</sub> annually, assuming an average overall energy saving potential of about 20% (see [IEES and UNFCCC](#)) for water extraction, pumping and treatment facilities.

The most decisive indicators for measuring the program results are: (i) Achievement of overall pump & motor efficiency ratio in compliance with international standards for each of the rehabilitated facilities; (ii) High level of reliability and sustainability of operation; and (iii) Reduction of energy consumption (kWh, kWh/unit, etc.; see Annex 8) in compliance with the agreed and confirmed planning principles.

## **1.4 Target Group and further relevant Parties**

The program is targeted to bring benefits to all water consumers in the mid and long-term perspective. The electricity cost for the water supply and wastewater service providers, WAJ, the local water authorities, Miyahuna and the Aqaba Water Company are currently highly subsidised. However, the required planned investments for the restructuring and optimisation of Jordan's energy sector will directly impact the future pricing policy for energy through higher and demand specific tariffs. An optimised energy operating concept for water production and pumping is therefore needed in order to counterbalance at least partially the expected negative financial effects for the consumers.

The energy costs of the water service providers in Jordan range from 25% to 40% of total operation costs. A possible substantial decrease of these costs will offer innovative opportunities for the service providers to increase the salaries of their personnel in order to enhance the management and operating capabilities and to provide additional financing for preventive and corrective repair and maintenance services of the assets.

The PSP engagement of local and international companies in the Jordanian water sector is still in an experimental stage. However, the Samra WWTP BOT project (25 years contract period) and the operation contract for the Zara-Ma'een desalination plant (the contract ended in 9/2009) are clearly indicating that the Jordanian authorities are by now willing and prepared to accept such contractual arrangements if the economic and socio-economic advantages are apparent and in the interest of the country. The EEP offers good opportunities to define contractual arrangements for combined work and service contracts which would be attractive for experienced international / local Joint Ventures. The



anticipated know-how transfer of specialised international producers and service providers for M&E installations will enhance the capabilities of directly participating Jordanian operating staff and consequently lead to a larger qualified work force for such services in Jordan.

## **2 Characteristics of the Program Area**

### **2.1 Generalities**

The program area of the planned EEP comprises all parts of Jordan, the Northern Governorates (Irbid, Ramtha, Mafraq, Ajloun and Jerash), the Middle Governorates (Zarka, Balqa, and Madaba), Amman, the Southern Governorates (Karak, Tafila and Ma'an) and the city of Aqaba.

Jordan has a land area of approximately 88,800 km<sup>2</sup> while the area of water bodies amounts to about 500 km<sup>2</sup> which includes both the Dead Sea and the Gulf of Aqaba. Jordan has three distinct ecological zones comprising. (i) The Jordan Valley located below the mean sea level with warm winters and hot summers; (ii) The western highlands where rainfall is relatively high; and (iii) The arid and semi-arid inland to the east. The altitude in Jordan ranges from about -415 m (below mean sea level) at the surface of the Dead Sea up to 1,845 m.a.s.l. In the year 2007, water resources availability amounted to about 867 MCM while the demand was 1,505 MCM thus resulting in a deficit of about 638 MCM (42% of total demand). The deficit is partially made up by the unsustainable use of groundwater through overdrawn of highland aquifers, resulting in lowered water table in many basins and declining water quality in some, also by planned supply rationing to the domestic and agricultural sectors. Only about 35% of the water allocations in 2007 were used for municipal and industrial water supply.

In the year 2008, the total population of Jordan exceeded about 5.9 million. The average population growth rate has decreased from 3.6% in 1996 to currently about 2.3%. Jordan is classified by the World bank as a "lower middle income country". In the year 2006, the per capita Gross Domestic Product (GDP) was JD 1,785 rising from JD 1,106 earned in the year 1995. The Jordanian currency has been stable with an exchange rate fixed to the U.S. dollar since 1995 at about JD 0.708 to 0.710.

### **2.2 The Operator of Water Supply & Wastewater Services**

The Water Authority of Jordan is the responsible lead institution for the financing, management and operation of water supply and wastewater services in the Country. However, as a result of the initiated reform process in recent years some of the management and operation responsibilities have been already delegated to independent water companies, the Jordan Water Company / Miyahuna and the Aqaba Water Company. The Northern Governorates Water Administration (NGWA) is currently in the process of being corporatized whereas all other local water authorities are still under the direct responsibility, guidance and control of WAJ.

The Jordan Water Company – Miyahuna is a limited liability national company which operates under a mandate agreement with the WAJ. The company started its operations from the beginning of 2007 and is responsible for the management of water and sewerage services in Amman. The company has about 1,260 employees, responsible for the provision of water and wastewater services to around 2.6 million citizens. The company enjoys full independence in terms of managing its budget, expenses and returns. However, the WAJ is still responsible for providing the financing necessary for the major water supply investments, the rehabilitation of the initial distribution system and the sewage main projects.

In 2004, the Aqaba Water Company (a limited liability company) started its activities as a legal successor to the Water Authority in Aqaba Governorate. The company is entrusted with the management of water supply and wastewater services for the city of Aqaba (about 115,000 citizens) and the Aqaba Special Economic Zone. The company receives its water from the Disi well field. The water extraction facilities at Disi are still under the direct responsibility of WAJ and the company pays 0.250 JD/m<sup>3</sup> for the bulk supply to the Water Authority.

Preparatory activities for transforming the NGWA into a public company are currently underway. The transformation process, which also includes the temporary assignment of a management contractor, is assisted and financially supported by KfW.

The water and wastewater services in all other districts are still operated by local water authorities under the direct guidance and control of the WAJ.

### **2.3 Program related Infrastructure and Energy Consumption**

The main focus of infrastructure rehabilitation and efficiency improvement under the EEP comprises well field extraction facilities, pumping and booster stations and components of high energetic relevance in water treatment facilities (desalination) and to a lesser extent wastewater pumping and/or treatment facilities, due to the fact that the current energy consumption in the wastewater sector amounts to only about 5% of WAJ's total energy costs and energetic improvements in wastewater treatment are preliminary and directly related to process improvements.

The total number of wells in Jordan for domestic use amounts to about 800 units and the number of pumping stations and booster stations of various sizes is estimated to be in the range of about 150 units.

The WAJ operates at present 23 domestic wastewater treatment plants with a total design flow of about 300,000 m<sup>3</sup>/d. The type of treatment comprises waste stabilization ponds, bio-filter and activated sludge processing. The process efficiency varies between 76% to 99%. The Samra WWTP, the most recently commissioned and by far the largest WWTP in Jordan, produces about 90% of the energy demand for processing through own sources, five biogas engine generators and Pelton turbines at the inlet and Francis turbines at the outlet of the plant. Similar energetic concepts for the reuse of biogas for energy generation have been provided for all recently implemented AS wastewater treatment plants.

The energy cost for all WAJ operations increased from 2003 to 2008 on average by about 9%/year from 35,2 Mill. JD in 2003 to about 50.7 Mill. JD in 2008 at almost unchanged subsidised tariffs of about 0.043 JD/kWh (see Annex 2). The distribution of energy consumption in the supply zones varies considerably, indicating that the energy consumption of Miyahuna represents about 44% of total demand of 0,979 GWh in 2007, followed by the Northern Governorates with a share of about 21%. The energy consumption in the Middle Governorates, the Southern Governorates and Aqaba amounts to 13%, 6% and 4% respectively whereas the remaining 12% are consumed by other WAJ and Operation Centres activities (see Annex 1). The quite considerable annual increase of energy consumption for water supply and wastewater operation in recent years clearly reflects higher water demand figures for a steadily growing population and extended wastewater activities. It may also however be due in part to decreasing efficiencies of M&E installations reflecting low level investments for rehabilitation of aging and worn-out M&E facilities. Only Miyahuna reported that systematic efficiency improvements measures have been carried out for the large pumping and booster stations in recent years. The results of the GTZ/ Dorsch assessment study on pumping stations in the Middle Governorates and the expert's own site visits to Tafila, Ma'an and NGWA clearly show that dedicated efforts and substantial investments are required in order to enhance the appearance and operating efficiency of many of the existing pumping facilities in the country.

## **2.5 Other Actors in the Water Sector**

The defined priorities of the EEP are focused on the rehabilitation and / or replacement of M&E and automation installations for pumping stations and improved well field operation. However, the full integration of ongoing and / or planned activities of other actors in the sector is a necessity in order to mobilise synergy effects and to achieve a maximum of program benefits for the water authority.

The following ongoing activities of other actors need to be carefully considered for the final planning of the EEP: (i) Energy Efficiency Program (BMU, GTZ); (ii) Operations and Management Support in the Middle Governorates (BMZ, GTZ); (iii) Accompanying Measures for WLR in the Northern Governorates and Karak (KfW); (v) FS for the Zarqa Governorate (MCC); (vi) SCADA System for NGWA (Spain); and (vi) Sector investments (JICA).

## **3 Proposed Concept and Design of the Program**

### **3.1 Generalities**

The most reliable available specific key-data for the drafting of a Jordan wide energy efficiency program concept are the findings and results of the BMU/GTZ financed "Assessment Study on Pump Efficiency, Pump Operation and Energy Saving Potential for the Middle Governorates (9/2009)" and the appraisal report prepared by SEVERN TRENT for "Energy Management / Rehabilitation of the Wadi Arab Pumping Scheme (4/2008)".

However, the individual project specific and overall results of the studies evidently reveal the large variety of: (i) Specific project configurations; (ii) Physical conditions of existing

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installations; (iii) Quality and efficiency of O&M interventions; (iv) Overall operating efficiency of the M&E installations; (v) Required total and specific investment costs; (vi) Saving potential in kWh and JD; and (vii) GHG reduction per JD of investment. The extracted details of all investigated cases are presented in Annex 4 and 5.

The variation of key-indicators for the analysed projects are as follows:

Table 3.1: Variation of Key-Indicators of investigated Projects

| No. | Indicator  | Unit                    | Min. Value | Max. Value | Average |
|-----|--|-------------------------|------------|------------|---------|
| 1   | Project specific Investment  | JD                      | 120,000    | 2,500,000  | 735,000 |
| 2   | Present Efficiency of Facility   | %                       | 24         | 60         | 50      |
| 3   | Present Energy Consumption   | Mill. kWh/y             | 0,630      | 79,730     | 13,800  |
| 4   | Planned Improved Efficiency  | %                       | 58         | 70         | 69      |
| 5   | Overall Saving Potential   | %                       | 5          | 66         | 21      |
| 6   | Energy Saving Potential  | Mill. kWh/y             | 0,240      | 16,340     | 3,000   |
| 7   | Cost Saving Potential  | JD/ year                | 10,000     | 700,000    | 125,000 |
| 8   | GHG Reduction Potential  | t CO <sub>2</sub> /year | 200        | 12,000     | 2,200   |
| 9   | Specific Investment for GHG Reduction  | JD/ t CO <sub>2</sub>   | 100        | 950        | 340     |
| 10  | Pay-back on Investment   | years                   | 4          | 16         | 6       |
| 11  | Specific Investment Cost for M&E, hydraulic and automation equipment and installation. | EUR/kW                  | 400        | 1,000      | 725     |
| 12  | Investment for complementary Works   | %                       | 0          | 100        | 45      |

Based on the detailed results of about 16% of the total pumping station infrastructure in Jordan it can be concluded that the overall average efficiency potential for existing pumping facilities amounts to about 20% and that the required specific investment cost for each tonne per year of GHG reduction will be in the range of 300 to 350 JD. The extracted key-indicators as stated above have been used for the drafting of the present EEP basic concept. However, it should be noted that project specific assessments with regard to Miyahuna and the Southern Governorates are based as well on information provided by the operators to the expert during his site visits together with his own professional judgement.

The institutional concepts proposed by the Improvement of Energy Efficiency Study (IEES) comprise the following contractual arrangements: (i) Energy Savings Performance Contracting (ESPC), full financing by the Contractor and 10 years service period; (ii) Shared ESPC Investment; (iii) External Investment and Extended Maintenance Guarantee; and (iv) External Investment and Performance based O&M Contract. For an overall investment of about 10million EUR the study proposes to split the future O&M of the rehabilitated pumping facilities into at least six individual contracts of the various listed above. The institutional concepts proposed by the authors of the study are preliminarily based on the calculated pay-back period. Projects with a short pay-back on energy investment period are considered to be qualified for ESP Contracting whereas all other projects with a relatively reduced individual saving potential and a long pay-back period have been listed as performance based O&M or extended maintenance guarantee period undertaking. The total assessed saving potential amounts to about 0,921 million EUR which translates into a contract specific average annual saving of only about 150,000

EUR/year (max. 300,000 EUR; min. 20,000 EUR). The existing Jordanian / International market study reveals that most of the reputable international pump producers are only represented in Jordan by their sales offices, with a main focus on private clients and the existing small local workshops are not yet sufficiently qualified for a full fledged ESPC, which comprises detailed design, supply of high quality M&E and automation equipment, installation, performance based delivery and servicing and fully remote controlled operation, monitoring and documentation. The assessment of operation functionality of pumping stations made apparent that the product quality of pumps, motors, measuring and automation devices has declined in recent years, probably due to the application of less stringent technical specifications in the purchase processes and an apparent lack of systematic and adequate repair and maintenance means and capabilities in WAJ's central workshop. Consequently, it can be concluded that ESPC contracts under the EEP must be technically and financially shaped in such a way that best performing international actors / producers feel attracted by the challenge to demonstrate the economic added value of high quality products in the long-term perspective.

### **3.2 Program Concept and proposed Priorities**

The final identification of prioritised specific projects to be financed under this initial phase of the EEP definitely requires more detailed case by case investigations as already executed under the IEES for the eleven pumping stations in the Middle Governorates. However, the proposed basic concept has been elaborated at this early preparatory stage on readily available data only. The following principles have been applied for assessing the need of investments and the anticipated energy saving potential in the distinctive program areas:

- Investment cost estimates are based on unit cost per KW of installed power output;
- An estimated need for rehabilitation factor has been applied individually for areas where detailed planning data are not yet available;
- Project related complementary investment measures (reservoirs, pumping and transmission mains, etc.) have been considered as a fixed percentage of the estimated M&E costs; and
- The overall investment cost assessment comprises additionally 20% for physical and financial contingencies and 10% for consulting services.
- **Northern Governorates:** The Wadi-Arab Option 2 project is considered to be a priority project and the data from the existing study have been used. The remaining installed power amounts to about 16,000 KW and it has been assumed that need for rehabilitation comprises about 35%.
- **Middle Governorates:** The existing IEES covers about 70% of the energy consumption in the Governorate. The data provided in the study have been used and all identified projects are rated as priority for financing under the EPP excluding the two projects earmarked for JICA financing. The ongoing MCC financed studies will provide more detailed data about the situation and performance of the two major well field in the Zarqa district at the end of 2010.

- **Miyahuna:** The two major pumping stations and water treatment facilities (Zai and Zara-Ma'een) represent about 70% of Miyahuna's total energy demand. The facilities are operating at good performance levels with an apparent but quite reduced optimisation potential. Presently, Miyahuna is in the process of improving the efficiency of pumping and booster stations in the network. Priority assistance under the EPP is proposed for the efficiency improvements in the network pumping facilities.
- **Southern Governorates:** Detailed data about the performance of pumping stations in Karak are available through the ongoing KfW financed WLR project. A rehabilitation factor of 30% has been considered. The pumping facilities in Tafila are in relatively good condition. The applied rehabilitation factor is 50%. The site visit to Ma'an revealed that major investments are needed in order to improve the overall and long-term performance and functionality of existing well field and pumping facilities. The estimated rehabilitation factor is 70%.
- **Aqaba Water Company:** The company receives bulk water supply from the Disi well field. The 32 wells of the Disi well-field are still managed and operated by WAJ. The applied rehabilitation factor is 40%.

The above stated assumptions have been taken into account for a preliminary estimate of O&M related investment cost. In summary it can be concluded that about 50% of the projected costs are confirmed through the existing studies for Wadi Arab and the Middle Governorates whereas the remaining budget allocation is based on the expert's professional assessment of prioritised rehabilitation needs in the remaining program areas (see Annex 7).

The existing studies confirm an average energy saving potential of about 21%. The same saving factor has been applied for the proposed rehabilitation projects in the other program areas. However, by taking into consideration the already achieved efficiency status of the companies (e.g. Miyahuna) and the applied reduced overall rehabilitation factor and corresponding financing under this initial program phase the global area related energy efficiency improvement only translates into 2% for Miyahuna, 10% for the Southern Governorates and 8% for Aqaba (see Annex 8).

The proposed program approach foresees the implementation of energy efficiency projects in all parts of the country. The estimated overall saving potential amounts to about 2,4 million EUR/year with a corresponding annual GHG reduction of about 38,000 t CO<sub>2</sub>/year.

### **3.3 Coordination with other relevant Projects**

The EEP is intended to be a supplementary financing tool, specifically tailored for the implementation of energy efficiency related measures, leading to sector related reduced GHG emissions and a sustainable decrease of operating costs. However, the measures foreseen under the program must be fully compatible with and supplementary to other sector related activities. The elaboration of the final EEP approach shall be based on data and information extracted from ongoing WLR projects and technical assistance programs

financed by BMZ and BMU, the MCC financed feasibility studies for Zarqa (consultancy services for the preparation of feasibility, environmental and social impact assessment studies for Zarqa water wells, water supply and sewer network rehabilitation and extension measures started in late 2009 and are expected to be submitted at the end of 2010), planned rehabilitation programs of Miyahuna and under consideration of confirmed JICA financing for infrastructure measures (project related specific budget allocation is still in the negotiation and final decision making process) and the planned Spanish financing of a SCADA system for the NGWA (under preparation).

### **3.4 Outsourcing of System Operation to Private Enterprises**

The creation of the Aqaba Water Company in 2004 and the Jordan Water Company - Miyahuna in 2007 in the form of limited liability national companies, operating under a mandate agreement with the Water Authority of Jordan, can be considered as a first step in the Jordan Water Sector to outsource management and operation responsibilities to independently acting bodies with the objective of improving service quality and reliability, optimising revenues, costs structures and monitoring and documentation processes. The Samra WWTP BOT project, which started operation in 2008 and will be serviced by the company for 25 years, underlines the GoJ's strong intention and willingness to integrate the competence of private companies into the water business in Jordan. Despite the fact that the Samra project has still to prove its combined technical and economic benefits for the country, basic lessons learnt from the initial discussions between the concerned stakeholders, the drafting of contract documents and the current monitoring of the undertaking by the WAJ/PMU will be of value for the creation of envisaged similar PSP arrangements as envisaged under the EEP.

The potential target groups for future PSP contract arrangements in the Jordanian Market have been investigated as an integral part of the GTZ IEES study. In general it can be concluded that: (i) All relevant international M&E supply companies are represented in Jordan; (ii) Only a few local consultant companies, supported by international partners, are involved in the planning and execution of pumping stations including all electromechanical equipment; and (iii) Some small local private workshops are enhancing their capabilities and capacities for the operation and maintenance of water sector related private and public M&E facilities. However, the basic conclusion of the market analysis reveals that the public Jordan water market is at present not attractive for the most competent international pump suppliers. The EEP would offer a good opportunities to attract these highly proficient companies by integrating design, supply, installation and the long-term operation of pumping facilities in a single contract arrangement. The higher prices of good quality products can be undoubtedly compensated by lower operating and maintenance costs and enhanced efficiency in the long-term perspective, which would be surely in the interest of WAJ and the final beneficiaries, the consumers.

The advantages and shortfalls of the four institutional concepts proposed by the IEES for private sector participation under the EEP are reviewed as follows:

- **Extended Maintenance Guarantee Period:** This contractual arrangement is normally used for bridging the transition period between the end of construction and

full functionality of the operator. The remuneration is at cost and the contractors responsibilities are limited to general operation and maintenance activities for a limited time span. The contractual arrangement is therefore considered to be inadequate for achieving the EEP objectives.

- **ESPC – 100% financing through Private Company:** A full-fledged ESPC constitutes the optimum solution for such performance based undertakings. However, at present it seems to be unrealistic that contractors can be found due to the fact that the financial crisis still limits the cash situation of companies and the lack of reference projects of similar type in Jordan. Moreover, it should be noted that the private injection of capital will be at much higher recurrent costs compared to the financing of international DPs.
- **Performance based O&M Contract:** A performance based contract excludes the design, supply and installation of M&E, measuring and SCADA installations. However, the initial quality and compatibility of all project components is of decisive importance for the long-term performance and effectiveness of the facilities. The contractor's tasks comprise an adequate operation of the installation but with limited direct responsibility for system and / or component failures. Consequently, this leads to the conclusion that the incorporation of incentive payments will be limited and of a rather fragile nature.
- **ESPC – Mainly external Investment:** The ESPC, with mainly external financing, constitutes the most beneficial institutional concept for the EEP. The contractor's combined responsibility for the construction and the 10 years service period will ensure that high quality products at elevated costs will be installed but balanced through the contractor's envisaged planning of reduced recurrent operating costs and absolutely minimised system and / or component failures. However, reputable and competent international / Jordanian JVs will be only attracted by the planned undertaking if economies of scale are ensured, which means that the overall contract value must be large enough to cover any initial and recurrent fixed costs needed to enter the Jordanian market. Due to the still prevailing unfavourable conditions of the international financial crisis it is recommendable to limit the private financing to not more than 10%.

The EEP offers an excellent opportunity for introducing ESPC into the Jordanian water sector. [The ESPC with mainly external financing is considered to be the most practicable and beneficial contractual arrangement for enhancing the operating reliability and efficiency of all larger pumping facilities in Jordan.](#) The initiation of this form of PSP driven construction and operating contracts requires a thorough assessment of the current project related situation, the execution of energy audits under full participation of all concerned stakeholders, the drafting of matching but well balanced contract documents, the pre-qualification of competent and experienced suppliers / contractors and the creation of a qualified unit at WAJ/PMU for initiating, planning, overseeing and monitoring the process over time.



### **3.5 Complementary Program related Support Measures**

The initiation and preparation of primary documents for the EEP were financed by BMU and executed through GTZ in close cooperation with WAJ/PMU. The still ongoing GTZ assistance program comprises the financing of the assessment studies for the Middle Governorates, the elaboration of institutional concepts for contracting, the execution of energy audits and continuous professional support to WAJ/PMU for developing ideas of how to implement water related energy efficiency projects in Jordan.

Without doubt, the completely new character of the EEP approach requires the creation of a specific and professionally well qualified **new EEP-Unit** at WAJ/PMU for the planning and handling of the EEP projects. This unit shall be composed of experts with technical, financial and legal background, preferably with the constant support of a team of international experts of proven subject-related experience. For enhancing systematically the capabilities of WAJ's EEP team it is indispensable that international and local training measures shall be considered as an important and integral part of the **envisaged complementary program measures**. The **CM** shall also include the intermittent financing of specialised external technical and financial expertise during the implementation period and the 10 years service period. An initial assessment of estimated costs for **complementary program measures** can be summarised as follows:

- Technical Assistance to **the required new "EEP Unit"** (for about 3 years): 500,000 EUR
- International and local training measures: 100,000 EUR
- External advisory services during implementation: 150,000 EUR
- External advisory services during the 10 years Service Period: 250,000 EUR
- **Total: Complementary Program Measures (CM) 1,000,000 EUR**

**Note:** Basic assessment studies, carrying out of energy audits, conceptual design, preparation of tender and contract documents, tendering, construction supervision and commissioning of works shall be executed - in compliance with KfW's financing rules and procedures – by international/ local consulting firms.

### **3.6 Implementation Schedule and Milestones**

The implementation of the EEP can tentatively be sub-divided in to the following four distinctive phases: (i) The program approval phase comprises the KfW/WAJ program appraisal, the final program approval from BMZ and the GoJ and the formal readiness for disbursement; (ii) The project preparation phase consist of the tendering and engagement of consultants, the execution of basic assessment studies and energy audits and the preparation and tendering of ESPCs; (iii) The project execution phase; and (iv) The ESPC service period.

The major milestones for program implementation can be tentatively defined as follows:

- Readiness for disbursement: June 2010 (Start of Program) (S+0)
- Contracting of Consultant(s): July to **December 2010** (S+1 to S+6)
- Preparatory Consulting Services: **January to September 2011** (S+7 to S+16)
- Tendering & Award of ESPCs: **October 2011 to March 2012** (S+17 to S+22)

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- Project Implementation Phase: **April 2012 to September 2013** (S+23 to S+40)
- ESPCs Service Period: **October 2013 to September 2023** (10 years)

The envisaged implementation of all proposed EEP projects within a period of about 18 months is based on the assumption that up to three individual ESP contracts will be awarded. The tendering and award of three separate contracts under this initial EEP will ensure competitive bidding conditions but still provide reasonable scale of economies for interested international / Jordanian suppliers and service providers of excellent reputation and experience.

## **4 Institutional and Organisational Set-up**

### **4.1 Overall Framework Conditions in the Sector**

Within the Ministry of Water and Irrigation, WAJ is the assigned responsible authority for all water supply and wastewater related activities and services in Jordan. The Water Authority Law of 1988 gave the status of Independent Public Corporation to WAJ which comprises functions of financial and administrative autonomy. In order to strengthen and enhance the management and operation performance of local water authorities, WAJ, with the support of international DPs, created in 2004 and 2007 respectively limited liability companies for Aqaba (Aqaba Water Company) and Amman (Miyahuna). The positive achievements of these semi-autonomous companies in recent years tends to promote the creation of similar organisational set-ups for other regions and will certainly open-up new opportunities for Jordanian and international PSP in the Jordanian water sector. In the mid and long-term perspective WAJ intends to delegate operation responsibilities and to concentrate on regulatory issues only.

### **4.2 The Program Executing Agency**

WAJ employs at present a total staff of about 7,500 people with a staff ratio of 6 staff / 1,000 HCs for water supply services. The current overall NRW rate of about 43.6% for all service areas is still above the envisaged target of 41% planned for 2007 but tentatively promising developments have been recorded in the recent past for some service areas. The operating costs, with energy expenditures ranging from about 25% to 40% of total O&M costs, were covered in 2007 by about 137% whereas the total cost coverage (including capital cost and depreciation) still falls short at only about 65%.

WAJ, the execution agency for the EEP, will be responsible for the structuring, planning, implementation and monitoring of all program related activities. The water authority has qualified staff of all disciplines required for the formation of a special in-house management unit for the EEP which should be preferably be an integral part of the already existing PMU. The PMU's acquired broad range of management experiences in recent years and especially with regard to the planning and implementation of the Samra WWTP BOT project shall be used as a positive strategic asset for the implementation of the EEP. However, training of staff and a continuous and sustained advisory support shall be provided in order to guarantee a successful and state of the art implementation of the

water sector related energy efficiency and energy saving measures through the envisaged ESPC arrangements.

## **5 Program Costs and Financing**

### **5.1 Investment Cost Assessment**

The proposed tentative investment cost assessment is essentially based on the following assumptions: (i) The investment cost for already investigated projects are identical with the estimates provided in the corresponding studies; (ii) Unit cost of 500 to 725 EUR/KW installed power have been applied for the complete rehabilitation / replacement of existing pumping facilities; (iii) A percentage of about +75% has been added for project related complementary investment measures; (iv) A percentage of 20% has been applied for physical and financial contingencies; and (v) The anticipated expenditures for consulting services represent about 10% of the earmarked total EEP budget of 27.5 million EUR. The projected investment in the five distinctive program areas varies between a low value of only about 10% for Aqaba and 35% for the Middle Governorates. The foreign cost portion is estimated to be in the range of about 55%. A summary of proposed investment costs is presented in table 5.1 below (for details, see Annex 7)

*Table 5.1: Investment Cost Assessment*

| No. | Description   | Total Investment Cost |               | Foreign Cost Portion |           |
|-----|---|-----------------------|---------------|----------------------|-----------|
|     |   | %                     | Mill. EUR     | Mill. EUR            | %         |
| 1   | Energy Efficiency related direct Investment Cost          |                       |               |                      |           |
|     | Northern Governorates                                     |                       | 2,481         | 1,736                |           |
|     | Middle Governorates                                       |                       | 4,087         | 2,861                |           |
|     | Southern Governorates                                     |                       | 2,491         | 1,743                |           |
|     | Miyahuna  |                       | 1,909         | 1,337                |           |
|     | Disi Well field (Aqaba)                                   |                       | 1,136         | 0,795                |           |
|     | <b>Total 1: Energy Efficiency related Investment Cost</b> | <b>44</b>             | <b>12,105</b> | <b>8,473</b>         | <b>70</b> |
| 2   | Program related complementary Investment Measures         | 31                    | 8,408         | 2,972                | 35        |
| 3   | Physical and Financial Contingencies                      | 15                    | 4,102         | 2,051                | 50        |
| 4   | Consulting Services                                       | 10                    | 2,883         | 1,730                | 60        |
|     | <b>GRAND Total: 1 to 4</b>                                | <b>100</b>            | <b>27,500</b> | <b>15,227</b>        | <b>55</b> |

### **5.2 Operating Cost and Incentive Schemes**

The operating data of all water authorities / companies in Jordan indicate that the expenditures for energy are extremely high in comparison to actual staff cost, recurrent expenditures for preventive and corrective maintenance and repair measures and all other service related expenses. This is despite the fact that WAJ's current tariff of 0.043 JD/kWh for electricity is highly subsidised, only representing about 66% of the average tariff paid by principal consumers in Jordan. Any likely increased adaptation of WAJ's electricity tariffs in the near future will therefore decisively and negatively impact the operators balance sheets whereas a substantial and sustainable decrease of energy consumption

will set off additional financial resources for enhanced salary payments and an overall better service performance.

For achieving the goal of an improved energy efficiency level for water extraction and pumping facilities in Jordan it is principally anticipated that private sector participation shall provide the required quality products, technology, management know-how and operation experiences necessary for keeping any newly installed facilities at highest operation and performance standards for the future. However, PSP in Jordan's water sector will have to be seen under consideration of the following financial consequences: (i) Staff cost for operating the facilities can be kept at similar levels by assuming that the engagement of fewer but more qualified staff will be counterbalanced by reduced overall staff numbers; (ii) Recurrent maintenance and repair cost can be reduced by installing only high quality products; (iii) Effective utilisation ratios of installations will be considerably enhanced through applied integrated performance analysis devices, systematic preventive maintenance and readily available spare parts; but (iv) Apparent recurrent fixed cost of the private enterprises for maintaining high quality service levels for the project and in the country must be remunerated additionally, as part of the performance incentive payments from the "energy saving budget".

Principally it is expected that PSP shall keep the overall operating expenditures at similar or preferably lower levels but with significantly improved economic benefits for the water authority and a positive environmental impact for Jordan in the long-term perspective.

### **5.3 Profitability Assessment**

For assessing the financial effect and consequences of the EEP investment on WAJ in the coming years, a basic profitability assessment has been elaborated under consideration of the following assumptions:

- The profitability assessment only considers the program specific investment costs and the estimated energy savings (other revenues and operating costs have been left out of the calculation);
- Investment costs have been separately calculated for the EEP relevant M&E project components and other project related complementary investment measures;
- The effective life span of assets has been set at 15 years for the M&E installations and at 25 to 40 years for other civil works;
- The current tariff of 0.043 JD/kWh has been applied for the calculation of energy savings;
- The GHG reduction is based on the equivalent of 0.728kg CO<sub>2</sub> emission per kWh;
- The program preparatory and implementation period covers 3 years (2010 to 2012) and the ESPC service period 10 years (2013 to 2022);
- The basic incentive payment for the ESP contractor has been set at 50% of energy savings, constant over the service period;
- A tariff increase of 5% annually has been considered; and
- A discount rate of 3% has been applied.

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For testing the sensitivity of total and only directly EEP related investments on pay-back period, net present value and specific cost for GHG reduction, two basic scenarios have been elaborated (for details, see Annex 8.1 and 8.2). The results are as follows:

Table 5.3: Results of basic Profitability Assessment

| No. | Description                                | Unit                   | Total Investment | EEP related Investment only |
|-----|--|------------------------|------------------|-----------------------------|
| 1   | Pay-back Period                            | years                  | > 10             | 9 to 10                     |
| 2   | Net Present Value at end of Service Period | Mill. EUR              | -4,6             | 1,4                         |
| 3   | Specific Investment for GHG Reduction      | EUR/ t CO <sub>2</sub> | 75               | 46                          |

The sensitivity analysis tentatively indicates that the return on investment shall be in a feasible range only in case that directly EEP related investments are applied. This leads to the conclusion that complementary measures, if required, shall be executed under the EEP but that their economic feasibility needs to be justified in the a broader sense, under full consideration of revenues and costs in the respective supply and service areas.

### 5.4 Financing

The estimated investment cost of the present initial phase of the EEP amounts to 27.5 million EUR, with 80% of investment cost (22 million EUR) financed with a KfW loan and the remaining 20% (5.5 million EUR) financed by the GoJ. The KfW loan conditions, both, transfer and on-lending conditions, are as follows: (i) Interest Rate - ... % p.a.; (ii) Term - ... years; and (iii) Grace Period - ... years.

The anticipated financing of [Complementary Program Measures of max. 1.0 million EUR](#) comes half from a KfW grant and half from the beneficiary.

## 6 Environmental Considerations and Impact

A substantial and sustainable reduction of overall and specific energy consumption in the water sector will constitute an effective impact on the environment and will positively support Jordan's contribution on climate change. The energy savings in the water sector will reduce Jordan's need of importing primary energy in form of petroleum and natural gas from neighbouring countries and will relieve pressure on investments for the renovation and expansion of power generating facilities in the country.

There are no negative environmental impacts associated with the rehabilitation and reconstruction of pumping stations and the planned improvement of well-field pumping and associated automation installations shall have sustained positive effects on the efficiency of groundwater exploitation in Jordan. However, some negative environmental impacts are always associated with the construction of any civil works (complementary investment measures). Such impacts include noise, dust and exposure of the public to the dangers of open excavation and increase in traffic. Measures to mitigate these impacts shall be built into the project design and will have to be implemented, controlled and monitored together with the rest of the works.

## **7 Risk Assessment**

Generally it can be stated that the EEP approach is matching urgent requirements of energy related improvement measures in the Jordanian water sector. The need for enhancing energy efficiency and for optimising the operation of pumping facilities is well recognised by all concerned stakeholders.

The overriding handicap in the Jordanian water sector is the fact that tariffs are still too low for full cost coverage and financial sustainability. The likely ending of subsidised electricity tariffs for the water sector will build up additional pressure for tariff increases in the future. A systematic implementation of energy efficiency measures can partially counterbalance the effects of rising cost but the main obstacles for achieving this goal is directly related whether such measures can be successfully implemented with WAJ's own resources (Miyahuna as an exception, might be considered as being capable for implementing such measures on its own) and to whether PSP in the program will be an attractive and economically viable option.

The Samra BOT contract indicates that the GoJ is willing to accept PSP in the water sector. However, the suspension of the O&M contract for the Zara-Ma'een desalination plant in September 2009 makes it quite apparent that the pros and cons for PSP in the sector are still under discussion. A decision about the kind of appropriate and acceptable private sector participation under the EEP has to be mutually agreed upon by WAJ and KfW during program appraisal. Moreover, the success of the undertaking depends first and foremost on comprehensiveness and quality of program / project preparation and attractiveness for private enterprises with regard to contractual concept, size, complexity and remuneration.

## **8 Conclusion**

The present program preparatory report is intended to assess the appropriateness of the planned EEP for Jordan and to investigate and recommend basic favourable technical options for implementation.

In summary it can be concluded that the Jordanian water sector offers good and substantial opportunities for the implementation of energy efficiency projects. However, more detailed investigations are required in order to define the specifics of some of the proposed projects to be financed under this program in more depth. The EPP offers good prospects for the outsourcing of energy efficiency related activities to the private sector but it is still vague if and under what conditions international / Jordanian companies might be attracted by the program. The results of a preliminary profitability assessment indicate that the planned program measures are feasible, with economic benefits for the WAJ in the mid and long-term perspective.

*Neu-Isenburg, 28.2.2010*

*Dipl.-Ing. Jürgen Bickert*

## **ANNEXES**

- Annex 1 Energy Consumption for Water Supply and Wastewater in 2007
- Annex 2 Increase of Energy Cost (2003 to 2008)
- Annex 3 Estimated Total New Value of Pumping Facilities
- Annex 4 Summary of assessed Energy Saving Potential (GTZ / September 2009)
- Annex 5 Basic General Assessment of Energy Saving Potential (December 2008)
- Annex 6 Tentative Implementation Schedule
- Annex 7 Proposed prioritised Investment Cost Assessment under the EEP
- Annex 8 Financial Appraisal of EEP Investment (Profitability Analysis)
- Annex 9 Umweltanlage
- Annex 10 List of Personnel Contacted and List of Documents
- Annex 11 Photo Documentation

**Energy Consumption for Water Supply and Wastewater in 2007**

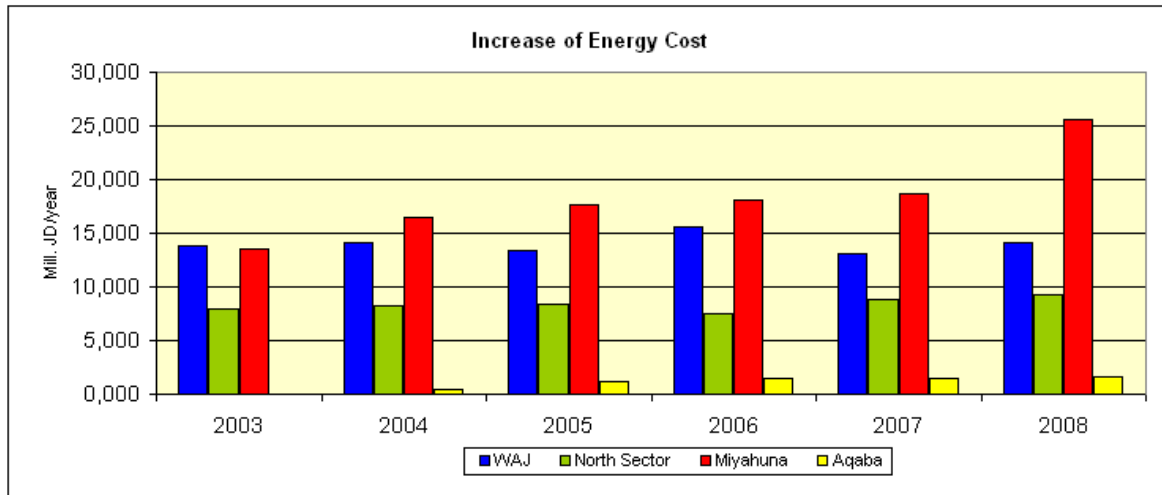
| No.      | Description                     | Total                          |                     |                              | Water Supply                   |                                       | Wastewater                     |                              |
|----------|---------------------------------|--------------------------------|---------------------|------------------------------|--------------------------------|---------------------------------------|--------------------------------|------------------------------|
|          |                                 | Energy Cons.<br>Mill. kWh/year | Share of Total<br>% | Energy Cost<br>Mill. JD/year | Energy Cons.<br>Mill. kWh/year | Energy Cost<br>0,043<br>Mill. JD/year | Energy Cons.<br>Mill. kWh/year | Energy Cost<br>Mill. JD/year |
| <b>1</b> | <b>Northern Governorates</b>    |                                |                     |                              |                                |                                       |                                |                              |
|          | Irbid                           | 45,025                         | 4,6%                | 1,936                        | 36,956                         | 1,589                                 | 8,069                          | 0,347                        |
|          | Mafrqa                          | 65,560                         | 6,7%                | 2,819                        | 65,374                         | 2,811                                 | 0,186                          | 0,008                        |
|          | Ajjloun                         | 11,537                         | 1,2%                | 0,496                        | 11,246                         | 0,484                                 | 0,291                          | 0,013                        |
|          | Jerash                          | 5,773                          | 0,6%                | 0,248                        | 5,012                          | 0,216                                 | 0,761                          | 0,033                        |
|          | Ramtha                          | 10,354                         | 1,1%                | 0,445                        | 6,285                          | 0,270                                 | 4,069                          | 0,175                        |
|          | <b>Sub-TOTAL 1:</b>             | <b>138,249</b>                 | <b>14%</b>          | <b>5,945</b>                 | <b>124,873</b>                 | <b>5,370</b>                          | <b>13,376</b>                  | <b>0,575</b>                 |
| <b>2</b> | <b>Middle Governorates</b>      |                                |                     |                              |                                |                                       |                                |                              |
|          | Zarka                           | 60,570                         | 6,2%                | 2,605                        | 50,850                         | 2,187                                 | 9,720                          | 0,418                        |
|          | Al Balqa'a                      | 39,162                         | 4,0%                | 1,684                        | 33,917                         | 1,458                                 | 5,245                          | 0,226                        |
|          | Madaba                          | 8,355                          | 0,9%                | 0,359                        | 5,201                          | 0,224                                 | 3,154                          | 0,136                        |
|          | <b>Sub-TOTAL 2:</b>             | <b>108,087</b>                 | <b>11%</b>          | <b>4,648</b>                 | <b>89,968</b>                  | <b>3,869</b>                          | <b>18,119</b>                  | <b>0,779</b>                 |
| <b>3</b> | <b>Amman</b>                    |                                |                     |                              |                                |                                       |                                |                              |
|          | Amman                           | 433,291                        | 44,2%               | 18,632                       | 432,252                        | 18,587                                | 1,039                          | 0,045                        |
|          | <b>Sub-TOTAL 3:</b>             | <b>433,291</b>                 | <b>44%</b>          | <b>18,632</b>                | <b>432,252</b>                 | <b>18,587</b>                         | <b>1,039</b>                   | <b>0,045</b>                 |
| <b>4</b> | <b>Southern Governorates</b>    |                                |                     |                              |                                |                                       |                                |                              |
|          | Karak                           | 31,340                         | 3,2%                | 1,348                        | 31,291                         | 1,346                                 | 0,049                          | 0,002                        |
|          | Tafila                          | 12,693                         | 1,3%                | 0,546                        | 12,473                         | 0,536                                 | 0,220                          | 0,009                        |
|          | Ma'an                           | 13,735                         | 1,4%                | 0,591                        | 13,512                         | 0,581                                 | 0,223                          | 0,010                        |
|          | <b>Sub-TOTAL 4:</b>             | <b>57,768</b>                  | <b>6%</b>           | <b>2,484</b>                 | <b>57,276</b>                  | <b>2,463</b>                          | <b>0,492</b>                   | <b>0,021</b>                 |
| <b>5</b> | <b>Aqaba</b>                    |                                |                     |                              |                                |                                       |                                |                              |
|          | Aqaba                           | 34,498                         | 3,5%                | 1,483                        | 28,609                         | 1,230                                 | 5,889                          | 0,253                        |
|          | <b>Sub-TOTAL 5:</b>             | <b>34,498</b>                  | <b>4%</b>           | <b>1,483</b>                 | <b>28,609</b>                  | <b>1,230</b>                          | <b>5,889</b>                   | <b>0,253</b>                 |
| <b>6</b> | <b>WAJ (other general uses)</b> |                                |                     |                              |                                |                                       |                                |                              |
|          | WAJ                             | 72,648                         | 7,4%                | 3,124                        |                                |                                       |                                |                              |
|          | Northern Sector                 | 67,996                         | 6,9%                | 2,924                        |                                |                                       |                                |                              |
|          | Zarka Coridor                   | 11,556                         | 1,2%                | 0,497                        |                                |                                       |                                |                              |
|          | Operation Centers               | 55,113                         | 5,6%                | 2,370                        |                                |                                       |                                |                              |
|          | <b>Sub-TOTAL 6:</b>             | <b>207,313</b>                 | <b>21%</b>          | <b>8,914</b>                 | <b>0,000</b>                   | <b>0,000</b>                          | <b>0,000</b>                   | <b>0,000</b>                 |
|          | <b>TOTAL 1 to 6:</b>            | <b>979,206</b>                 | <b>100%</b>         | <b>42,106</b>                | <b>732,978</b>                 | <b>31,518</b>                         | <b>38,915</b>                  | <b>1,673</b>                 |

| Energy Consumption by Sector (% of Total) |     |
|---|-----|
| Water Supply / Pumping                    | 75% |
| Wastewater                                | 4%  |
| WAJ (other general uses)                  | 21% |



**Increase of Energy Cost / Expenses (2003 to 2008)**

| No.                  | Year         | Energy Cost in JD |               |               |               |               |               | Increase of Cost |                |
|----------------------|--------------|-------------------|---------------|---------------|---------------|---------------|---------------|------------------|----------------|
|                      |              | 2003              | 2004          | 2005          | 2006          | 2007          | 2008          | Total            | Annual Average |
|                      |              | Mill. JD/year     | Mill. JD/year | Mill. JD/year | Mill. JD/year | Mill. JD/year | Mill. JD/year | %                | %/year         |
| 1                    | WAJ          | 13,785            | 14,058        | 13,361        | 15,559        | 13,123        | 14,190        | 103%             | 1%             |
| 2                    | North Sector | 7,977             | 8,212         | 8,406         | 7,448         | 8,869         | 9,323         | 117%             | 3%             |
| 3                    | Miyahuna     | 13,457            | 16,529        | 17,657        | 18,156        | 18,632        | 25,657        | 191%             | 18%            |
| 4                    | Aqaba        |                   | 0,452         | 1,246         | 1,407         | 1,483         | 1,565         | 346%             | 49%            |
| <b>TOTAL 1 to 4:</b> |              | <b>35,220</b>     | <b>39,252</b> | <b>40,669</b> | <b>42,570</b> | <b>42,106</b> | <b>50,735</b> | <b>144%</b>      | <b>9%</b>      |



**Estimated Total New Value of Pumping Facilities**

(Pumps, motors, piping, measuring devices, electrical and SCADA equipment and installations)

| No.      | Description                  | Energy Consumption<br>2007 <sup>1)</sup> | Energy Cost<br>2007 <sup>1)</sup> | Estimated<br>Installed<br>Power <sup>2)</sup> | Investment<br>Cost<br>per KW<br>Output <sup>3)</sup> |
|----------|------------------------------|--|-----------------------------------|---|--|
|          |                              | Mill. kWh/year                           | Mill. JD/year                     | 20<br>8760<br>KW                              | 725<br>Mill. JD                                      |
| <b>1</b> | <b>Northern Governorates</b> |  |                                   |   |  |
|          | Irbid                        | 36,956                                   | 1,589                             | 5.062   | 3,670  |
|          | Northern Sector              | 67,996                                   | 2,924                             | 9.315   | 6,753  |
|          | Mafraq                       | 65,374                                   | 2,811                             | 8.955   | 6,493  |
|          | Ajloun                       | 11,246                                   | 0,484                             | 1.541   | 1,117  |
|          | Jerash                       | 5,012                                    | 0,216                             | 687   | 0,498  |
|          | Ramtha                       | 6,285                                    | 0,270                             | 861   | 0,624  |
|          | <b>Sub-TOTAL 1:</b>          | <b>192,869</b>                           | <b>8,293</b>                      | <b>26.420</b>                                 | <b>19,155</b>  |
| <b>2</b> | <b>Middle Governorates</b>   |  |                                   |   |  |
|          | Zarka                        | 50,850                                   | 2,187                             | 6.966   | 5,050  |
|          | Zarka Coridor                | 11,560                                   | 0,497                             | 1.584   | 1,148  |
|          | Al Balqa'a                   | 33,917                                   | 1,458                             | 4.646   | 3,368  |
|          | Madaba                       | 5,201                                    | 0,224                             | 712   | 0,517  |
|          | <b>Sub-TOTAL 2:</b>          | <b>101,528</b>                           | <b>4,366</b>                      | <b>13.908</b>                                 | <b>10,083</b>  |
| <b>3</b> | <b>Amman</b>                 |  |                                   |   |  |
|          | Amman                        | 432,252                                  | 18,587                            | 59.213  | 42,929   |
|          | <b>Sub-TOTAL 3:</b>          | <b>432,252</b>                           | <b>18,587</b>                     | <b>59.213</b>                                 | <b>42,929</b>  |
| <b>4</b> | <b>Southern Governorates</b> |  |                                   |   |  |
|          | Karak                        | 31,291                                   | 1,346                             | 4.286   | 3,108  |
|          | Tafila                       | 12,473                                   | 0,536                             | 1.709   | 1,239  |
|          | Ma'an                        | 13,512                                   | 0,581                             | 1.851   | 1,342  |
|          | <b>Sub-TOTAL 4:</b>          | <b>57,276</b>                            | <b>2,463</b>                      | <b>7.846</b>                                  | <b>5,688</b>   |
| <b>5</b> | <b>Aqaba</b>                 |  |                                   |   |  |
|          | Aqaba                        | 28,609                                   | 1,230                             | 3.919   | 2,841  |
|          | <b>Sub-TOTAL 5:</b>          | <b>28,609</b>                            | <b>1,230</b>                      | <b>3.919</b>                                  | <b>2,841</b>   |
|          | <b>TOTAL 1 to 6:</b>         | <b>812,534</b>                           | <b>34,939</b>                     | <b>111.306</b>                                | <b>80,697</b>  |

1) Energy consumption and energy costs at 0.043 JD/kWh for 2007 extracted from WAJ data sheets.

2) Estimated installed power based on pump operation of 20 hours/day.

3) Assessment of New Value of existing M&E pumping facilities based on 725 JD/KW



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**Annex 4**

**Summary of assessed Energy Saving Potential (GTZ / September 2009)**

Reference: "Assessment of Pump Efficiency, Pump Operation and Energy saving Potential", GTZ

| No.                  | Identified Projects              | Estimated Investment Cost<br>JD | Estimated Energy Consumption |              |                    |              |                         |                |            | Potential of Greenhouse Gas Reduction<br>0,728 t CO2/year | Specific Investment per t CO2<br>JD/tCO2 year | Pay-back on Invest.<br>years | Proposed Institutional Concept & Financing<br><i>Note: Still in the decision making process!</i> |                 |
|----------------------|----------------------------------|---------------------------------|------------------------------|--------------|--------------------|--------------|-------------------------|----------------|------------|---|---|------------------------------|--|-----------------|
|                      |                                  |                                 | Present Situation            |              | Improved Situation |              | Annual Saving Potential |                |            |   |   |                              | Institutional Concept  | Financing       |
|                      |                                  |                                 | %                            | Mill. kWh/y  | %                  | Mill. kWh/y  | Mill. kWh/y             | 0,043 JD/year  | %          |   |   |                              |  |                 |
| 1                    | Zarqa Desalination Plant         | 171.000                         | 24%                          | 0,63         | 70%                | 0,22         | 0,41                    | 17.802         | 66%        | 301   | 567   | 10                           | External Investment -<br>Extended Maintenance<br>Gurantee Period                                 | BMU             |
| 2                    | Hallabat Pumping Station         | 346.000                         | 57%                          | 3,95         | 68%                | 3,31         | 0,64                    | 27.476         | 16%        | 465   | 744   | 13                           | External Investment -<br>Extended Maintenance<br>Gurantee Period                                 | JICA            |
| 3                    | Azraq Pumping Station            | 1.907.000                       | 56%                          | 17,66        | 68%                | 14,54        | 3,12                    | 134.008        | 18%        | 2.269   | 841   | 14                           | ESPC   | JICA            |
| 4                    | Khaw Old Pumping Station         | 1.282.000                       | 42%                          | 18,42        | 68%                | 11,38        | 7,04                    | 302.846        | 38%        | 5.127   | 250   | 4                            | ESPC   | ESC             |
| 5                    | Yazidieh Pumping Station         | 889.000                         | 44%                          | 5,41         | 58%                | 4,10         | 1,31                    | 56.152         | 24%        | 951   | 935   | 16                           | ESPC with shared<br>Investment   | ESC / KfW (BMU) |
| 6                    | Azraq Spring Pumping Station     | 168.000                         | 55%                          | 1,58         | 65%                | 1,34         | 0,24                    | 10.452         | 15%        | 177   | 949   | 16                           | External Investment -<br>Extended Maintenance<br>Gurantee Period                                 | KfW             |
| 7                    | Share'a Pumping Station          | 782.000                         | 38%                          | 6,80         | 68%                | 3,80         | 3,00                    | 129.000        | 44%        | 2.184   | 358   | 6                            | ESPC with shared<br>Investment   | ESC / WAJ       |
| 8                    | Naqab Al Daboor Pumping Station  | 0                               | 60%                          | 1,78         | 70%                | 1,53         | 0,25                    | 10.934         | 14%        | 185   | 0   | 0                            | No Measures<br>recommended   | KfW             |
| 9                    | Madaba Pumping Station - Pumping | 555.000                         | 54%                          | 3,97         | 68%                | 3,15         | 0,82                    | 35.146         | 21%        | 595   | 933   | 16                           | External Investment:<br>Performance Based<br>O&M   |                 |
| 10                   | Wala Pumping Station             | 120.000                         | 62%                          | 12,88        | 65%                | 12,29        | 0,59                    | 25.562         | 5%         | 433   | 277   | 5                            | External Investment:<br>Performance Based<br>O&M   | BMU             |
| 11                   | Lib Pumping Station              | 120.000                         | 56%                          | 12,87        | 64%                | 11,26        | 1,61                    | 69.176         | 13%        | 1.171   | 102   | 2                            | External Investment:<br>Performance Based<br>O&M   | BMU             |
| <b>TOTAL 1 to 11</b> |                                  | <b>6.340.000</b>                |                              | <b>85,95</b> |                    | <b>66,91</b> | <b>19,04</b>            | <b>818.555</b> | <b>22%</b> | <b>13.858</b>   | <b>457</b>                                    | <b>8</b>                     |  |                 |

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**Annex 5**

**Basic General Assessment of Energy Saving Potential (December 2008)**

*Reference: Preparation of New Project "Investment Program for Improving Energy Efficiency in the Water Sector of Jordan"*

| No.                  | Identified Projects                 | Estimated Investment Cost<br>JD       | Estimated Energy Consumption |                            |                          | Potential of Greenhouse Gas Reduction<br>0,740 t CO2/year | Specific Investment per t CO2<br>JD/tCO2 year | Annual Saving<br>0,043 JD/year | Pay-back on Invest.<br>years |
|----------------------|-------------------------------------|---------------------------------------|------------------------------|----------------------------|--------------------------|---|---|--------------------------------|------------------------------|
|                      |                                     |                                       | Present<br>Mill. kWh/year    | Improved<br>Mill. kWh/year | Saving<br>Mill. kWh/year |   |   |                                |                              |
| 1                    | KARAK: 17 Pumping Stations          | 1.600.000                             |                              |                            | 10,000                   | 7.400   | 216   | 430.000                        | 4                            |
| 2                    | Restructuring of Bulk Supply/Madaba | 8.000.000                             |                              |                            | 36,000                   | 26.640  | 300   | 1.548.000                      | 5                            |
| 3                    | PS - Northern Governorates          | 6.000.000                             |                              |                            | 20,000                   | 14.800  | 405   | 860.000                        | 7                            |
| 4                    | Wadi Arab PS - Option 2             | 2.481.000                             | 79,730                       | 63,390                     | 16,340                   | 12.092  | 205   | 702.620                        | 4                            |
| 5                    | Bulk Supply system - Amman          | <i>No further infirmation stated!</i> |                              |                            |                          |   |   |                                |                              |
| 6                    | Aqaba Wellfield Pumps               | <i>No further infirmation stated!</i> |                              |                            |                          |   |   |                                |                              |
| <b>TOTAL: 1 to 6</b> |                                     | <b>18.081.000</b>                     |                              |                            | <b>72,34</b>             | <b>53.532</b>   | <b>338</b>                                    | <b>3.540.620</b>               | <b>5</b>                     |

**Annex 6**

**Tentative Implementation Schedule**

| No.      | Description  | Duration of Activity months | 2010   |    |     |    | 2011   |    |     |    | 2012   |    |     |    | 2013   |    |     |    |  |
|----------|--|-----------------------------|--------|----|-----|----|--------|----|-----|----|--------|----|-----|----|--------|----|-----|----|--|
|          |  |                             | I      | II | III | IV | I      | II | III | IV | I      | II | III | IV | I      | II | III | IV |  |
|          |  |                             | 3      | 6  | 9   | 12 | 15     | 18 | 21  | 24 | 27     | 30 | 33  | 36 | 39     | 41 | 45  | 48 |  |
|          |  |                             | Year 1 |    |     |    | Year 2 |    |     |    | Year 3 |    |     |    | Year 4 |    |     |    |  |
| <b>1</b> | <b>Program Preparation and Accompanying Measures</b>                   |                             |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.1      | Preparation of "Program Preparation Report" and "PP Report"            | 3 to 6                      |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.2      | WAJ / KfW Program Appraisal  | 1                           |        | ↓  |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.3      | Final Program Approval from BMZ and GoJ                                | 1 to 3                      |        |    | ↓   |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.4      | Readiness for Disbursement   | 1 to 3                      |        |    |     | ↓  |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.5      | Agreement on Complementary Measures with concerned Stakeholders        | 1 to 3                      |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.6      | Agreement on selected Project Measures by WAJ and KfW                  | 1 to 3                      |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.7      | External advisory & auditing Services during Program Implementation    | 33                          |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 1.8      | External Technical / Financial Auditing during Service Period          | 120                         |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| <b>2</b> | <b>Consulting Services and Project Implementation</b>                  |                             |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.1      | ToR and Pre-Qualification of Consultant(s)                             | 3                           |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.2      | Tendering, Evaluation and Award of Contract for Consulting Services    | 3                           |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.3      | Preparation of Assessment Studies, Design, Tender & Contract Documents | 9                           |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.4      | Pre-Qualification of ESPC Contractors / Service Providers              | 3                           |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.5      | Tendering, Evaluation and Award of ESP Contracts                       | 6                           |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.6      | Start of Program Implementation and Construction Supervision           | 18                          |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |
| 2.7      | Commissioning of works and Start of 10 Years Service Contract          | 120                         |        |    |     |    |        |    |     |    |        |    |     |    |        |    |     |    |  |

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## Annex 7

### Proposed prioritised Investment Cost Assessment under the EEP

| No.        | Description   | Global Investment Cost Assessment |        |                               |              |  | Proposed<br>Prioritised<br>Investment<br>Under the<br>EEP<br>EUR | Foreign / Local Costs |                   |                   |
|------------|---|-----------------------------------|--------|-------------------------------|--------------|--|--|-----------------------|-------------------|-------------------|
|            |   | Unit                              | Quant. | Estimated<br>Rehab.<br>Factor | Unit<br>Rate | Total<br>Estimated<br>Investment<br>Costs<br>EUR |  | Foreign               |                   | Local             |
|            |   |                                   |        | %                             | EUR          | EUR  | %  | EUR                   | EUR               |                   |
| <b>1</b>   | <b>Energy Efficiency related direct Investment Cost</b>                 |                                   |        |                               |              |  |  |                       |                   |                   |
| <b>1.1</b> | <b>Northern Governorates (Irbid, Mafraq, Ajloun, Jerash and Ramtha)</b> |                                   |        |                               |              |  |  |                       |                   |                   |
| 1.1.1      | Wadi Arab PS - Option 2   | LS                                | 1      |                               | 2 481.000    | 2 481.000  | 2 481.000  | 70%                   | 1 736.700         | 744.300           |
| 1.1.2      | Other Pumping Stations in the Region                                    | KW                                | 16 244 | 35%                           | 725          | 4 121.915  |  | 70%                   | 0                 | 0                 |
|            | <b>Sub-Total 1.1</b>  |                                   |        |                               |              | <b>6 602.915</b>                                 | <b>2 481.000</b>   |                       | <b>1 736.700</b>  | <b>744.300</b>    |
| <b>1.2</b> | <b>Middle Governorates (Zarqa, Balqa and Madaba)</b>                    |                                   |        |                               |              |  |  |                       |                   |                   |
| 1.2.1      | Zarqa Desalination Plant  | LS                                | 1      |                               | 171.000      | 171.000  | 171.000  | 70%                   | 119.700           | 51.300            |
| 1.2.2      | Hallabat Pumping Station  | LS                                | 1      |                               | 346.000      | 346.000  |  | 70%                   | 0                 | 0                 |
| 1.2.3      | Azraq Pumping Station   | LS                                | 1      |                               | 1 907.000    | 1 907.000  |  | 70%                   | 0                 | 0                 |
| 1.2.4      | Khaw Old Pumping Station  | LS                                | 1      |                               | 1 282.000    | 1 282.000  | 1 282.000  | 70%                   | 897.400           | 384.600           |
| 1.2.5      | Yazidieh Pumping Station  | LS                                | 1      |                               | 889.000      | 889.000  | 889.000  | 70%                   | 622.300           | 266.700           |
| 1.2.6      | Azraq Spring Pumping Station  | LS                                | 1      |                               | 168.000      | 168.000  | 168.000  | 70%                   | 117.600           | 50.400            |
| 1.2.7      | Share'a Pumping Station   | LS                                | 1      |                               | 782.000      | 782.000  | 782.000  | 70%                   | 547.400           | 234.600           |
| 1.2.8      | Naqab Al Daboor Pumping Station   | LS                                | 1      |                               | 0            | 0  |  | 70%                   | 0                 | 0                 |
| 1.2.9      | Madaba Pumping Station - Pumping  | LS                                | 1      |                               | 555.000      | 555.000  | 555.000  | 70%                   | 388.500           | 166.500           |
| 1.2.10     | Wala Pumping Station  | LS                                | 1      |                               | 120.000      | 120.000  | 120.000  | 70%                   | 84.000            | 36.000            |
| 1.2.11     | Lib Pumping Station   | LS                                | 1      |                               | 120.000      | 120.000  | 120.000  | 70%                   | 84.000            | 36.000            |
| 1.2.12     | Other Pumping Stations / Wells in the Region                            | KW                                | 2 965  | 50%                           | 725          | 1 074.813  |  | 70%                   | 0                 | 0                 |
|            | <b>Sub-Total 1.2</b>  |                                   |        |                               |              | <b>7 414.813</b>                                 | <b>4 087.000</b>   |                       | <b>2 860.900</b>  | <b>1 226.100</b>  |
| <b>1.3</b> | <b>Southern Governorates (Karak, Tafila and Ma'an)</b>                  |                                   |        |                               |              |  |  |                       |                   |                   |
| 1.3.1      | KARAK   | KW                                | 4 286  | 30%                           | 725          | 932.205  | 932.205  | 70%                   | 652.544           | 279.662           |
| 1.3.2      | Tafila  | KW                                | 1 709  | 50%                           | 725          | 619.513  | 619.513  | 70%                   | 433.659           | 185.854           |
| 1.3.3      | Ma'an   | KW                                | 1 851  | 70%                           | 725          | 939.383  | 939.383  | 70%                   | 657.568           | 281.815           |
|            | <b>Sub-Total 1.3</b>  |                                   |        |                               |              | <b>2 491.100</b>                                 | <b>2 491.100</b>   |                       | <b>1 743.770</b>  | <b>747.330</b>    |
| <b>1.4</b> | <b>Miyahuna - Jordan Water Company</b>                                  |                                   |        |                               |              |  |  |                       |                   |                   |
| 1.4.1      | Main Pumping Station: Zai and Zara-Ma'een                               | KW                                | 41 449 | 3%                            | 500          | 621.737  | 621.737  | 70%                   | 435.216           | 186.521           |
| 1.4.2      | Other Pumping and Booster Stations                                      | KW                                | 17 764 | 10%                           | 725          | 1 287.883  | 1 287.883  | 70%                   | 901.518           | 386.365           |
|            | <b>Sub-Total 1.4</b>  |                                   |        |                               |              | <b>1 909.619</b>                                 | <b>1 909.619</b>   |                       | <b>1 336.733</b>  | <b>572.886</b>    |
| <b>1.5</b> | <b>Aqaba Water Company</b>  |                                   |        |                               |              |  |  |                       |                   |                   |
| 1.5.1      | Disi / Aqaba Wellfield Pumps  | KW                                | 3 919  | 40%                           | 725          | 1 136.510  | 1 136.510  | 70%                   | 795.557           | 340.953           |
| 1.5.2      | Other Pumping and Booster Stations                                      | KW                                | 0      |                               | 725          | 0  | 0  | 70%                   | 0                 | 0                 |
|            | <b>Sub-Total 5</b>  |                                   |        |                               |              | <b>1 136.510</b>                                 | <b>1 136.510</b>   |                       | <b>795.557</b>    | <b>340.953</b>    |
|            | <b>TOTAL 1: 1.1 to 1.5</b>  |                                   |        |                               |              | <b>19 554.957</b>                                | <b>12 105.229</b>  | <b>70%</b>            | <b>8 473.660</b>  | <b>3 631.569</b>  |
| <b>2</b>   | <b>Project related complementary Investment Measures</b>                |                                   |        |                               |              |  |  |                       |                   |                   |
| 2.1        | General Rehabilitation of PS Civil Structures, etc.                     | %                                 | 10     |                               |              | 1 955.496  | 1 955.496  | 20%                   | 391.099           | 1 564.397         |
| 2.2        | Replacement / Rehabilitation of Pumping Mains                           | %                                 | 22     |                               |              | 4 302.090  | 4 302.090  | 50%                   | 2 151.045         | 2 151.045         |
| 2.3        | Rehabilitation / Enlargement of Storage Capacities                      | %                                 | 11     |                               |              | 2 151.045  | 2 151.045  | 20%                   | 430.209           | 1 720.836         |
|            | <b>Total 2</b>  |                                   |        |                               |              | <b>8 408.631</b>                                 | <b>8 408.631</b>   | <b>35%</b>            | <b>2 972.353</b>  | <b>5 436.278</b>  |
|            | <b>Total 1 and 2</b>  |                                   |        |                               |              | <b>27 963.588</b>                                | <b>20 513.861</b>  | <b>56%</b>            | <b>11 446.014</b> | <b>9 067.847</b>  |
| <b>3</b>   | <b>Contingencies</b>  |                                   |        |                               |              |  |  |                       |                   |                   |
| 3.1        | Physical Contingencies  | %                                 | 10     |                               |              | 2 796.359  | 2 051.386  | 90%                   | 1 846.247         | 205.139           |
| 3.2        | Price Contingencies   | %                                 | 10     |                               |              | 2 796.359  | 2 051.386  | 10%                   | 205.139           | 1 846.247         |
|            | <b>Total 3</b>  |                                   |        |                               |              | <b>5 592.718</b>                                 | <b>4 102.772</b>   | <b>50%</b>            | <b>2 051.386</b>  | <b>2 051.386</b>  |
|            | <b>Total 1, 2 and 3</b>   |                                   |        |                               |              | <b>33 556.306</b>                                | <b>24 616.633</b>  | <b>55%</b>            | <b>13 497.400</b> | <b>11 119.233</b> |
| <b>4</b>   | <b>Consulting Services</b>  |                                   |        |                               |              |  |  |                       |                   |                   |
| 4.1        | Design, Tender and Contract Documents                                   | %                                 | 6      |                               |              | 2 013.378  | 1 476.998  | 60%                   | 886.199           | 590.799           |
| 4.2        | Construction Supervision  | %                                 | 6      |                               |              | 1 917.101  | 1 406.370  | 60%                   | 843.822           | 562.548           |
|            | <b>Total 4</b>  |                                   |        |                               |              | <b>3 930.479</b>                                 | <b>2 883.368</b>   | <b>60%</b>            | <b>1 730.021</b>  | <b>1 153.347</b>  |
|            | <b>GRAND TOTAL 1, 2, 3 and 4</b>  |                                   |        |                               |              | <b>37 486.785</b>                                | <b>27 500.000</b>  | <b>55%</b>            | <b>15 227.421</b> | <b>12 272.580</b> |

# Energy Efficiency Program / Jordan Program Preparatory Report

BCT Technology Enterprises GmbH

## Annex 8-1

### Financial Appraisal of EEP Investment (Profitability Analysis – Case 1)

| No.      | Cost Item   | Investment     |              |              | Life Span of Assets (years) | ESP Preparation and Implementation Period |      |      | ESP Contract Service Period |                |                |                |                |                |                |                |                |                |               |
|----------|---|----------------|--------------|--------------|-----------------------------|---|------|------|-----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------|
|          |   | 1,20           | 20%          | 0,043        |                             | Percent. of Total Annual Cons. %          | 2010 | 2011 | 2012                        | 2013           | 2014           | 2015           | 2016           | 2017           | 2018           | 2019           | 2020           | 2021           | 2022          |
|          |   | Mill. EUR      | Mill. kWh/yr | Mill. EUR/yr |                             |   | Year | Year | Year                        | Year 1         | Year 2         | Year 3         | Year 4         | Year 5         | Year 6         | Year 7         | Year 8         | Year 9         | Year 10       |
| <b>1</b> | <b>Revenues / Income</b> (not applicable, considered to be identical for situation with and without EEP)                        |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | Water Service Charges   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | Other Income  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>Total Income</b>   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
| <b>2</b> | <b>Estimated Investment Costs for EEP Infrastructure</b>  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>2.1 M &amp; E and SCADA Installations</b> (pumps, motors, hydraulic installations, measuring devices and remote control)     |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 2.1.1 WADI Arab Pumping Stations  | -2,977         |              |              | 15                          |   |      |      | -1,012                      | -1,965         |                |                |                |                |                |                |                |                | 0,992         |
|          | 2.1.2 Middle Governorates (GTZ Assessment)  | -4,904         |              |              | 15                          |   |      |      | -1,667                      | -3,237         |                |                |                |                |                |                |                |                | 1,635         |
|          | 2.1.3 Southern Governorates (Karak, Tafila, Ma'an)  | -2,989         |              |              | 15                          |   |      |      | -1,016                      | -1,973         |                |                |                |                |                |                |                |                | 0,996         |
|          | 2.1.4 Miyahuna (Pumping and Booster Stations)   | -2,291         |              |              | 15                          |   |      |      | -0,779                      | -1,512         |                |                |                |                |                |                |                |                | 0,764         |
|          | 2.1.5 Disi - Agaba Wellfield Pumps  | -1,363         |              |              | 15                          |   |      |      | -0,463                      | -0,900         |                |                |                |                |                |                |                |                | 0,454         |
|          | <b>Sub-Total: 2.1</b>   | <b>-14,525</b> |              |              |                             |   |      |      | <b>-4,938</b>               | <b>-9,586</b>  |                |                |                |                |                |                |                |                | <b>4,842</b>  |
|          | <b>2.2 Project related complementary Investment Measures</b>  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 2.2.1 General Rehabilitation of PS Civil Structures   | -2,346         |              |              | 25                          |   |      |      | -1,173                      | -1,173         |                |                |                |                |                |                |                |                | 1,408         |
|          | 2.2.2 Replacement / Rehabilitation of Pumping Mains   | -5,162         |              |              | 30                          |   |      |      | -1,549                      | -3,614         |                |                |                |                |                |                |                |                | 3,442         |
|          | 2.2.3 Rehabilitation / Enlargement of Storage Capacities  | -2,581         |              |              | 30                          |   |      |      | -0,774                      | -1,807         |                |                |                |                |                |                |                |                | 1,721         |
|          | <b>Sub-Total: 2.2</b>   | <b>-10,090</b> |              |              |                             |   |      |      | <b>-3,496</b>               | <b>-6,594</b>  |                |                |                |                |                |                |                |                | <b>6,570</b>  |
|          | <b>2.3 Other Project related Costs</b>  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 2.3.1 Consulting Services   | -2,883         |              |              |                             |   |      |      | -1,442                      | -1,442         |                |                |                |                |                |                |                |                |               |
|          | 2.3.2 Complementary Measures  | -1,000         |              |              |                             |   |      |      | -0,270                      | -0,280         | -0,270         | -0,015         | -0,015         | -0,015         | -0,015         | -0,030         | -0,015         | -0,015         | -0,015        |
|          | 2.3.3 Other Costs   | -0,003         |              |              |                             |   |      |      | -0,002                      | -0,002         |                |                |                |                |                |                |                |                | -0,030        |
|          | <b>Sub-Total: 2.3</b>   | <b>-3,886</b>  |              |              |                             |   |      |      | <b>-0,270</b>               | <b>-1,723</b>  | <b>-1,713</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,030</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b> |
|          | <b>Total 2</b>  | <b>-28,500</b> |              |              |                             |   |      |      | <b>-0,270</b>               | <b>-10,158</b> | <b>-17,893</b> | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,030</b>  | <b>-0,015</b>  | <b>-0,015</b>  | <b>-0,015</b> |
| <b>3</b> | <b>Operating Expenses / Savings</b>   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>3.1 Operation &amp; Maintenance Costs</b> (not applicable, to be considered as identical for situation with and without EEP) |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 3.1.1 General Operation & Maintenance Costs   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 3.1.2 Other Costs   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>Sub-Total: 3.1</b>   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>3.2 Energy Saving</b>  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 3.2.1 WADI Arab Pumping Stations  | 16,340         | 0,703        | 20,5%        |                             |   |      |      | 0,738                       | 0,775          | 0,813          | 0,854          | 0,897          | 0,942          | 0,989          | 1,038          | 1,090          | 1,144          |               |
|          | 3.2.2 Middle Governorates (GTZ Assessment)  | 19,040         | 0,819        | 22,2%        |                             |   |      |      | 0,860                       | 0,903          | 0,948          | 0,995          | 1,045          | 1,097          | 1,152          | 1,210          | 1,270          | 1,334          |               |
|          | 3.2.3 Southern Governorates (Karak, Tafila, Ma'an)  | 5,827          | 0,261        | 10,2%        |                             |   |      |      | 0,263                       | 0,276          | 0,290          | 0,305          | 0,320          | 0,336          | 0,353          | 0,370          | 0,389          | 0,408          |               |
|          | 3.2.4 Miyahuna (Pumping and Booster Stations)   | 8,760          | 0,377        | 2,0%         |                             |   |      |      | 0,396                       | 0,415          | 0,436          | 0,458          | 0,481          | 0,505          | 0,530          | 0,557          | 0,584          | 0,614          |               |
|          | 3.2.5 Disi - Agaba Wellfield Pumps  | 2,289          | 0,098        | 8,0%         |                             |   |      |      | 0,103                       | 0,109          | 0,114          | 0,120          | 0,126          | 0,132          | 0,138          | 0,145          | 0,153          | 0,160          |               |
|          | <b>Sub-Total: 3.2</b>   | <b>52,256</b>  | <b>2,247</b> |              |                             |   |      |      | <b>2,359</b>                | <b>2,477</b>   | <b>2,601</b>   | <b>2,731</b>   | <b>2,868</b>   | <b>3,011</b>   | <b>3,162</b>   | <b>3,320</b>   | <b>3,486</b>   | <b>3,660</b>   |               |
|          | <b>3.3 Incentives for ESPC Contractors</b>  |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 3.3.1 Basic Incentive for ESPC (min. 50% of energy savings needs to be taken into account in the financial analysis)            |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | 3.3.2 Supplementary Incentive (still to be defined)   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>Sub-Total: 3.3</b>   |                |              |              |                             |   |      |      |                             |                |                |                |                |                |                |                |                |                |               |
|          | <b>Total 3</b>  |                |              |              |                             |   |      |      | <b>2,359</b>                | <b>2,477</b>   | <b>2,601</b>   | <b>2,731</b>   | <b>2,868</b>   | <b>3,011</b>   | <b>3,162</b>   | <b>3,320</b>   | <b>3,486</b>   | <b>3,660</b>   |               |
|          | <b>Net Cash Flow (1 +2+3) (EUR)</b>   |                |              |              |                             |   |      |      | <b>-0,270</b>               | <b>-10,158</b> | <b>-17,893</b> | <b>2,344</b>   | <b>2,462</b>   | <b>2,586</b>   | <b>2,716</b>   | <b>2,838</b>   | <b>2,996</b>   | <b>3,147</b>   | <b>3,305</b>  |
|          | <b>Discount Factor (6%)</b>   |                |              |              | 1,05                        |   |      |      | 1,000                       | 0,952          | 0,907          | 0,864          | 0,823          | 0,784          | 0,746          | 0,711          | 0,677          | 0,645          | 0,614         |
|          | <b>Net Present Value (NPV)</b>  |                |              |              |                             |   |      |      | <b>-0,270</b>               | <b>-9,674</b>  | <b>-16,229</b> | <b>2,025</b>   | <b>2,026</b>   | <b>2,026</b>   | <b>2,027</b>   | <b>2,017</b>   | <b>2,028</b>   | <b>2,028</b>   | <b>2,029</b>  |
|          | <b>Cumulative NPV (EUR)</b>   |                |              |              |                             |   |      |      | <b>-0,270</b>               | <b>-9,944</b>  | <b>-26,173</b> | <b>-24,148</b> | <b>-22,122</b> | <b>-20,096</b> | <b>-18,069</b> | <b>-16,052</b> | <b>-14,024</b> | <b>-11,996</b> | <b>-9,967</b> |
|          | <b>Greenhouse Gas Reduction (t/CO<sub>2</sub>/year)</b>   |                |              |              | 0,728                       |   |      |      | 38,042                      | 38,042         | 38,042         | 38,042         | 38,042         | 38,042         | 38,042         | 38,042         | 38,042         | 38,042         | 38,042        |
|          | <b>Cumulative CO<sub>2</sub> Reduction (t/CO<sub>2</sub>/year)</b>  |                |              |              |                             |   |      |      | 38,042                      | 76,085         | 114,127        | 152,169        | 190,211        | 228,254        | 266,296        | 304,338        | 342,381        | 380,423        |               |

BCT Technology Enterprises GmbH

|   |                           |
|---|---------------------------|
| Pay-back Period:                            | about 10 Years            |
| NPV at end of ESPC Service Period:          | 438.116 EUR               |
| Investment per t/CO <sub>2</sub> Reduction: | -75 EUR/t CO <sub>2</sub> |



# Energy Efficiency Program / Jordan Program Preparatory Report

BCT Technology Enterprises GmbH

## Annex 8-2

### Financial Appraisal of EEP Investment (Profitability Analysis – Case 2)

| No.   | Cost Item  | Investment                | Saving Potential |              |       | Life Span of Assets | ESP Preparation and Implementation Period |      |        | ESP Contract Service Period |         |         |         |         |         |         |         |         |        |       |
|---|--|---------------------------|------------------|--------------|-------|---------------------|---|------|--------|-----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|--------|-------|
|   |  |                           | 1,20             | 20%          | 0,043 |                     | Percent. of Total Annual Cons. %          | 2010 | 2011   | 2012                        | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    | 2019    | 2020    | 2021   | 2022  |
|   |  | Mill. EUR                 | Mill. kWh/yr     | Mill. EUR/yr |       | Year                |   | Year | Year   | 1                           | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10     |       |
| <b>1 Revenues / Income</b> (not applicable, considered to be identical for situation with and without EEP)                      |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Water Service Charges   |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Other Income  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>Total Income</b>   |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>2 Estimated Investment Costs for EEP Infrastructure</b>  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>2.1 M &amp; E and SCADA Installations</b> (pumps, motors, hydraulic installations, measuring devices and remote control)     |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.1.1   | WADI Arab Pumping Stations   | -2,977                    |                  |              |       | 15                  |   |      | -1,012 | -1,965                      |         |         |         |         |         |         |         |         | 0,992  |       |
| 2.1.2   | Middle Governorates (GTZ Assessment)   | -4,904                    |                  |              |       | 15                  |   |      | -1,667 | -3,237                      |         |         |         |         |         |         |         |         | 1,635  |       |
| 2.1.3   | Southern Governorates (Karak, Tafila, Ma'an)   | -2,989                    |                  |              |       | 15                  |   |      | -1,016 | -1,973                      |         |         |         |         |         |         |         |         | 0,996  |       |
| 2.1.4   | Miyahuna (Pumping and Booster Stations)  | -2,291                    |                  |              |       | 15                  |   |      | -0,779 | -1,512                      |         |         |         |         |         |         |         |         | 0,764  |       |
| 2.1.5   | Disi - Agaba Wellfield Pumps   | -1,363                    |                  |              |       | 15                  |   |      | -0,463 | -0,900                      |         |         |         |         |         |         |         |         | 0,454  |       |
| Sub-Total: 2.1  |  | -14,525                   |                  |              |       |                     |   |      | -4,938 | -9,586                      |         |         |         |         |         |         |         |         | 4,842  |       |
| <b>2.2 Project related complementary Investment Measures</b>  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.2.1   | General Rehabilitation of PS Civil Structures  |                           |                  |              |       | 25                  |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.2.2   | Replacement / Rehabilitation of Pumping Mains  |                           |                  |              |       | 30                  |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.2.3   | Rehabilitation / Enlargement of Storage Capacities   |                           |                  |              |       | 30                  |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Sub-Total: 2.2  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>2.3 Other Project related Costs</b>  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.3.1   | Consulting Services  | -2,863                    |                  |              |       |                     |   |      | -1,442 | -1,442                      |         |         |         |         |         |         |         |         |        |       |
| 2.3.2   | Complementary Measures   |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 2.3.3   | Other Costs  | -0,003                    |                  |              |       |                     |   |      | -0,002 | -0,002                      |         |         |         |         |         |         |         |         |        |       |
| Sub-Total: 2.3  |  | -2,866                    |                  |              |       |                     |   |      | -1,443 | -1,443                      |         |         |         |         |         |         |         |         |        |       |
| Total 2   |  | -17,411                   |                  |              |       |                     |   |      | -6,381 | -11,029                     |         |         |         |         |         |         |         |         | 4,842  |       |
| <b>3 Operating Expenses / Savings</b>   |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>3.1 Operation &amp; Maintenance Costs</b> (not applicable, to be considered as identical for situation with and without EEP) |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 3.1.1   | General Operation & Maintenance Costs  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 3.1.2   | Other Costs  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Sub-Total: 3.1  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| <b>3.2 Energy Saving</b>  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 3.2.1   | WADI Arab Pumping Stations   |                           | 16,340           | 0,703        | 20.5% |                     |   |      | 0,738  | 0,775                       | 0,813   | 0,854   | 0,897   | 0,942   | 0,989   | 1,038   | 1,090   | 1,144   |        |       |
| 3.2.2   | Middle Governorates (GTZ Assessment)   |                           | 19,040           | 0,819        | 22.2% |                     |   |      | 0,860  | 0,903                       | 0,946   | 0,995   | 1,045   | 1,097   | 1,152   | 1,210   | 1,270   | 1,334   |        |       |
| 3.2.3   | Southern Governorates (Karak, Tafila, Ma'an)   |                           | 5,827            | 0,251        | 10.2% |                     |   |      | 0,263  | 0,276                       | 0,290   | 0,305   | 0,320   | 0,336   | 0,353   | 0,370   | 0,389   | 0,408   |        |       |
| 3.2.4   | Miyahuna (Pumping and Booster Stations)  |                           | 8,760            | 0,377        | 2.0%  |                     |   |      | 0,396  | 0,415                       | 0,436   | 0,458   | 0,481   | 0,505   | 0,530   | 0,557   | 0,584   | 0,614   |        |       |
| 3.2.5   | Disi - Agaba Wellfield Pumps   |                           | 2,289            | 0,098        | 8.0%  |                     |   |      | 0,103  | 0,109                       | 0,114   | 0,120   | 0,126   | 0,132   | 0,138   | 0,145   | 0,153   | 0,160   |        |       |
| Sub-Total: 3.2  |  |                           | 52,256           | 2,247        |       |                     |   |      | 2,359  | 2,477                       | 2,601   | 2,731   | 2,868   | 3,011   | 3,162   | 3,320   | 3,486   | 3,660   |        |       |
| <b>3.3 Incentives for ESPC Contractors</b>  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 3.3.1   | Basic Incentive for ESPC (min. 50% of energy savings needs to be taken into account in the financial analysis) |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| 3.3.2   | Supplementary Incentive (still to be defined)  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Sub-Total: 3.3  |  |                           |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Total 3   |  |                           |                  |              |       |                     |   |      | 2,359  | 2,477                       | 2,601   | 2,731   | 2,868   | 3,011   | 3,162   | 3,320   | 3,486   | 3,660   |        |       |
| Net Cash Flow (1 +2+3) (EUR)  |  |                           |                  |              |       |                     |   |      | -6,381 | -11,029                     | 2,359   | 2,477   | 2,601   | 2,731   | 2,868   | 3,011   | 3,162   | 3,320   | 3,486  | 8,502 |
| Discount Factor (5%)  |  |                           |                  |              |       | 1,05                | 1,000                                     |      | 0,952  | 0,907                       | 0,864   | 0,823   | 0,784   | 0,746   | 0,711   | 0,677   | 0,645   | 0,614   | 0,585  | 0,557 |
| Net Present Value (NPV)   |  |                           |                  |              |       |                     |   |      | -6,078 | -10,004                     | 2,038   | 2,038   | 2,038   | 2,038   | 2,038   | 2,038   | 2,038   | 2,038   | 2,038  | 4,734 |
| Cumulative NPV (EUR)  |  |                           |                  |              |       |                     |   |      | -6,078 | -16,082                     | -14,043 | -12,005 | -9,967  | -7,929  | -5,891  | -3,853  | -1,815  | 0,223   | 2,261  | 6,995 |
| Greenhouse Gas Reduction (t/CO <sub>2</sub> /year)  |  |                           |                  |              |       | 0,728               |   |      | 38,042 | 38,042                      | 38,042  | 38,042  | 38,042  | 38,042  | 38,042  | 38,042  | 38,042  | 38,042  | 38,042 |       |
| Cumulative CO <sub>2</sub> Reduction (t/CO <sub>2</sub> /year)  |  |                           |                  |              |       |                     |   |      | 38,042 | 76,085                      | 114,127 | 152,169 | 190,211 | 228,254 | 266,296 | 304,338 | 342,381 | 380,423 |        |       |
| Pay-back Period:  |  | about 7 Years             |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| NPV at end of ESPC Service Period:  |  | 6,995,446 EUR             |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |
| Investment per t/CO <sub>2</sub> Reduction:   |  | -46 EUR/t CO <sub>2</sub> |                  |              |       |                     |   |      |        |                             |         |         |         |         |         |         |         |         |        |       |

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## **Umweltanlage**

Ziel des Vorhabens ist es, die Energie Effizienz in Jordanischen Wassersektor nachhaltig zu verbessern, um damit einen Beitrag zur CO<sub>2</sub> Reduzierung zu leisten und durch eine damit verbundene Reduzierung der Energiekosten für die Wasserver- und Abwasserentsorgung einen positiven Beitrag zur Entlastung der Tarife für die Verbraucher zu erreichen.

**Ausgangssituation:** Der Energieverbrauch der WAJ betrug im Jahre 2007 rund 0,979 GWh. 95% des gesamten Energieverbrauchs entfallen auf die Wasserversorgung wohingegen zur Zeit nur etwa 0,050 GWh pro Jahr (5%) für die Abwasserentsorgung aufgewendet werden müssen. Die maschinen- und elektrotechnischen Einrichtungen der überwiegenden Zahl der Wasserpumpstationen befinden sich in einem wenig zufrieden stellendem Zustand, was zur Folge hat, dass die Zuverlässigkeit und vor allem die Energie Effizienz des Betriebes weit unter den international üblichen Standards liegt. Untersuchungen haben ergeben (IEES und UNFCCC), dass das mittlere Energieeinsparpotential aller im öffentlichen Betrieb befindlichen Pump- und Aufbereitungseinrichtungen rund 20% beträgt. Bei einer derzeitigen mittleren CO<sub>2</sub> Emission von 0.728 kg CO<sub>2</sub>/kWh kann somit der Ausstoß an Treibhausgasen im Wassersektor in Jordanien durch gezielte Energieeffizienzmaßnahmen um etwa 150,000 t jährlich reduziert werden.

**Projektmaßnahmen:** Als Maßnahmen zur nachhaltigen Verbesserung der Energieeffizienz im jordanischen Wassersektor sind im Einzelnen vorgesehen: (i) Nachhaltige Verbesserung von ausgewählten Pumpstationen in den Mittleren Governoraten (siehe Vorschläge der IEES Studie; (ii) Energetische Verbesserung der Wadi Arab Pumpstationen (vorliegende Erkenntnisse müssen durch ergänzende Untersuchungen noch präzisiert und bestätigt werden); (iii) Ergänzende finanzielle und fachtechnische Unterstützung von Miyahuna bei der Umsetzung des bereits eingeleiteten Energieeffizienzprogramms für Amman; (iv) Nachhaltige energetische Verbesserung von Pumpstationen in den südlichen Governoraten (Karak, Tafila und Ma'an) und dem Disi/Aqaba Brunnenfeld (Basisuntersuchungen sind noch erforderlich); und (v) Komplementäre Programm Maßnahmen zur Verbesserung der Qualifikation des Trägerpersonals der WAJ (EEP-Unit) für die Programmplanung, Steuerung, Überwachung und die übergeordnete Koordination von Kontroll- und Aufsichtspflichten. Das Hauptaugenmerk der Programm Investitionen betrifft die maschinen- und elektrotechnische Ertüchtigung von Pumpstationen, allerdings wird auch ein Teil der verfügbaren Mittel für die strukturelle Verbesserung tangierender Einrichtungen (Wasserbehälter, Transportleitungen, etc.) zu verwenden sein.

**Projektzielerreichung:** Projektziel des Vorhabens ist es, die Effizienz von energetischen Einrichtungen im jordanischen Wassersektor auf ein international anerkannt hohes Niveau zu bringen. Als vorbereitende Maßnahmen zur eigentlichen Projektdurchführung sind umfangreiche und zielgerichtete Status-quo Basisuntersuchungen und Umwelt-Audits erforderlich und zudem müssen Möglichkeiten eines effizienteren zukünftigen Betriebs der Anlagen durch die Einbeziehung privater Betreiber in Betracht gezogen werden. Durch die technische Umsetzung des „Energy Efficiency Programs“ ergeben sich für Jordanien, den Betreiber und die im Umfeld der Projektmaßnahmen lebende Bevölkerung keinerlei negative umweltrelevante Nachteile. Von der geplanten substanziellen und nachhaltigen Reduzierung der Energiekosten im Wassersektor profitieren letztendlich die Verbraucher, durch einen herabgesetzten Kostendruck auf zukünftige Wasser- und Abwassertarife.

**List of Personnel Contacted**

| <b>No.</b> | <b>Name</b>                 | <b>Designation</b>                               | <b>Organisation</b>                   |
|------------|-----------------------------|--|---------------------------------------|
| 1          | Eng. Munir Qweis            | Secretary General                                | MoWI, WAJ                             |
| 2          | Eng. Bassam Saleh           | Assistant Secretary general for Water Affairs    | MoWI, WAJ                             |
| 3          | Eng. Ms Diana Kawwa         | Secretary General Adviser                        | MoWI, WAJ                             |
| 4          | Eng. Basem Telfah           | Director - PMU                                   | MoWI, PMU                             |
| 5          | Eng. Mohammed Hossam Sallam | Project Manager - PMU                            | MoWI, PMU                             |
| 6          | Eng. Zaid El-Keilani        | Assistant Secretary General for Sewerage Affairs | WAJ                                   |
| 7          | Eng. Walid Al Heyasat       | Electro-Mechanical Eng.                          | WAJ                                   |
| 8          | Eng. Fakhri Alradaideh      | Operation Manager                                | NGWA                                  |
| 9          | Eng. Hamad Khalid           | Wadi Arab Pumping Station Manager                | NGWA                                  |
| 10         | Eng. Bassam                 | Wadi Arab Treatment Plant Manager                | NGWA                                  |
| 11         | Eng. Ghazi Khalil Hammash   | Operations Director                              | Miyahuna                              |
| 12         | Eng. Haitham Al Kilani      | Maintenance Manager                              | Miyahuna                              |
| 13         | Eng. Khaled Walid Almasri   | Head of Electromechanical Maintenance Section    | Miyahuna                              |
| 14         | Eng. Adnan Kiat             | Director   | Tahfila Water                         |
| 15         | Eng. Mustafa Zanon          | Manager - Maintenance, Operation and NRW         | Tahfila Water                         |
| 16         | Eng. Akram Zhaneen          | Director   | Ma'an Water                           |
| 17         | Eng. Samer Maaitah          | Manager – Operation and Maintenance              | Ma'an Water                           |
| 18         | Eng. Ms Rodana Al Dabbas    | Program Manager (Package 1 and 2)                | Millenium Challenge Corporation (MCC) |
| 19         | Guy Honoré                  | Deputy Director –GTZ Office Jordan               | GTZ                                   |
| 20         | Dieter Rothenberger         | Programme Manager (OMS-MG)                       | GTZ                                   |
| 21         | Reinhard Meierjohann        | Principle Advisor                                | ACWUA                                 |
| 22         | Udo Kachel                  | Regional Director                                | Dorsch Consult                        |
| 23         | Stephan Kugler              | Project Manager                                  | Dorsch Consult                        |

**List of available Documents**

| <b>No.</b> | <b>Title</b>   | <b>Author</b>                          | <b>Date</b> |
|------------|--|--|-------------|
| [1]        | Assessment of Pump Efficiency, Pump Operation and Energy Saving Potential  | DORSCH & CONSULAQUA                    | 9/2009      |
| [2]        | Annual Report 2007 and 2008 - Miyahuna   | Miyahuna                               | 2008/2009   |
| [3]        | Investitionsprogramm zur Verbesserung der Energieeffizienz im Wassersektor Jordaniens                                    | R. Meierjohann                         | 7.1.2009    |
| [4]        | Jordan's Second Communication to the United Nations Framework Convention on Climate Change (UNFCCC) 2009                 | Ministry of Environment                | 2009        |
| [5]        | MOM – Preparation of the New Project „Investment Program for Improving Eenergy Efficiency in the water Sector of Jordan“ | WAJ/KfW                                | 21.12.2008  |
| [6]        | Energetic assessment of Za'atai and Karak Pumping Station (Mafrak)   | Energy Management Services (EMS)       | 2009        |
| [7]        | Energetic assessment of Khaw Pumping Station   | National Energy Research Center (NERC) | 2009        |
| [8]        | Operational Business Case Proposal – Bwaidah Service Reservoir Pumping Station   | SEVERN TRENT                           | 5/2008      |
| [9]        | Energy Management – Wadi Arab Rehabilitation Appraisal Report  | DJ Wildey                              | 4/2008      |
| [10]       | Annual Report 2006 – Aqaba Water Company   | Aqaba Water Company                    | 2007        |

**Photo Documentation**

**Tafila (1)**



**HISA Pumping Station No. 1**



**ZEBDA Pumping Station**



**HISA Pumping Station No. 1**



**ZEBDA Pumping Station**



**ZEBDA Pumping Station**



# Energy Efficiency Program / Jordan Program Preparatory Report

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RAWAZ Booster Station



Ma'an Main Pumping Station



RAWAZ Booster Station



Ma'an Main Reservoir

## Ma'an (2)



Ma'an Main Pumping Station

## Wadi Arab (3)



ZABDA Pumping Station

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ZABDA Pumping Station



WADI-ARAB New Pumping Station No. 1



WADI-ARAB New Pumping Station No. 1



WADI-ARAB Pumping Station No. 1



WADI-ARAB New Pumping Station No. 1



WADI-ARAB Pumping Station No. 1



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WADI-ARAB Pumping Station - Bended Shaft



Main Pumping Station in Amman



Main Pumping Station in Amman

## Miyahuna (4)



Main Pumping Station in Amman



Main Pumping Station in Amman