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Final Regional Policy Workshop on the Water- Energy Nexus: Technology Transfer: Regional Case Studies



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- 1. Technology Transfer (TT)?**
- 2. Case Study 1**
- 3. Case Study 2**
- 4. PPP**
- 5. Case Study 3**
- 6. Conclusions**



Technology transfer is the “broad set of processes covering the flows of know-how, experience and equipment, and is the result of many day-to-day decisions of the different stakeholders involved”.

Many different channels:

- **the public to the private sector,**
- **from a big firm to a smaller one and**
- **between universities or countries**

It is also described as the conversion of research output into products on the market.

Transfers can take various forms, such as PPPs and joint ventures.

Case study 1: Morocco

Project involving MEDRC



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Autonomous Desalination System Concepts for Sea Water and Brackish Water in Rural Areas with Renewable Energies – ADIRA

Four PV-RO systems have been installed subsequently in 4 locations of Morocco. Raw water is brackish water from inland wells (salinity 2.5 – 8.7 g/l).

Dessol®.

5 m³ freshwater per day: Sufficient for 100 people → Covering food & sanitation

Site parameters:

- Water production capacity of 1 m³/h
- Energy consumption: 4 kWh / m³
- PV capacity: 8 kWp
- Capital cost: 70.000 Euro
- Cost of water: 3 – 6 Euro / m³



RO unit (1 m³/h).



PV field (4 kWp)



2003-2007 (Countries: GR,DE,EG,JO,MA,TR,ES,OM)

Case study 2: Tunisia



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Autonomous PV-RO unit in Tunisia (since 2006)

The village of Ksar Ghilène first African location with 2 years operating PV-RO system. 300 inhabitants with no access to electric grid (nearest at 150 km) or fresh water.



Building partially underground (in summer $T > 50\text{ }^{\circ}\text{C}$), PV power 10.5 kWp.

Dessol®.



Operating more than 3,100 h producing 6,000 m³ of drinking water in 27 months. Raw water salinity 3.5 g/l.



BWRO plant (2.1 m³/h).

Public-Private Partnership (PPP)



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PPPs are agreements between government & the private sector for the purpose of providing public infrastructure, community facilities & related services.

The private sector enter into a contract with government for the design, delivery, & operation of the facility or infrastructure & the services provided.

The private sector finance the capital investment and recover the investment over the course of the contract.

The asset transfers back to the public sector at the end of the contract

In the MENA region, the need to utilize **PPPs is crucial** for certain projects like: water supply & sanitation (**desalination, wastewater treatment**, etc.) --- It brings **technology and/or managerial know-how** to the project



The integrated approach for managing the **WEF nexus** is shown in the use of RE for WWT at **Khirbit As-samra WWTP in Jordan**.

The business model is based on a **PPP** to finance the construction and operation of public infrastructures based on **BOT** contract for 22 years!

The annual average energy consumption of the activated sludge system at Khirbit As-samra plant was around **61.58 GWh in 2014**.

The plant has achieved a self-energy sufficiency of **78-90% between 2009 and 2014**. This energy saving is achieved by utilizing **RE resources** including **hydraulic energy and biogas produced through anaerobic digestion**.

Biogas production generates **thermal & electrical power of 5.4 MW & hydraulic energy accounts for 3.45 MW!**

Case Study 3: As-Samra WWTP



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As-Samra channels the 'grey' (sewage) water from Amman towards Zarqa.

The natural gradient gravity flow turns a turbine that generates electricity to power the Jordanian capital.

The waste water is then treated and sent on for irrigation purposes in the agricultural fields around Zarqa.

The complexity arises in the financial meanders of the PPP: As-Samra consists of a grant from the US government, a loan from a consortium of banks via the Arab Bank, and the As-Samra Project Company that is paid for its services by the Jordan Ministry of Water for the provision of 'clean' water.

Case Study 3: As-Samra WWTP



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Project Objectives:

- Improve the Wastewater services in Amman Area
- Establish environmentally friendly treatment plant with elimination of offensive odors in the area, safe use of treated wastewater and bio-solids treatment and disposal.
- Achieve the desired improvements with reasonable costs to optimize the use of public funds
- Improve water quality in Wadi Dhleil , Zaqa river and King Talal reservoir
- **Technology and know-how transfer**
- Cost efficiency based on competition between treatment technologies



- 25 year Build, Operate and Transfer (BOT) contract for a Wastewater Treatment Plant built at As Samra
- Expand Ain-Ghazal Pre-treatment Plant/ added during negotiations
- Operation & Maintenance of Ain Ghazal Pre-treatment Plant, Siphons from Ain Ghazal Pre-treatment Plant to the Plant, and pumping stations at Hashimiyya and West Zarqa.
- Treat effluent of Greater Amman area including Russeifa, Zarqa and Hashimiyya: current population served 2.2 million

Project Description (2/2)



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Scope of the BOT :

- Existing 1200mm line
- Existing 500mm line
- New 1500mm line
- Effluent
- Influent point

Project Benefits (1/2)

Social & Knowledge transfer Success



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Controlled reuse of water for irrigation

The high-quality water is used downstream for irrigation.

65% of available water resources are consumed by agriculture



Employment & transfer of know-how

Local individuals are developed and promoted.

180 permanent local employees
Up to 2,500 employees during construction phases



Tariff affordability

The low cost of treatment is part of the strategy to boost the economy

Tariff JOD/m³ : the lowest in Jordan



The equivalent of **4,000 farms** or **10,000 hectares** are irrigated with Samra high quality water

Transfer of Know-how and industry best practices

O&M staff became specialists for other projects over the world

Project Benefits (2/2)

Social & Knowledge transfer Success



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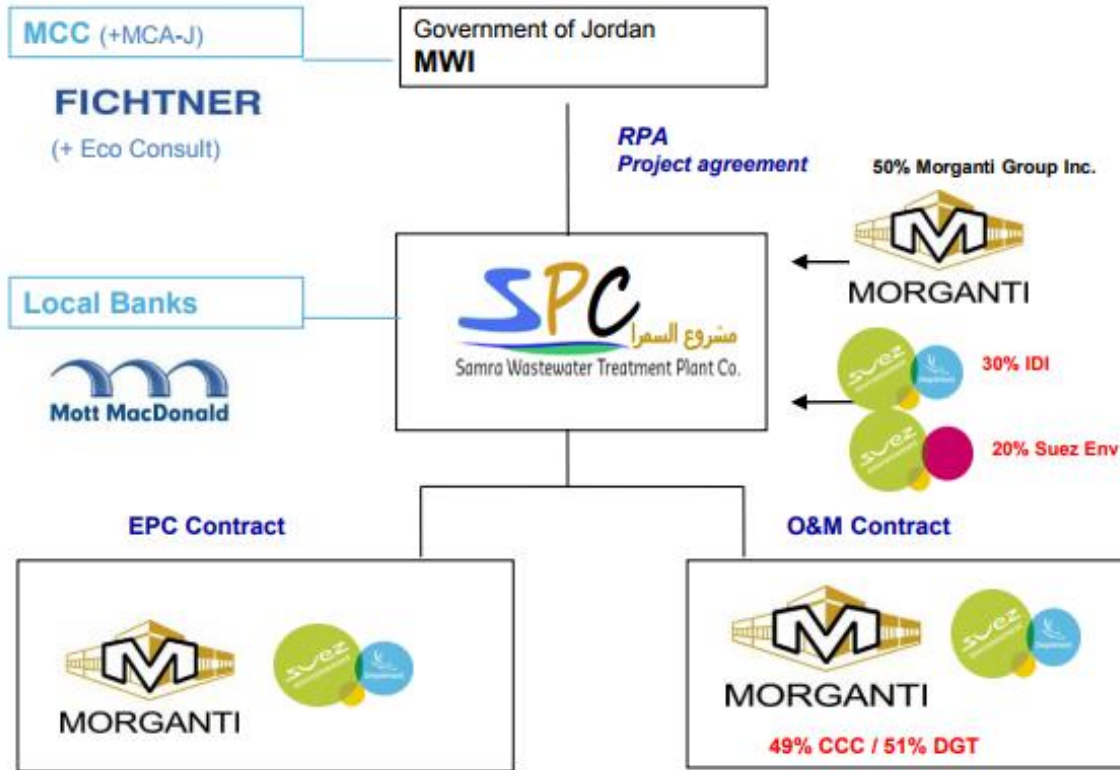
- 70% of the wastewater treated in Jordan
- 100% of treated water used for irrigation
- 10% of global water consumption thanks to high quality treated water that frees up fresh water
- 80% self-sufficient in energy with renewable resources
- 185 tons/day valuable resource of biosolids (organic fertilizer, soil conditioner, energy recovery, etc.). Landfill for now.
- It operates at 18% of the operating budgets, compared to global figures which range between 25-40%.
- It reduced CO2 emission by around 300,000 tons per year and the effluent of the treatment plant (100 Million m3 annually) is used for agricultural production
- Reduction in GOJ Borrowing for Infrastructure
- Shared Public/Private Sector Risk & Attraction of Private Sector for Capital investment and assurance of proper O&M
- **Technology Transfer**
- Cost Efficiency with Private Sector Competition Between Available Technologies

Success Story – AS SAMRA WWTP (1/3)



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Stakeholders



- **Client:** Government of Jordan represented by the Ministry of Water and Irrigation (MWI)
- **Donor:** Millennium Challenge Corporation (MCC); U.S. foreign aid agency
- **Grant Fund Manager:** Millennium Challenge Account (MCA-Jordan).
- **Authorities Engineer:** Fichtner (+ local consultant Eco Consult)
- **Project Companies:** Samra Wastewater Treatment Plant Company Ltd. (SPC) and Samra Plant Operation and Maintenance Co. Ltd. (O&M).
- **Sponsors:** Suez Environment / IDI and Morganti-CCC
- **Lenders:** Lender Syndicate led by Arab Bank
- **Lenders Advisor:** Mott Mac Donald

Civil engineering /
Earthworks /
Civil works /
M&E Erection

Process Engineering /
M&E Equipments supply
/
Commissioning



Risk Mitigation Instruments



Success Story – AS SAMRA WWTP (3/3)



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Winner of two international prizes:

- WEX global Award for innovative financing
 - World Finance Infrastructure Award
 - **Lenders fully familiar and enthusiastic for the project**
 - Reputable and professional sponsors giving confidence to the Lenders
 - Reliable operator
 - Track record of first phase
 - Same risk profile
 - The sponsors have accepted to carry the risk of refinancing at year 13
 - **Excellent financing package offered by Arab Bank**
 - Rare opportunity therefore strong competition from local banking industry
 - Best conditions ever offered for an infrastructure project in Jordan
 - 20 years tenor, Prime rate – 0,5%
 - Ratios, Minimal fees, no reserve account
- **Benefit for MWI**
- Refinancing gains to GoJ – Lower cost passed-through to GoJ
 - Local currency financing = no foreign exchange risk for GoJ
 - Ease of concluding financial documentation



- There are many example of how various entities can **collaborate to facilitate successful technology transfer**: (e.g. **Collaborative projects under EC programmes**)
- The local and national authorities must ensure that the technology solution chosen is **adapted to local conditions**
- Frequently the required technology is already being used in other countries; **the transfer of the technology to the Arab countries must be facilitated.**
- The case studies presented show that **successful examples of TT** are already present in the Arab world
- In general, TT need not always be from outside the Arab world to within it, but can also be between Arab countries (need **to capitalize our knowledge, localize technologies such as desalination, etc.**)



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