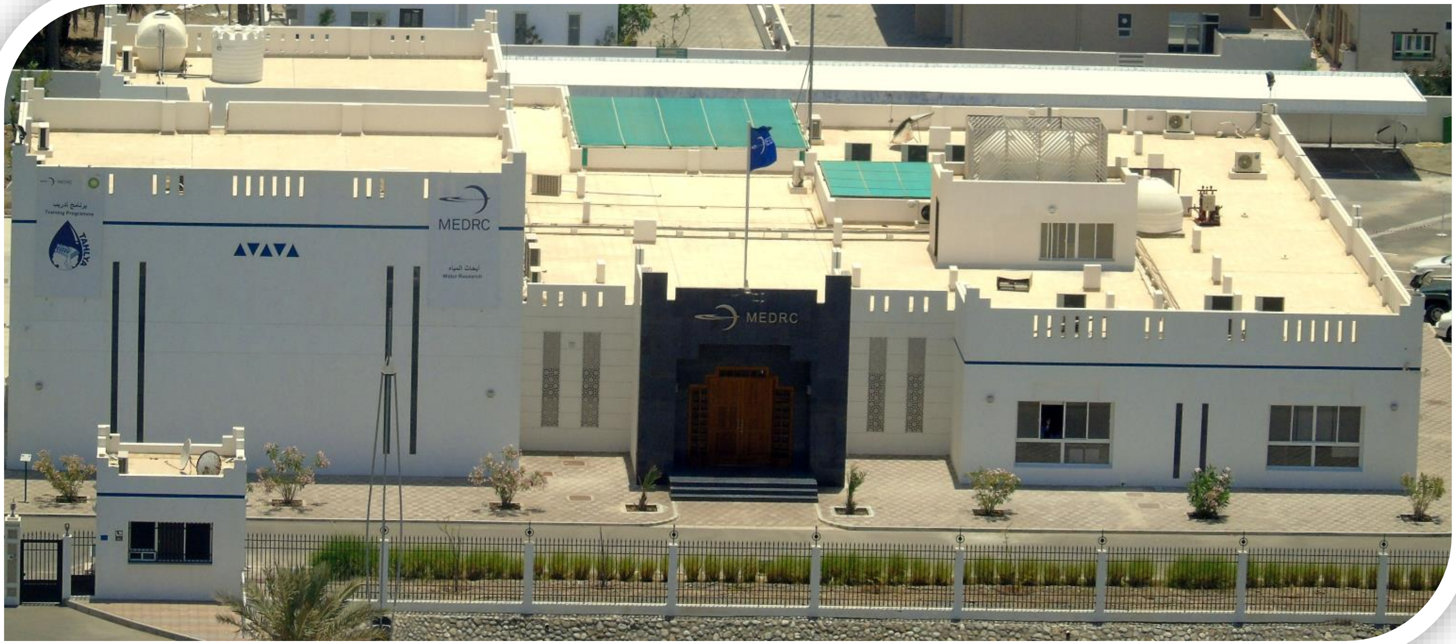
Technology Transfer in the Arab region – Challenges and Opportunities



Dr. Jauad EL KHARRAZ, MEDRC Head of Research
Expert Group Meeting on "Enhancing capacity building addressing Water and Energy interlinkages for Sustainable Development in the Arab Region", Beirut, 25-26 June 2019

Outline

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1- MEDRC in brief
2- Technology Transfer (TT)
3- TT challenges in the Arab world
4- TT opportunities in the Arab world
5- TT case studies in the Arab world
6- Conclusions and recommendations

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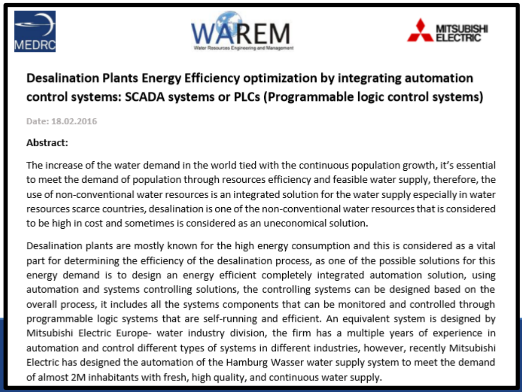
State of the art water research & training facility.

Supplying all levels of water research, training and consultancy to governments and enterprises.

Since 1996 MEDRC has led a multi million dollar program of support for water training, research & technology transfer in MENA

Extensive experience in project design, management and implementation

Research goals include reducing the cost of desalination, developing sustainable desalination technologies and maximising technology transfers, among others.



Desalination Plants Energy Efficiency optimization by integrating automation control systems: SCADA systems or PLCs (Programmable logic control systems)

Date: 18.02.2016

Abstract:

The increase of the water demand in the world tied with the continuous population growth, it's essential to meet the demand of population through resources efficiency and feasible water supply, therefore, the use of non-conventional water resources is an integrated solution for the water supply especially in water resources scarce countries, desalination is one of the non-conventional water resources that is considered to be high in cost and sometimes is considered as an uneconomical solution.

Desalination plants are mostly known for the high energy consumption and this is considered as a vital part for determining the efficiency of the desalination process, as one of the possible solutions for this energy demand is to design an energy efficient completely integrated automation solution, using automation and systems controlling solutions, the controlling systems can be designed based on the overall process, it includes all the systems components that can be monitored and controlled through programmable logic systems that are self-running and efficient. An equivalent system is designed by Mitsubishi Electric Europe- water industry division, the firm has a multiple years of experience in automation and control different types of systems in different industries, however, recently Mitsubishi Electric has designed the automation of the Hamburg Wasser water supply system to meet the demand of almost 2M inhabitants with fresh, high quality, and continuous water supply.

Oman Humanitarian Desal Challenge

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Challenge: An ambitious but achievable goal using science and innovation.

•Solves an important global problem and captures the public's imagination.

•Solutions have led to creation of industries and jobs of the future.

Vision: To provide individuals with the ability to inexpensively purify saline contaminated water sources during short-term catastrophic events.

Criteria: Hand-held, stand-alone, low-cost, desalination device for short-term use and rapid deployment following a humanitarian crisis.

1. The humanitarian desalination **Prize** – TRC **($700,000 prize**/ 2018 – 2022)
2. Yearly **Pathway Research** projects – USAID

•est. $90,000 each

•est. two per year, 2019 – 2021 www.desalinationchallenge.com

تحدي عمان لتطوير أنظمة التحلية الفردية لحالات الكوارث الإنسانية

OMAN HUMANITARIAN DESALINATION CHALLENGE

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Technology Transfer (TT)?

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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 & joint ventures.

The technology transfer/innovation system

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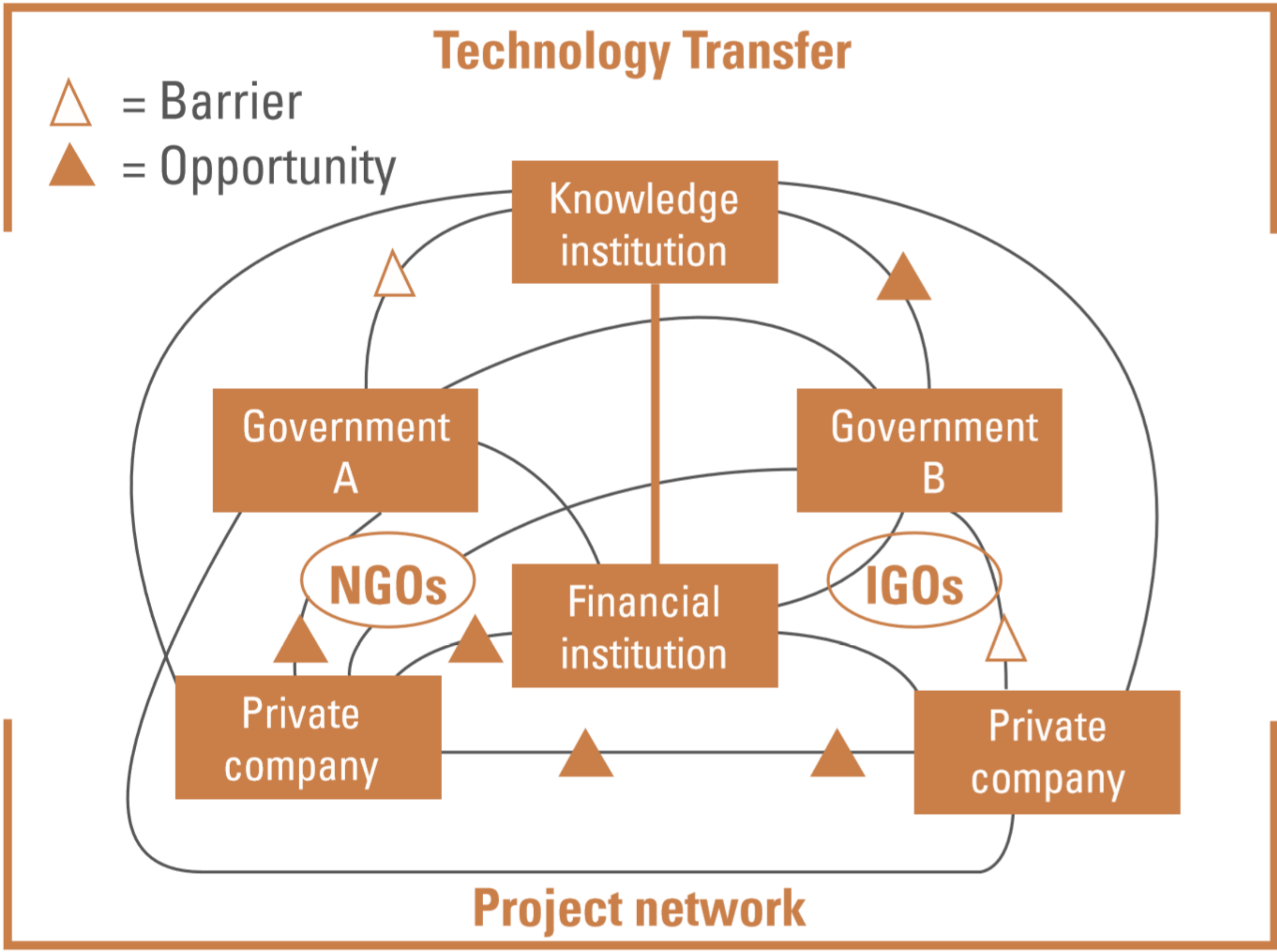
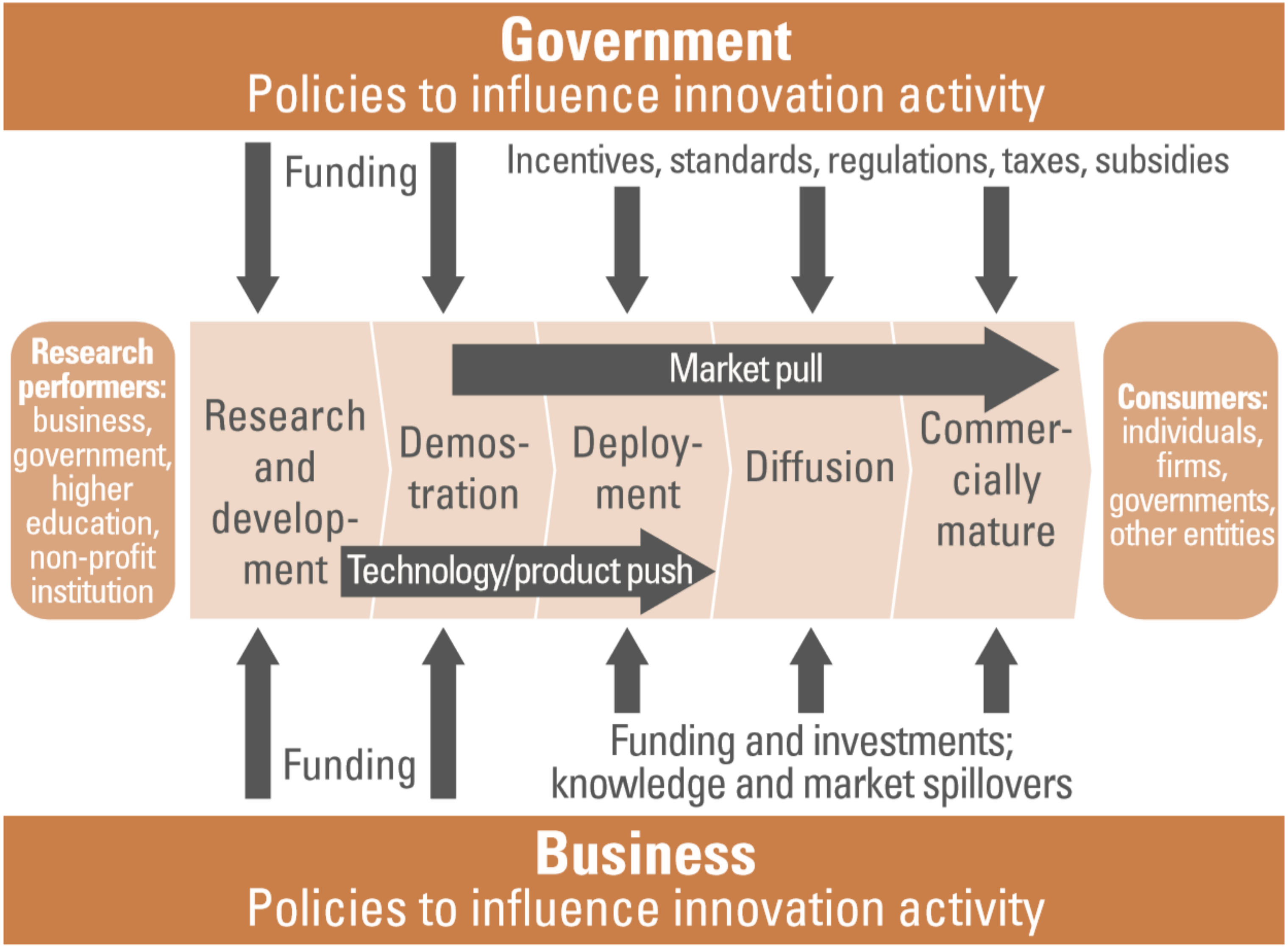


Source: Metz and others 2000.

The innovation process



Source: United Nations Framework Convention on Climate Change, 2009.

Technology Transfer:
A link between Research & Industry

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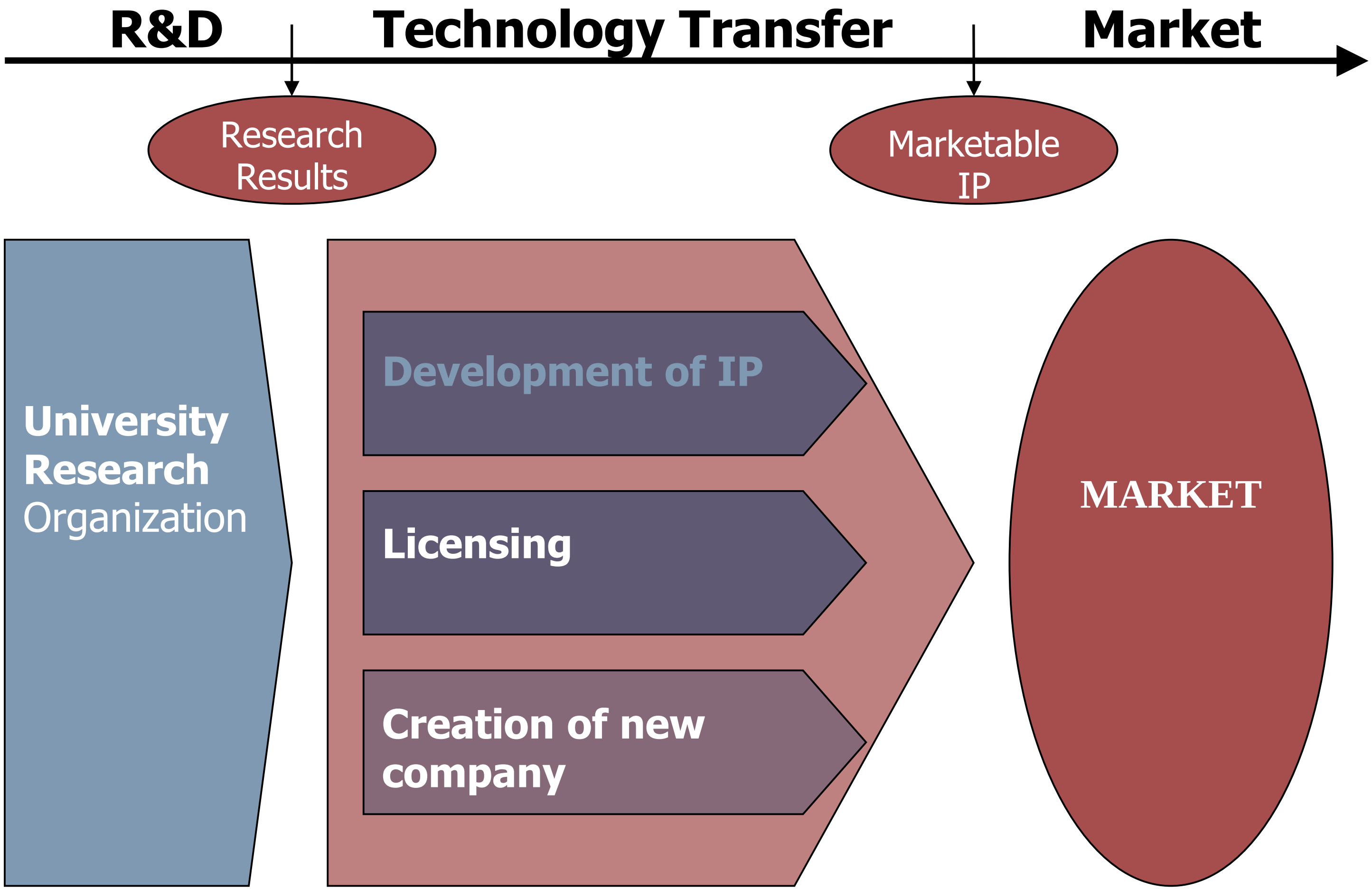

Intellectual property rights (IPR) constitute a key factor where cutting-edge research is part of the technology transfer process.

TT Challenges in the Arab region

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- The deficit in new patents in many Arab countries is not due to a lack of entrepreneurial spirit, rather, the gap is due to the fact that universities cannot bear the cost of research and technology transfer for lack of financial resources.
- Lack of access by domestic enterprises to information on available technologies and the transfer and absorption of foreign technologies;
- The challenge to transfer the knowledge and skills currently concentrated in research institutions and science parks to productive units situated in rural areas, including farms and SMEs.
- Lack of financing for early stage technology/product development due to classic innovation barriers combined with perceived energy technology market and/or policy risks
- Lack of capacity to research emerging water and energy nexus technologies, develop appropriate products,
- Lack of research and test facilities
- Problems in Arab National Innovation Systems (NIS).

TT Opportunities in the Arab region

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In July 2013, Algeria signed a memorandum of understanding with the EU in the field of energy which includes provisions for the transfer of technology to Algeria for both fossil fuels and renewable energy.

In Saudi Arabia, King Abdulaziz City for Science and Technology (KACST) serves as both the national science agency and as a hub for national laboratories. It is involved in policy-making, data collection and funding of external research. It also acts as the national patent office. It also acts as a technology incubator by fostering ties between research universities and between the public and private sectors to encourage innovation and the transfer and adaptation of technology with commercial potential.

TT Opportunities in the Arab region

- PPPs are playing an increasingly important role in technology transfer. They can consist of entities such as NGOs, private companies, private financial institutions and government entities at the local and national levels. Examples of PPPs include technology partnerships and projects to facilitate the development of innovative financial instruments.
- Increased funding for RE and resource efficiency-related businesses and products, and for the environment that supports the corresponding new technologies.
- More research in local institutions related to RE technologies and resource efficiency.
- Greater availability of funds for researchers outside individual countries (through, for instance, the Qatar National Research Fund and the Arab Science and Technology Foundation).
- In many Arab countries, specific institutions deal with technology transfer and research in the water and energy sectors (Morocco, Oman, Sudan, Egypt, Tunisia..)

TT Opportunities in the Arab region

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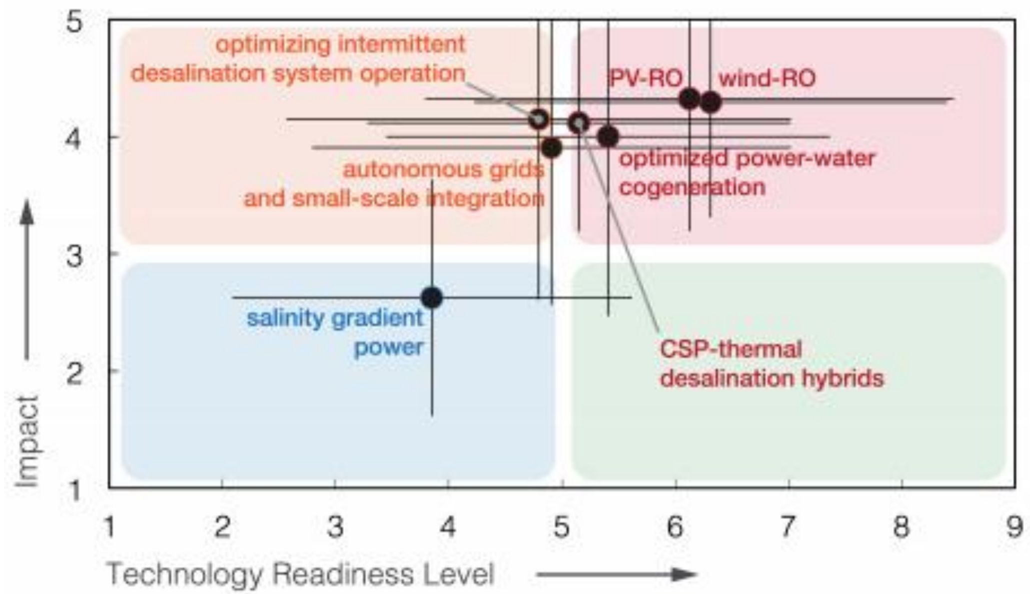
Areas of priority:

- Water Desalination
- Agriculture
- Renewable Energy



Source: Abdul Latif Jameel World Water and Food Security Lab, MIT

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 m^3 freshwater per day: Sufficient for 100 people → Covering food & sanitation

RO unit (1 m^3/h).

Site parameters:

- Water production capacity of 1 m^3/h
- Energy consumption: 4 kWh / m^3
- PV capacity: 8 kWp

→ Capital cost: 70.000 Euro

→ Cost of water: 3 – 6 Euro / m^3

PV field (4 kWp).

MEDA Water

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 ºC), PV power 10.5 kWp.

Operating more than 3,100 h producing 6,000 m^3 of drinking water in 27 months.

Raw water salinity 3.5 g/l.

Dessol®.

BWRO plant (2.1 m^3/h).

COOPERACIÓN CANARIA

EMBAJADA DE ESPAÑA EN TÚNEZ

aecid OFICINA TÉCNICA DE COOPERACIÓN

Case study 3: Agadir desalination plant

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Potable water reinforcement of Agadir by seawater desalination
Duration 30 years

- Shared project including irrigation needs for a total capacity of 400.000 m3/d at term.
- A Capacity of 150.000 m3/d expandable to 200.000 m3/d for potable water needs.
- Open intake
- Cost : 150 Millions €.
- Construction works under progress.
- Works commissioning date: 2020

Case study 3: Agadir desalination plant Shared risks

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Under Moroccan law 54-05 related to delegation of public services

Public Party

- Feasibility studies
- To Mobilaze land and infrastructures: adduction pipes and Energy
- Biding
- negotiating
- Sign Contract
- Off taker
- Contract monitoring: performance indicators
- Public Service

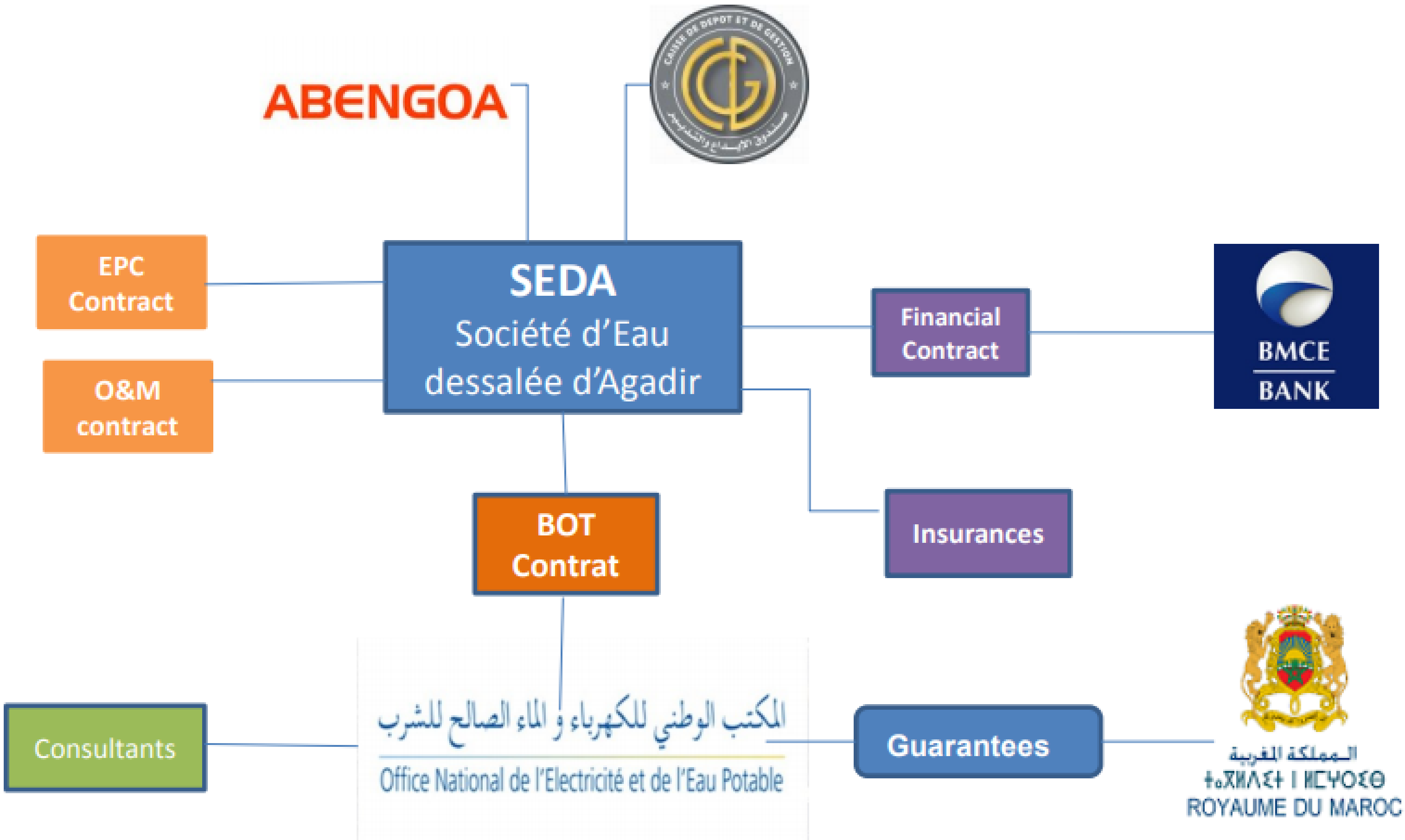
1st BOT CONTRACT: June 29th 2017

- Partnership for a long term.
- Share responsibilities and risks

Private Party

- Submit offer
- Negotiating
- Sign Contract
- Financing
- Design
- Built
- O&M
- reporting
- Sell drinking water
- Make a profit
- Transfer

Case study 3: Agadir desalination plant Institutional set-up



Case study 3: Agadir desalination plant Keys of success

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- To launch economic studies for the opportunity of BOT project
- To built a strong and sustainable PPP Contract because of the long term of the Partnership
- International consultancy have a supportive role to play in the 3 aspects:
  - Technical- financial and legal, closely with authority for the main mile stones of the project : biding- negotiating- Construction – commissioning
- Good allocation of risks between 2 parties: regulatory - Design- O&M respect of calendar– budget- environment- performance indicators… with appropriate risk mitigation : subject of long negotiations
- Secure payment by public party to the private party for the provision of service and use of assets
- Assets reverting to public party ownership at the end of the contract must be in a good manner
- Capacity building and exchange experiences with international community is the school of a strength PPP

Case study 4: Renewable Energy for Wastewater Treatment and Reuse in Agriculture

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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 4: 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 4: Success Story- AS SAMRA WWTP

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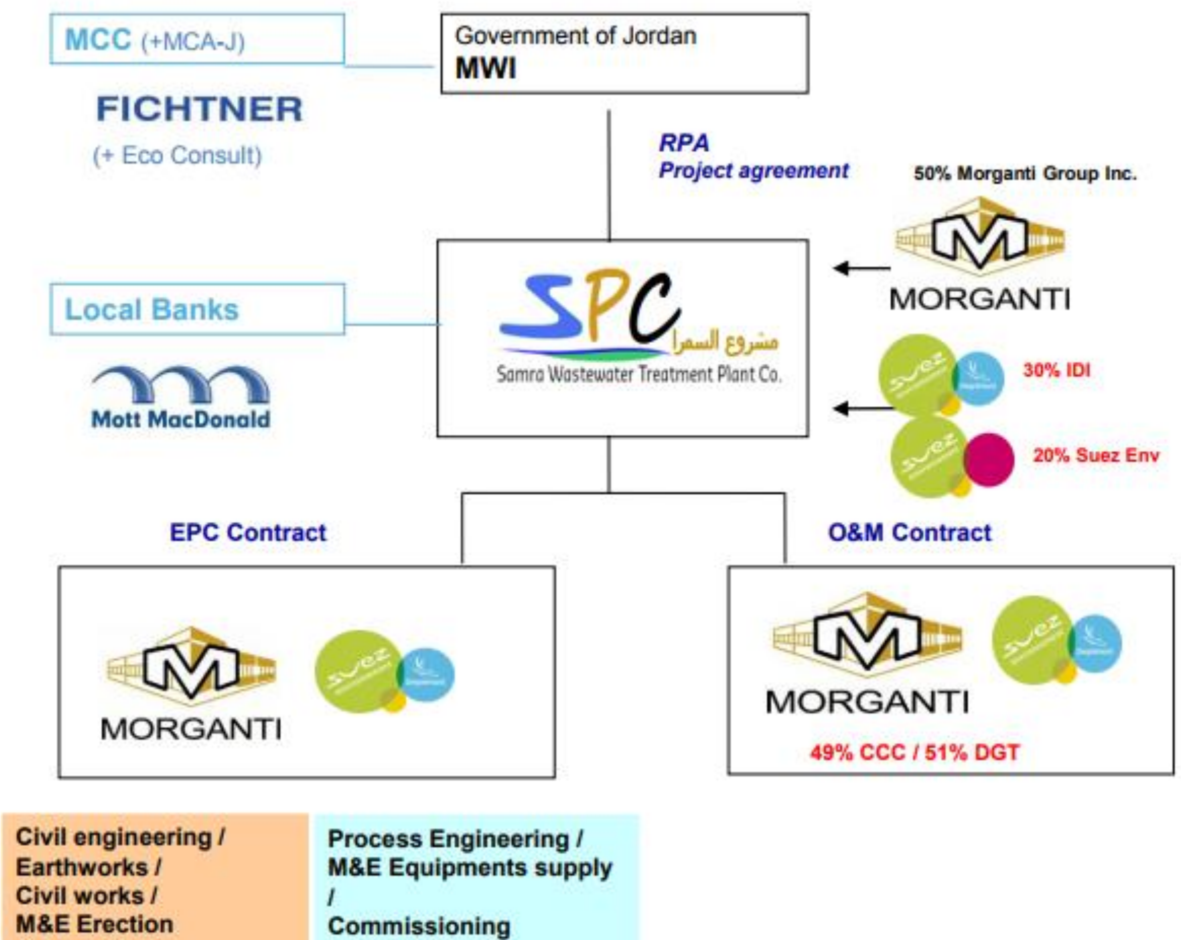
Stakeholders



- **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

Case Study 4:
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

Case study 4


Ain Ghazal Pre-treatment
AMMAN
RUSSEIFA
Zarqa PS
ZARQA
King Talal Dam ➜
HASHIMIYYA
Hashimiyya PS
As Samra WWTP
Scope of the BOT :
Existing 1200mm line
Existing 500mm line
New 1500mm line
Efluent
Influent point

Case study 4:
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/m^3 : the lowest in Jordan

Transfer of Know-how and industry best practices

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

Case study 4:
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

Case study 5: Solar Desalination in Saudi Arabia

To harness solar energy for all water desalination during 2010-2019.
- to reduce production costs of desalinated water from 0.67- 1.47 USD/m3 to 0.27 -0.40 USD/m3.

1st large-scale desalination plant to be powered by solar energy in Saudi Arabia.

Al-Khafji sewater RO Desalination Using Solar Energy

Phase I: Construction of a solar-powered desalination plant (10 MW and RO) at Al-Khafji Town (30,000 m3/day).
Phase II: Construction of a another solar-powered desal. plant (300,000 m3/day)
Phase III: Construction of several solar plants for desalination in all parts of the kingdom

Case study 6: Renewable Energy Desalination Pilot Programme

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- A notable example of successful technology transfer. Work began in Ghantoot, Abu Dhabi, in 2015. Co-funded by the Government of Abu Dhabi and industry partners, aims to develop desalination technologies that are energy and cost efficient. It is planned to have a commercial facility up and running by 2020, and thereafter to build RE-powered desalination plants in the UAE and other Arab countries.

- Full-scale implementation is expected to lead to energy and cost savings of about $94 million annually for Abu Dhabi, assuming that 15 per cent of new desalination capacity is met through the RE-powered energy-efficient technology. The partners benefit from Masdar financial support.
- Masdar plans to invite more companies to develop and test their advanced RE-powered desal technology, thereby extending the technology transfer process.
- The benefits of addressing the water-energy nexus in this manner are clear. Similar programmes could be set up in other Arab countries to transfer the technology.

Conclusions

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- There are many examples of how various Arab entities can collaborate to facilitate successful technology transfer: (e.g. Collaborative projects under EC programmes such as PRIMA)
- 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 needs 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.)

Recommendations

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- For the Arab States, it is imperative to accelerate the transfer of innovative technologies by developing educational large-scale pilot projects in priority areas, including renewable energy systems & sustainable desalination technologies. This will also help to build up a critical mass of technicians in the region.
- Technology transfer by EPC (Engineering, procurement, construction) contractor to build seawater desalination plants should be designated clearly in the EPC contract.
- Arab countries must establish or develop technology transfer offices to improve intellectual property protection and thereby encourage industrial R&D;
- The Arab countries should focus initially on making the most versatile and least complex parts.

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