



**Mekorot**  
Israel National  
Water Company

**EMS**  
Mekorot  
Projects

**Mekorot**  
Development  
& Enterprise



## *“Smart Water Management Systems for Water Stress Regions”*

**AVRAHAM BEN JOSEF**  
**VP Engineering & Technology**



Water should not be taken for granted. We make it happen, in Israel and in the world!

# Mekorot Group



{ Unique Global Competitive Edge }

# General Information





# Facts and Figures About Mekorot

**71,000** water samples analyzed per year

**9,000** km and more of water pipelines

**70%** of the total water consumption in Israel

**1,050** wells drilled

**85%** of potable water in Israel

**3,000** installations for production and supply

**60%** of the Recharge of the effluents in Israel

**6** certified laboratories in Israel

**10** command and control centers

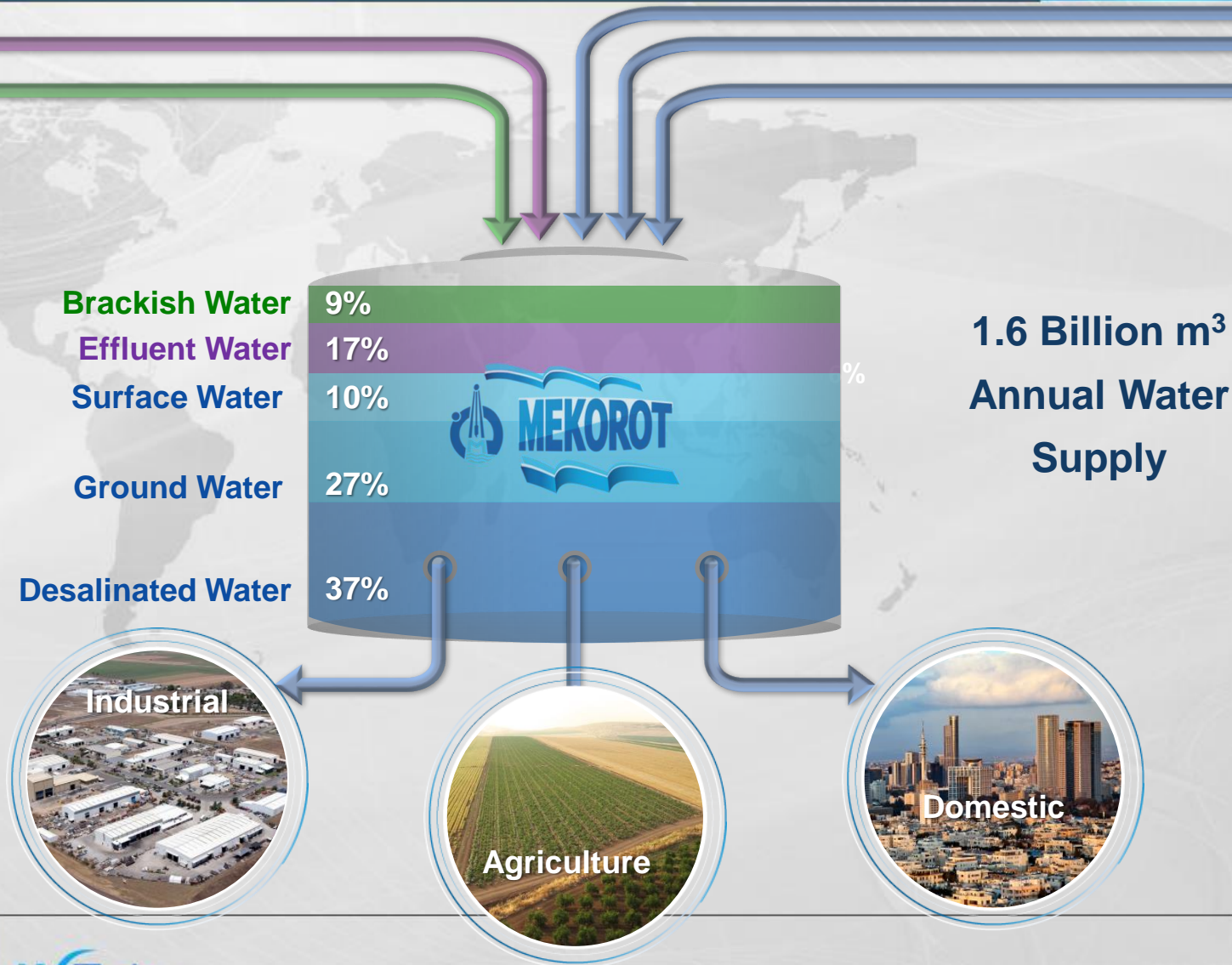
**13** wastewater purification centers and reclamation plants

**43** desalination plants

**1.6 billion m<sup>3</sup>** of water supplied per year  
(423 billion gallons)

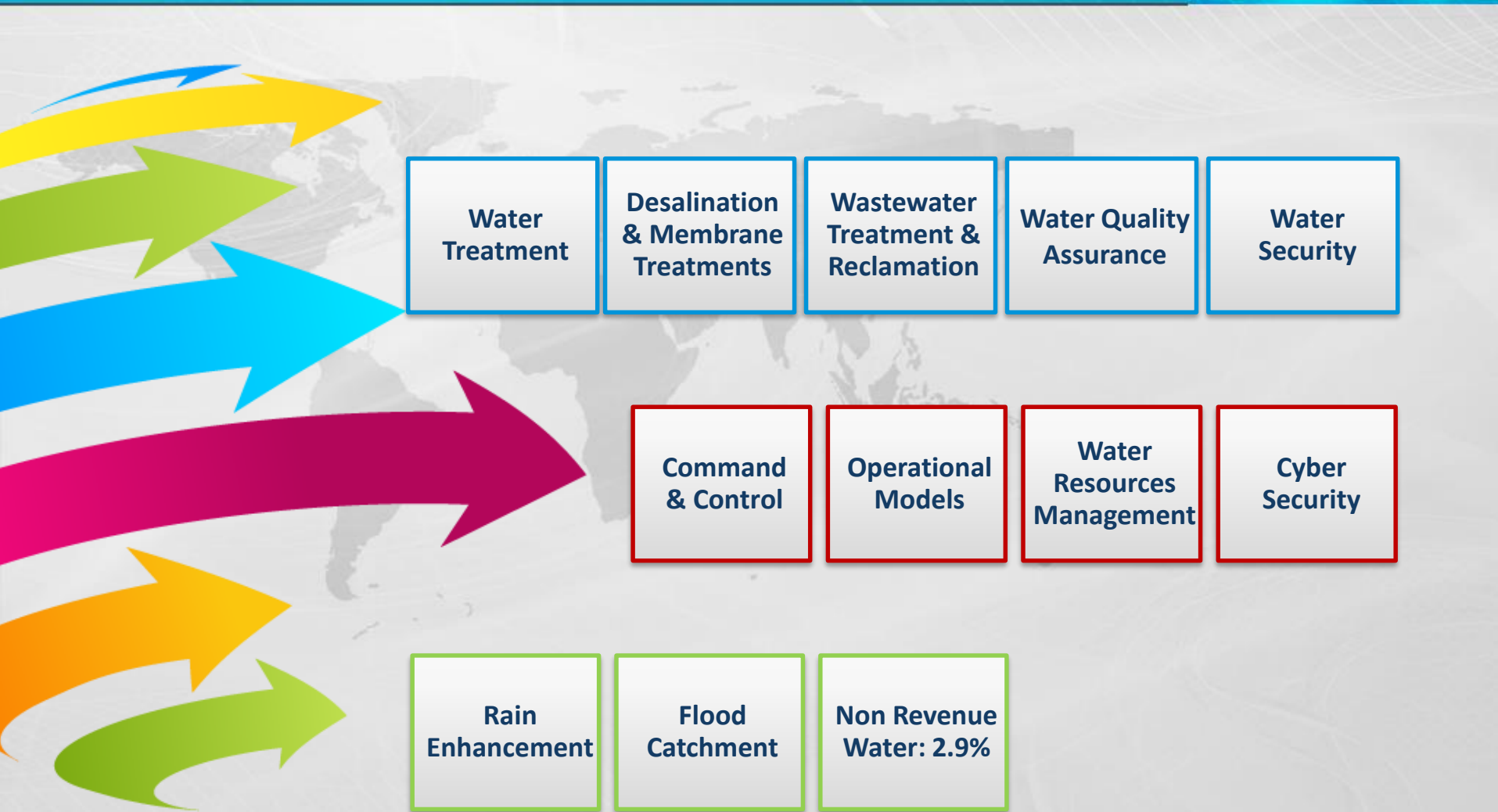
{ 95% cover of the water sector }

# The Uniqueness of Israel's Water Supply System



# The Challenge

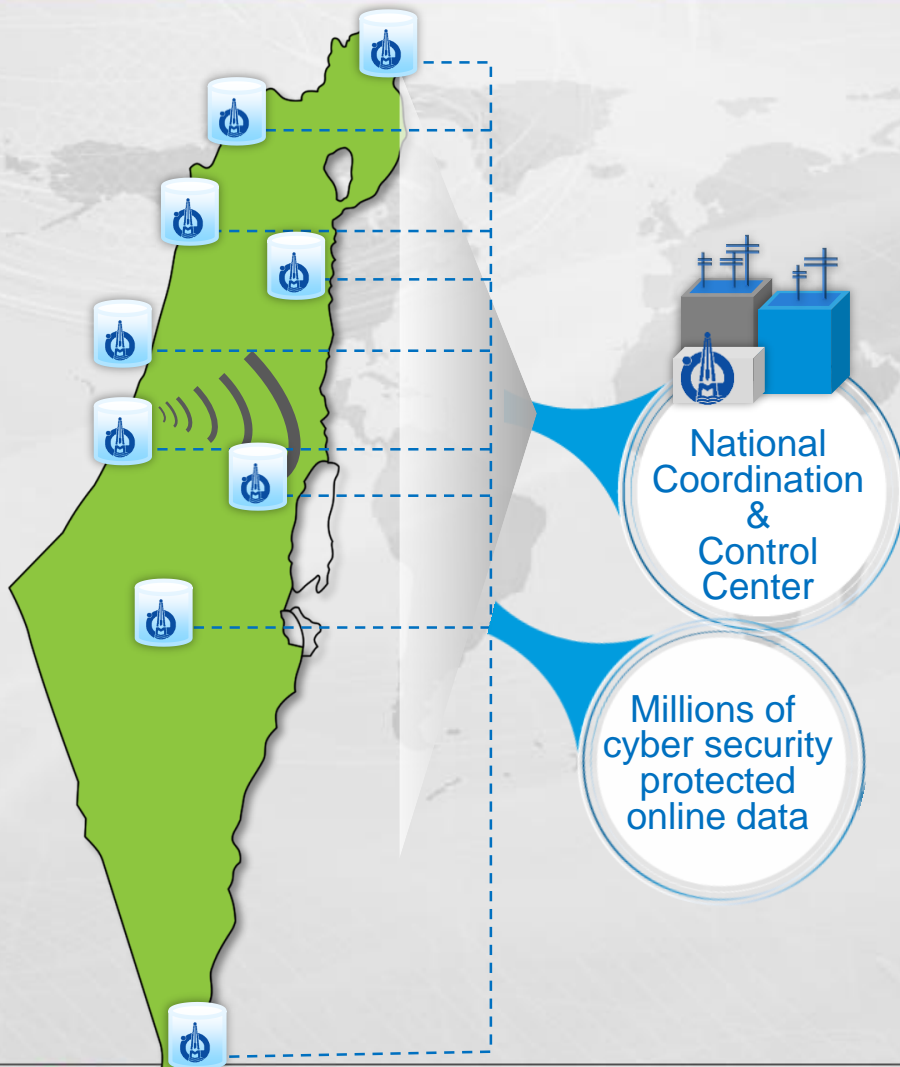
## Integrative Real-Time Management of the Water Resources





# Water Management

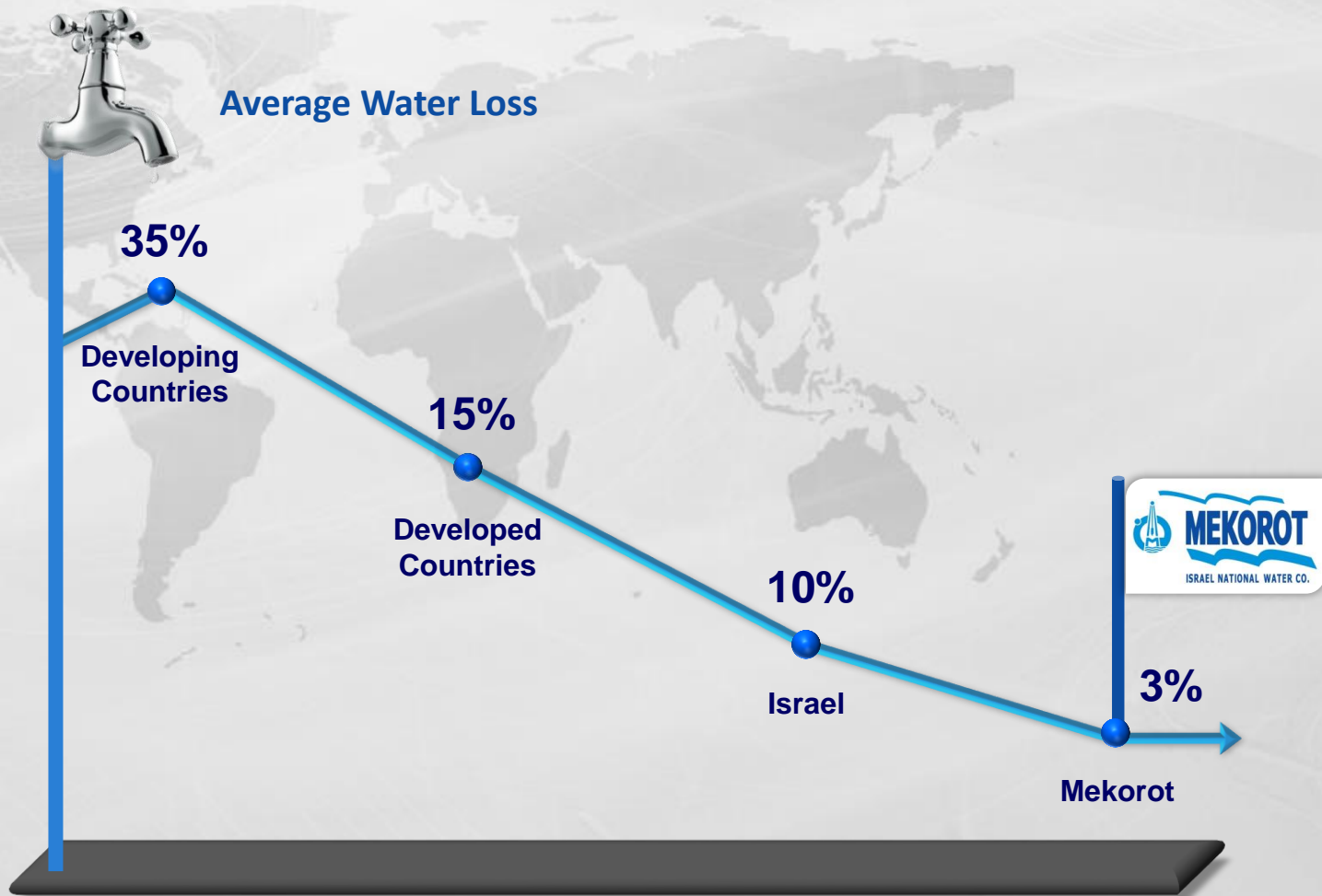
## Command Control Communication and Cyber



- Managing the entire national water system requires smart integrative management
- Mekorot operates 10 command and control centers which monitor 3,000 facilities in real-time by remote control
- Optimizing and increasing efficiency, by means of local and remote control, automatic meter reading (AMR), advanced models and decision support systems (DSS)

# Water Management

## 3% Water Loss - World Record





# Water Treatment & Quality

- Mekorot operates **800** water treatment plants from different types of sources
- Improving water quality by using a variety of advanced water treatment technologies
- Mekorot operates **6** certified advanced water quality laboratories, conducting **260,000** tests per year



# Wastewater Treatment and Reclamation of Effluents

170 million cubic meters of wastewater are collected from Dan region municipalities to the Shafdan Waste water treatment plant

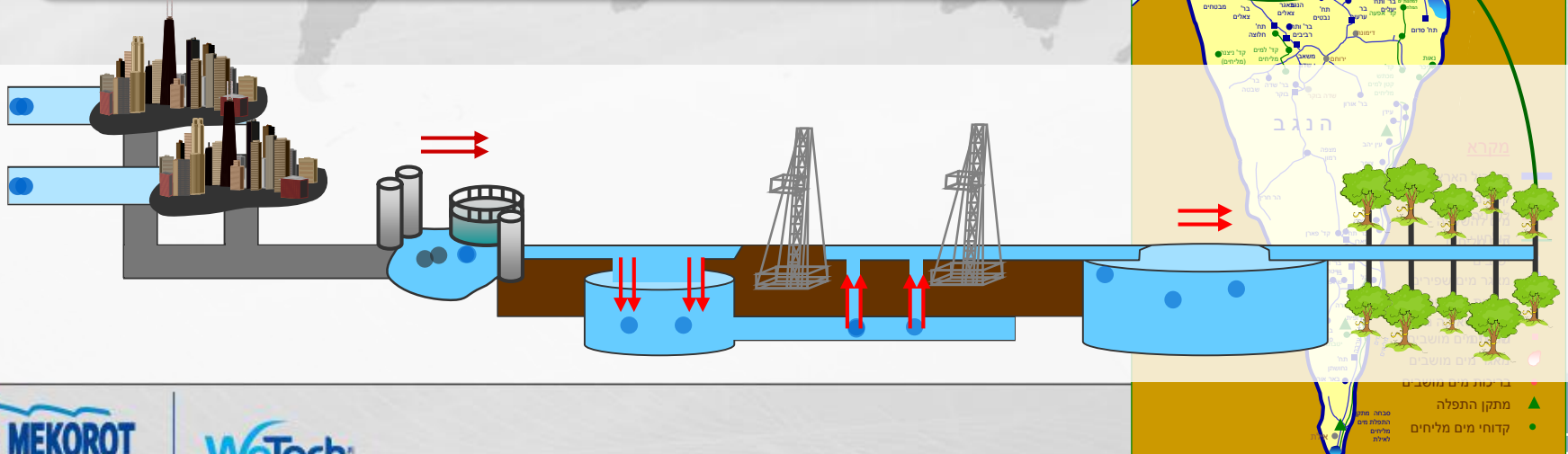
Shafdan WWTP produces secondary effluents

6 infiltration ponds are used in the SAT ( Soil Aquifer Treatment) process for effluent reclamation

150 wells for reclaimed water production and monitoring

90 km of reclaimed water pipeline to the Northren Negev

32 pumping stations, 500,000 cubic meters operational reservoirs, 17.2 million cubic meters seasonal reservoirs



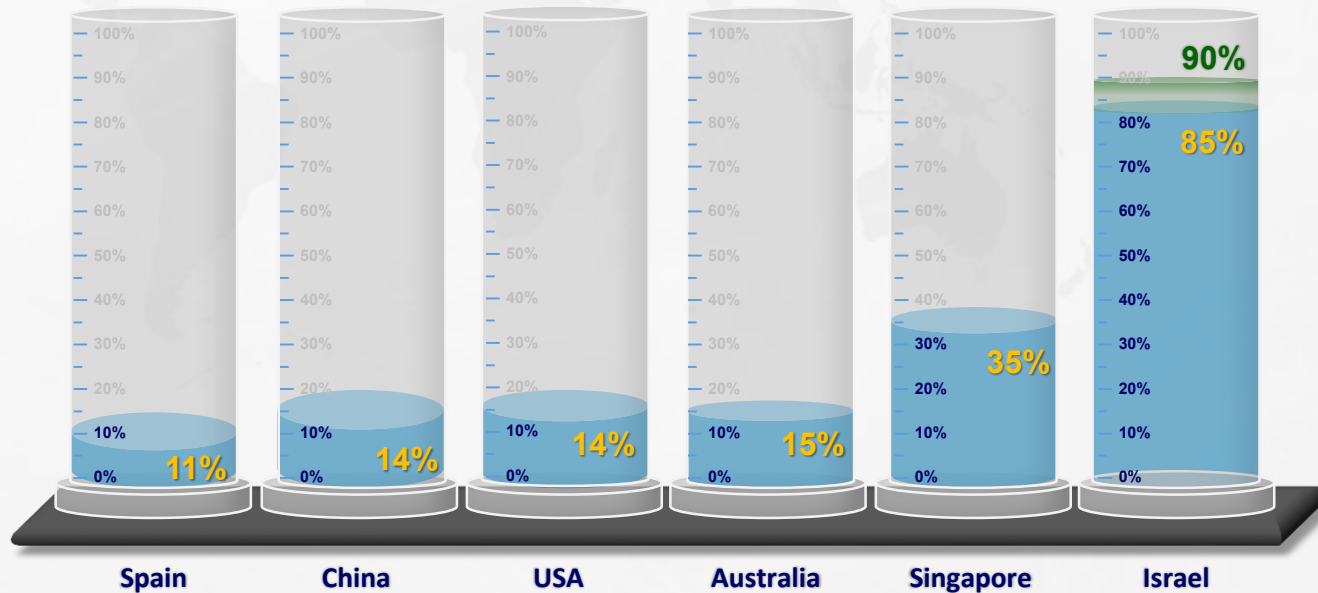
# Wastewater Treatment and Effluent Reclamation

Reclamation of 85% of all the effluent in Israel, for agriculture and irrigation

Ability to supply all the agricultural needs

Quarterly wastewater treatment by means of ultra filtration and desalination

The Goal:  
90%  
Reclamation



\*GWI Municipal Water Reuse Markets 2010



# MEKOROT'S Desalination Plants in Israel and Cyprus

Israel: 39 brackish water and 4 seawater plants

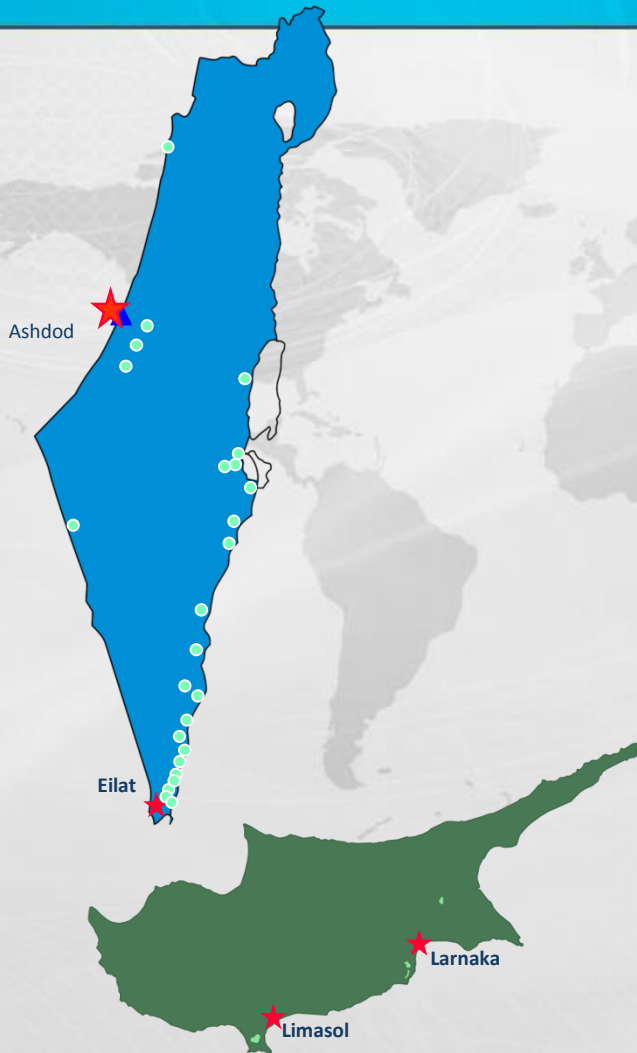
**Yearly capacity, 2017: 156 million m<sup>3</sup>**

- Water Supply rural areas that are not connected to national grid
- Treatment of heavily contaminated water

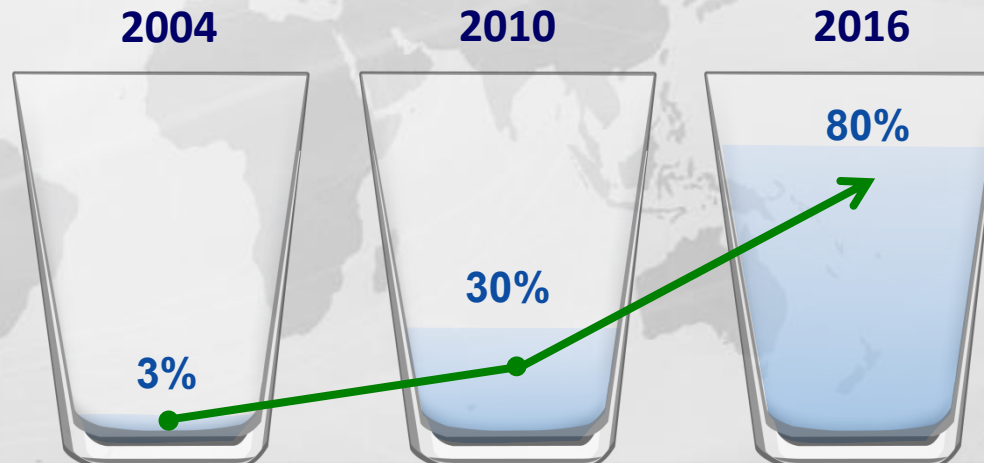
Cyprus: 2 seawater plants

**Yearly capacity, 2017: 34 million m<sup>3</sup>**

- **Limassol**: BOT project for 23 years
- **Larnaca**: BOT project for 27 years, upgrade + operation

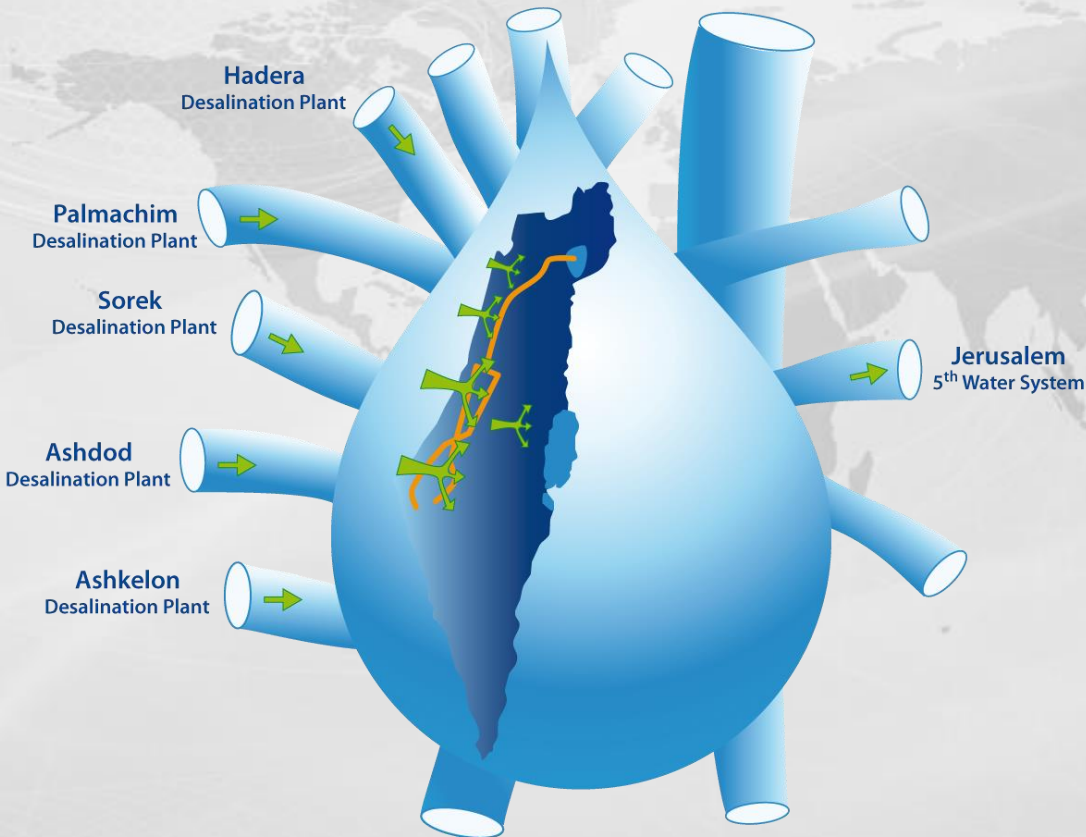


# Desalination: The Israeli Water Revolution



**In 2016, 80% of the drinking water  
Are from desalination facilities**

# Operational Complexity in the New Era



Supplying water from the Kinneret  
**within 7 days**

Supplying desalinated water  
**within 3 hours**

Water from various water sources  
are supplied in a short time without  
storage capabilities  
**A huge operational challenge**





There's still some water missing.

WATECH

Join us to fill it up!



Founded in 2004

### Key Goals

Positioning Mekorot at the cutting edge of technology

Improving Mekorot's technological performance and reducing Mekorot's CAPEX and OPEX costs

Developing the human capital in Mekorot

Creating new sources of income

### How we achieve it?

Identifying Mekorot's technological needs

Attracting innovative technological partners

Implementing innovative technologies to address Mekorot's needs, and needs of the international water industry

# Entrepreneurship & Partnership Center for Water Technologies





# Center of Excellence

Innovation-validation survey

Techno economic analysis and support

Joint planning of alpha & beta and demo projects . These are executed in Mekorot's diversified applications throughout the water sector

Technological advice and support in R&D projects based on the extensive experience of more than 250 of Mekorot's engineers

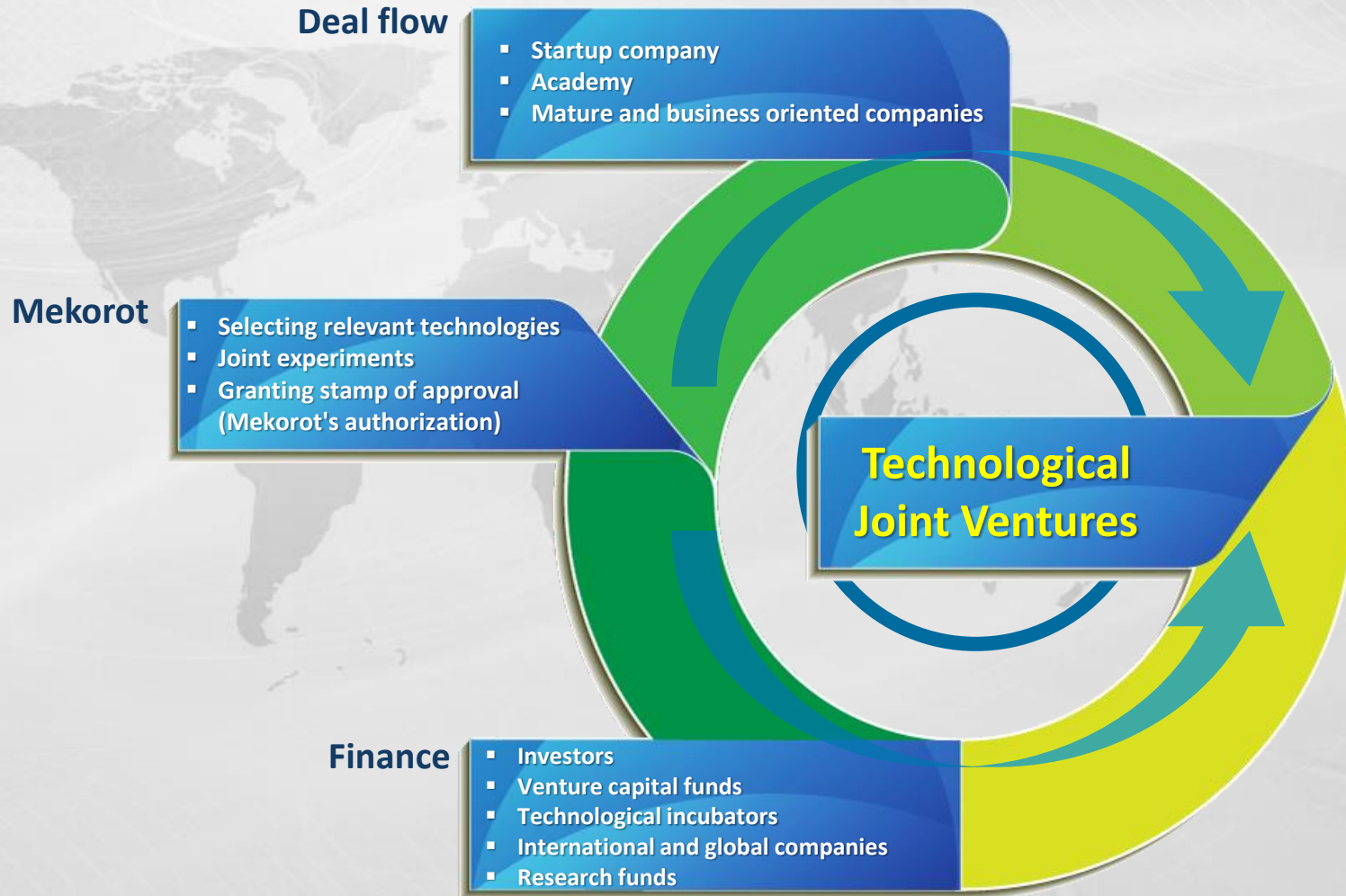
Feasibility tests and validation

Partial participation in the funding of the project

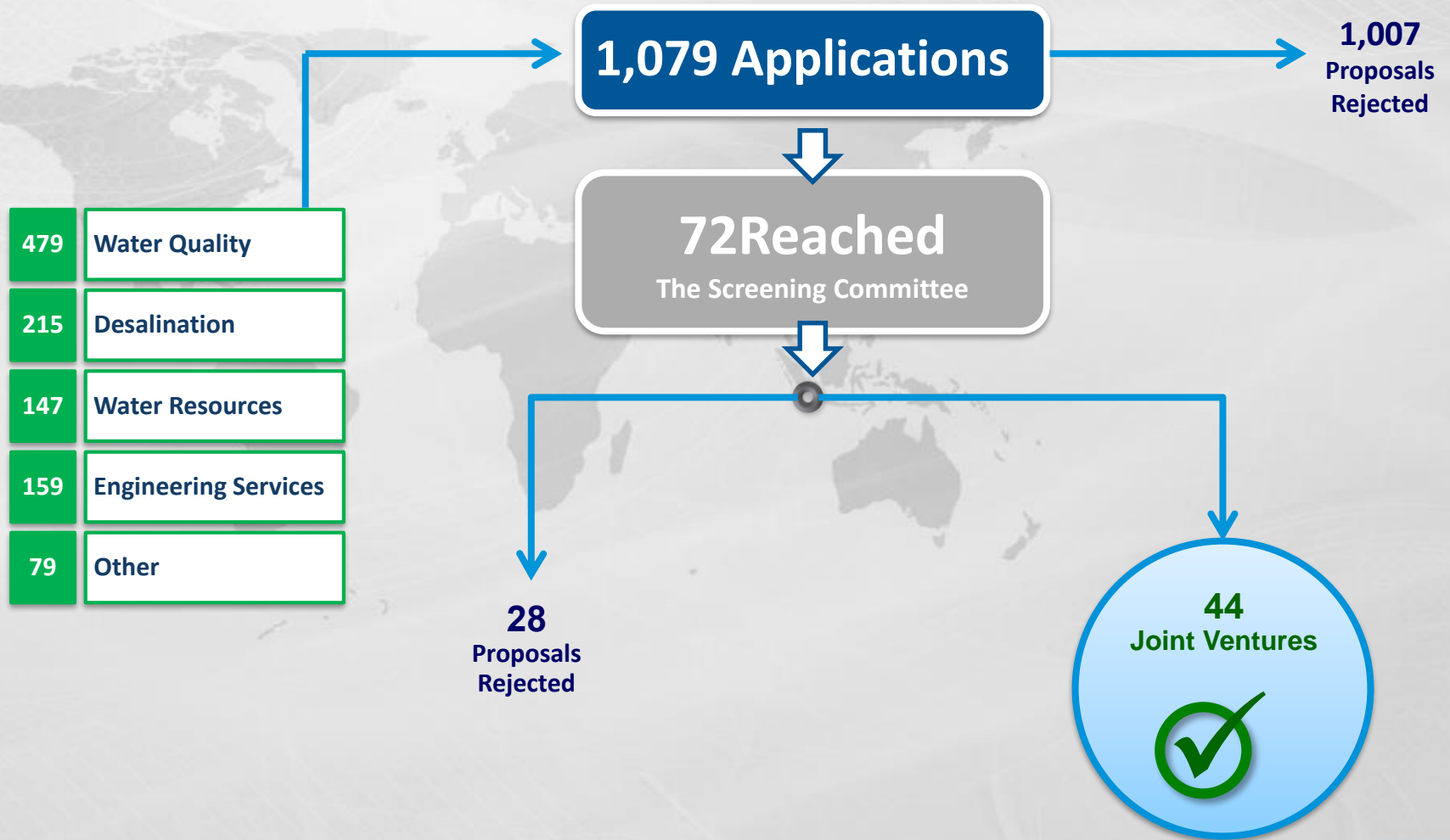
Support in the commercialization of technologies

**WaTech®**  
Water Technologies Accelerator

# Water Technology Commercialization Platform



# The Number of Applications Handled by the WaTech® Division 8/2017





# Business Partners

## Water Resources Management



## Water & Wastewater Treatment & Water Quality



## Digital

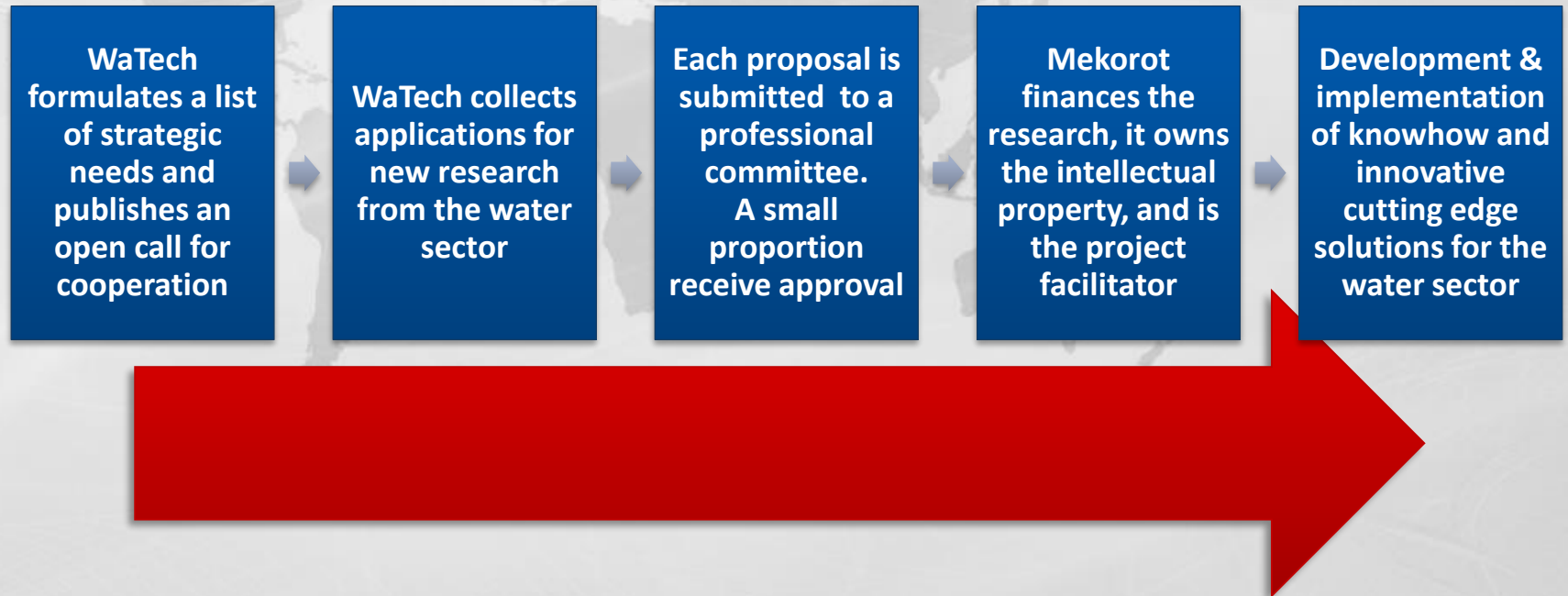


## Digital Solutions



# Applied Research at Mekorot

## The Process



# R&D Centers and Key Partners

## From the Israeli Academia and Industry

### Partners

Ben-Gurion University

Hebrew University

Technion

Tel Aviv University

The local water sector

### Mekorot R&D Centers

Eshkol – Central Laboratory: Center for Surface Water Purification and Monitoring Technologies

Shafdan – Center for Advanced Wastewater and Effluent Technologies

Sabcha (Eilat) – Center for Desalinated Brackish and Sea Water Technologies

3,000 well diversified facilities across Israel



# Significant Achievements in R&D

Reducing costs and consumption of energy in seawater and brackish water desalination

Protecting large diameter pipelines from heavy loads by cost effective measures

Reducing cost of maintenance of water pipelines that accrue from external corrosion

New methods and products for water security

# Local and International Platforms for Cooperation

Ways for cooperation with the academia, mature companies and start ups



Israel Innovation Authority



Bilateral Programs



European Framework for R&D

# Examples of International Collaboration in Bi-National Research

## US – ISRAEL (BIRD)

GE – Desalitech (and Mekorot as a subcontractor)



- **The Application-** Advanced municipal wastewater treatment
- **The Need-** Achieving RO process efficiency: higher rejection with lower energy, higher flux with lower bio-fouling tendency, higher recovery with lower scaling tendency
- **The Technology-** Innovative high flux membranes by GE, innovative CCD™ RO configuration by Desalitech, Benchmark - Multistage RO configuration for comparison by Mekorot, Beta site from Mekorot

## CANADA – ISRAEL (CIIRDF)

RealTech – Mekorot



- **The Application-** UV absorbance monitoring as an indication of organic pollution in drinking water
- **The Need-** Distinguishing between abnormal (water quality event) and normal (operational) variation in organic content
- **The Technology-** A combination of affordable sensitive monitoring systems by Realtech and EDS (event detection system) developed by Mekorot water quality security and modeling specialists



# STOP-IT Strategic, Tactical, Operational Protection of water Infrastructure against Cyber-physical Treats



## Goal

**STOP-IT project aims to efficiently tackle cyber-physical security threats, bridge an existing risk management gap in utilities' practices and an untapped technology market potential for protection solutions for water infrastructure**

## Benefit

STOP-IT will cover the whole risk management chain from Prevention and Detection to Response and Mitigation and it will allow to integrate security and technical aspects of risk management into the same view, so to guarantee permanent control over the water systems. This will result to a new approach that will enable flexible water systems management tailored to the need of the water utilities.

## Partners

SINTEF (Norway) as a coordinator and another 21 partners including CETAQUA (Spain), KWR (The Netherlands), Technion (Israel), Aigues De Barcelona (Spain), Berliner Wasserbetriebe (Germany), Aplicatzia (Israel)



**Implement Innovative  
Engineering Technologies**

**- Commercialization  
- Implementing Technologies  
in Israel & Abroad**



**-3 Main R&D Centers  
Throughout the Country  
- Development of Alpha &  
Beta Stage Prototypes  
- Joint Ventures with Start  
Up's & Academia**







# BQR Technologies

## Real-Time Predictive Maintenance



### Need

Water facilities demonstrate varying amounts of components wear, derived from contaminated water, corrosion, dust, particles, sea weeds leading to: Unexpected failures, Expensive reactive maintenance, Reduced Production and Availability.

### Solution

Industrial Internet of Things (IIOT) wide range of sensors are used for cloud based data collection. Data Analysis and Prognosis delivers a user friendly dashboard which presents:

Components' State of Health (SoH), Remaining Useful Life (RUL), Alerts regarding approaching failures

The tool includes a unique analytic algorithm which uses the collected data in order to optimize the maintenance strategy including: Predictive Maintenance (PdM), Spare part provisioning, Central/ distributed / forward / local spare location policy Repair/Discard policy

This results in significant reduction of maintenance cost while keeping a high asset availability and performance.



### The Need

Improved efficiency of the desalination process by increasing the ratios of recovery (the amount of produced water in relation to the amount of raw water), which is likely to be significantly beneficial both economically and environmentally, leading to considerable saving in the consumption of chemicals, reducing water consumption and the volume of processed residual brine, and prolonging the membrane's life

Generally, the reclamation ratio is dictated by certain types of fouling (blockage), the major one being scaling. Therefore, innovative technologies are required to offer a solution to this process challenge, for economic/environmental improvement of desalination process performances.

### The Solution

Technology A - flow reversal increasing the recovery ratio, increasing the plant's output, decreasing brine volumes, and decreasing chemical consumption without fouling; the development has been completed

Technology B - a sensor for immediate detection of significant fouling development, such as scaling or biofouling, for quick preventive process response; under development.



### The Need

#### Target Market >

- Desalination of process water and wastewater in different industries, desalination of brackish water, desalination of effluents, desalination of seawater (boron removal system)

#### The Consumers >

- A wide range of industries, companies engaged in water treatment, public bodies, municipal water companies, water authorities, engineering companies

#### Market Value >

- Over \$40 billion

### Product Status

“Flow reversal” has been successfully tested by Mekorot in salt water desalination

The success of this technology has also been proven in facilities sold for industrial uses in several countries

A pilot is underway, with European funding, to test flow reversal in effluent desalination

A pilot has started in testing flow reversal, to improve boron removal system performances (Pass 2) in seawater desalination





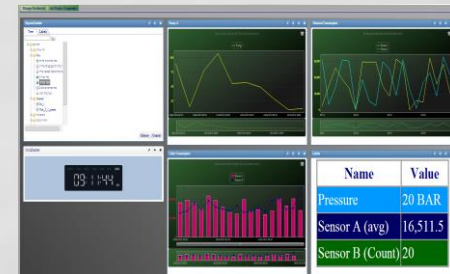
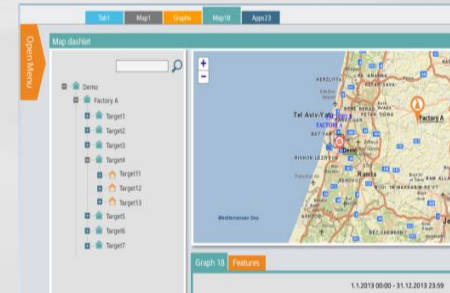
### The Need

A holistic system is required for a rapid response to water quality events in drainage basins

There are multiple systems worldwide; however they lack the integrative approach from the level of the sensor, through algorithmics, to an online model that enables real time decision making

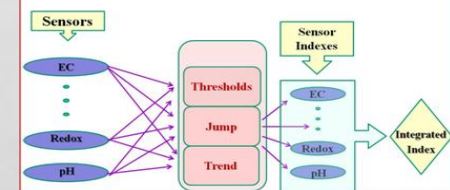
### The Solution

A holistic system, comprising of advanced sensors, geographically deployed monitoring stations, a sophisticated algorithm to identify water events, a hydrologic model to predict contamination spread, and a smart and friendly interface



#### Real-Time Integrated Multi-Channel System

##### Algorithm: Flow-Chart



### Potential

In many regions of the world, surface water is the main source of water. The solution is relevant to any watershed

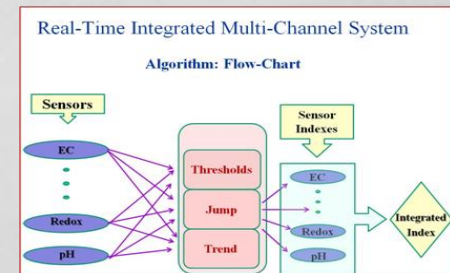
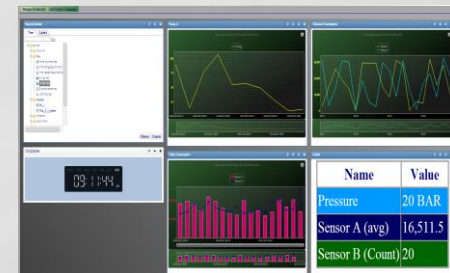
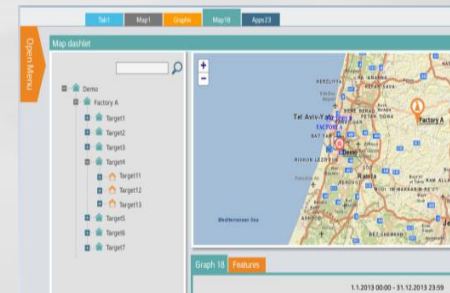
### Product Status

The infrastructure and algorithmics have already been successfully applied.

The expansion/spread model is under development.

A system of information collection, processing and presentation is operating in dozens of plants

An interface of event mapping presentation and event-management screen has been developed and is currently being tested



# Wadis

## Water Treatment by Electrical Pulses Discharge



### Need

Resolution of muddy and/or heavy organic load liquid limitation in wastewater, aquaculture, agriculture, cooling towers, food and beverages etc.

### Solution

Non reagent ecological method, based on electrical pulse discharge in the water. High electrical volt is discharged into water, following : strong shock waves, high light radiation including UV, high magnetic and electric fields, ionization and polarization of the molecules, cavitations, and very high temperatures at the discharge canal. All of these act as disinfection agents, effective against a wide range of microorganisms in various applications.

Wadis first demo system is working on a full scale at Kfar Saba-Hod Hasharon WWTP (30,000 m<sup>3</sup> /day) and a second demo system will be installed soon at the Karmiel WWTP, under a joint project with Mekorot.

Third demo system to be installed at the SHAFDAN WWTP, for an advanced oxidation treatment application.

