"M.B.T-3"

real-time computerized system for optimal operation of large-scale water supply networks

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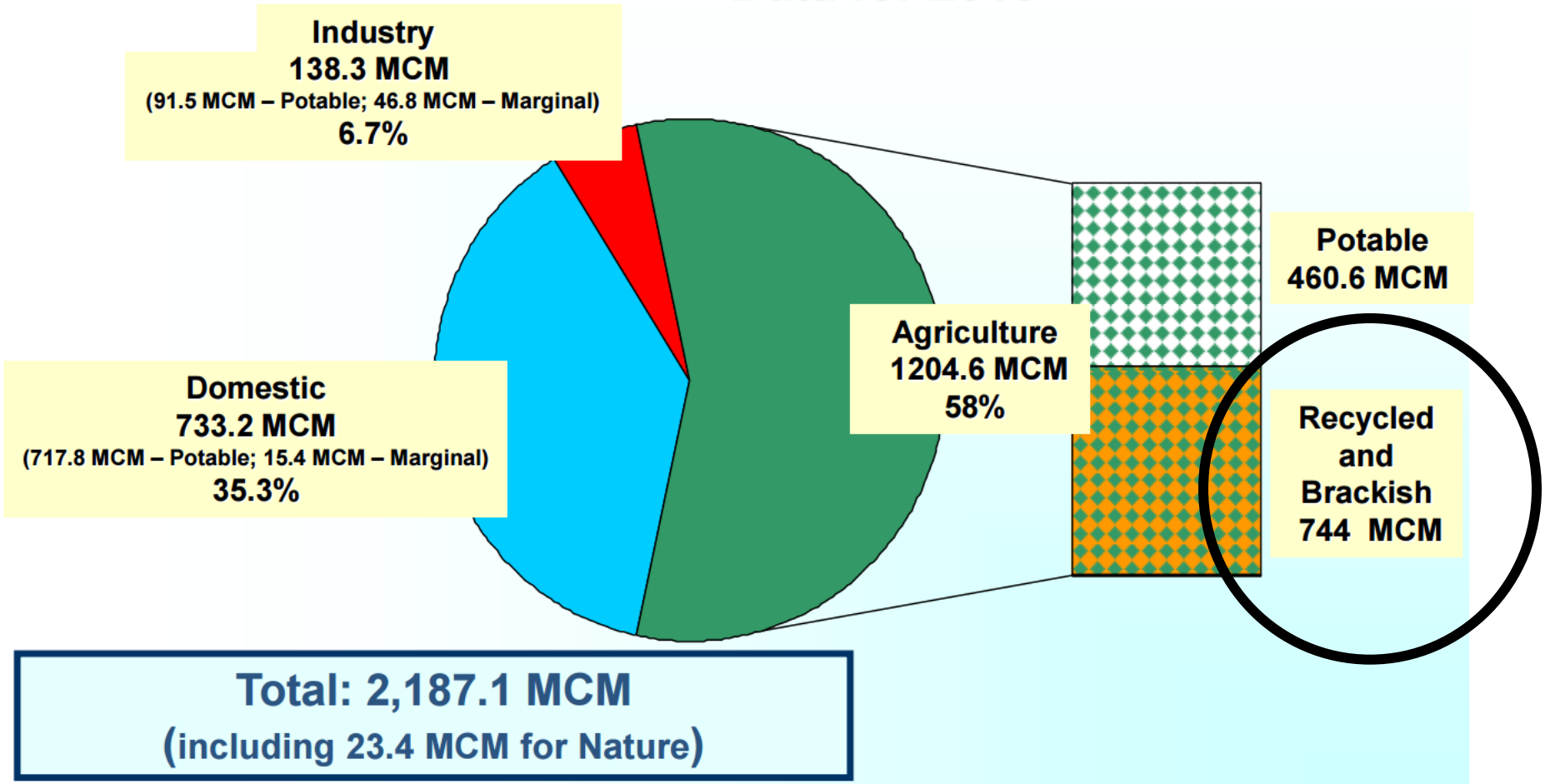
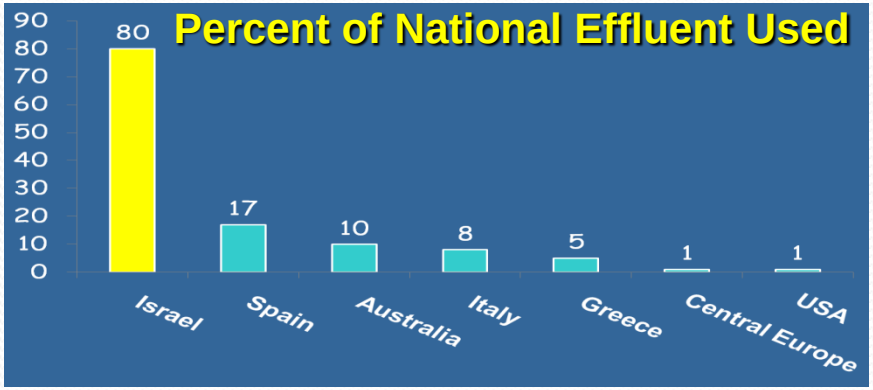
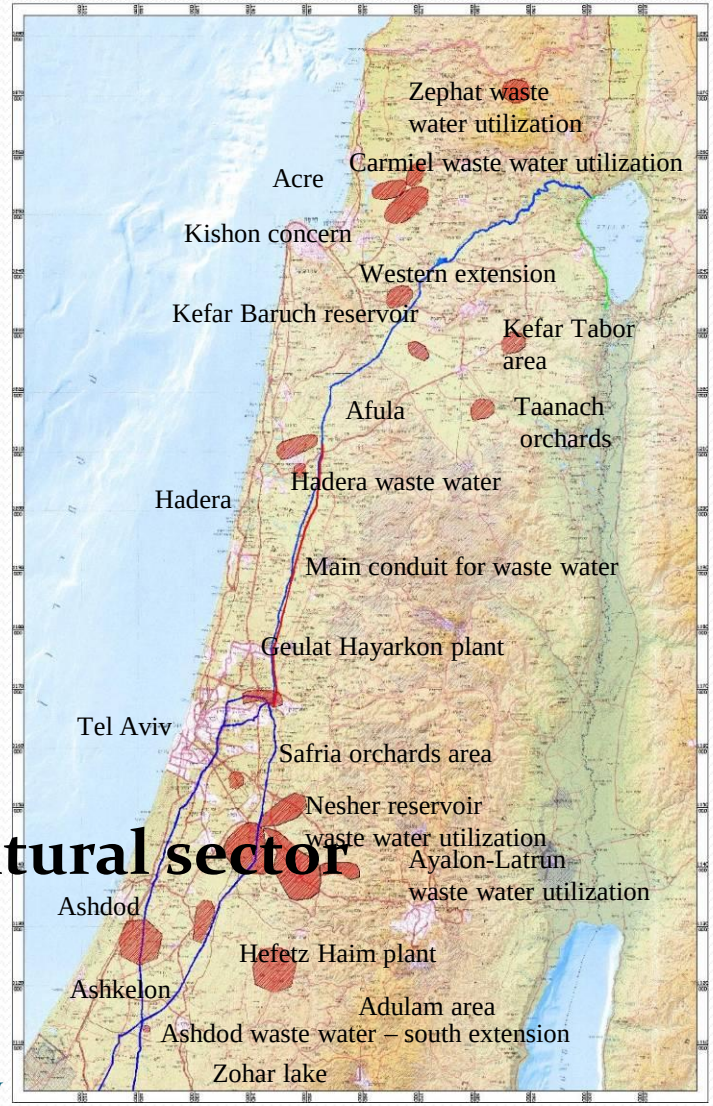
water consumption in Israel



treated wastewater as a major source for irrigation





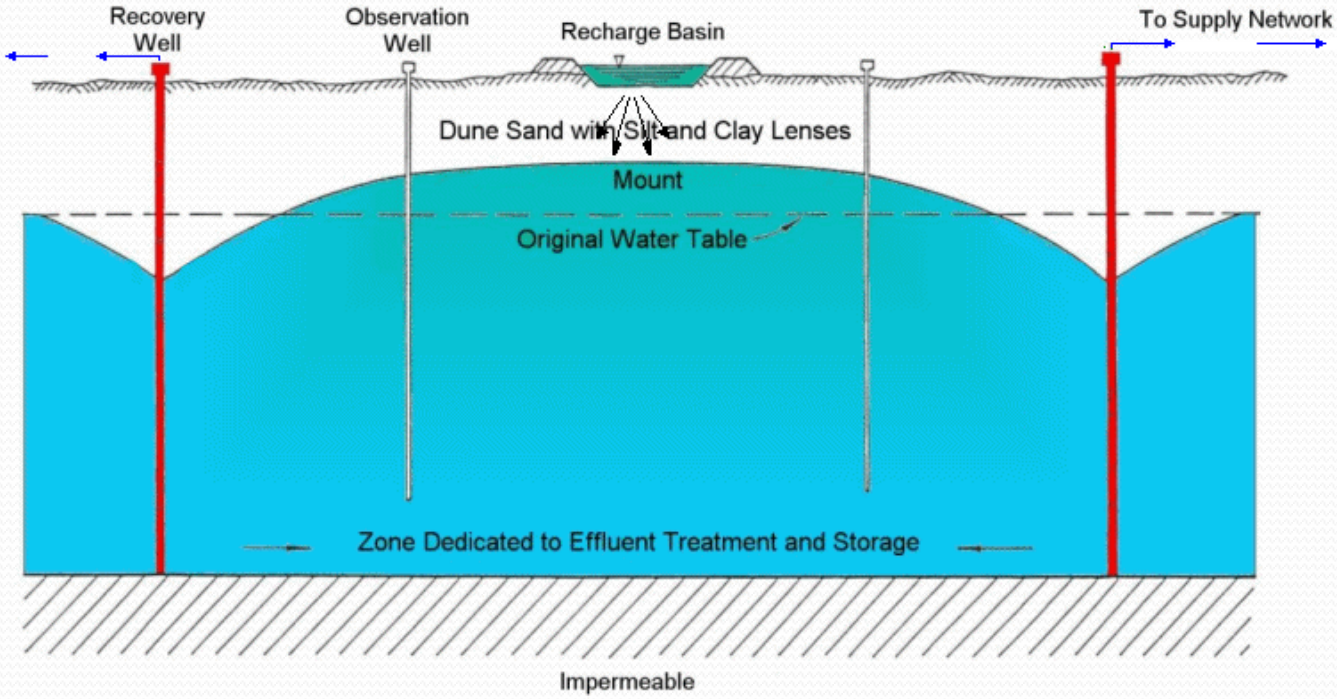
50% of allocation for the Agricultural sector
Total 410 MCM/Y
2014

the supply system of treated waste water SHAFDAN – NEGEV 3rd line

Supply network

6 infiltration fields

secondary treatment – 130 MCM/Y effluent



- 170 MCM annual supply
- 150 wells
- 52 pumping stations
- 7 faucets
- 8 connections to potable water
- 19 reservoirs
  - 5 seasonal reservoirs
  - 14 operational reservoirs
- 602 supply connections
- 100 km by 100 km geographical spread

Energy consumption 200 Mkwh
Annual pumping cost 19 million US$

The complexity of the operation

seasonal reservoirs

- **Is the maximum filling required?**
- **Which is the preferred season of filling?**
- **What is the rate of depletion?**
- **Electricity cost variables?**
- **Evaporation and seepage losses?**

additional potable water

- **from where?**
- **how much?**
- **When?**

Production wells supply

- **a constant flow rate?**
- **division between well?**
- **hydrological constraints?**
- **Different water quality?**

Control and management

- **15 operation regions**
- **4 Control centers managed by 2 distinct districts**

The challenges

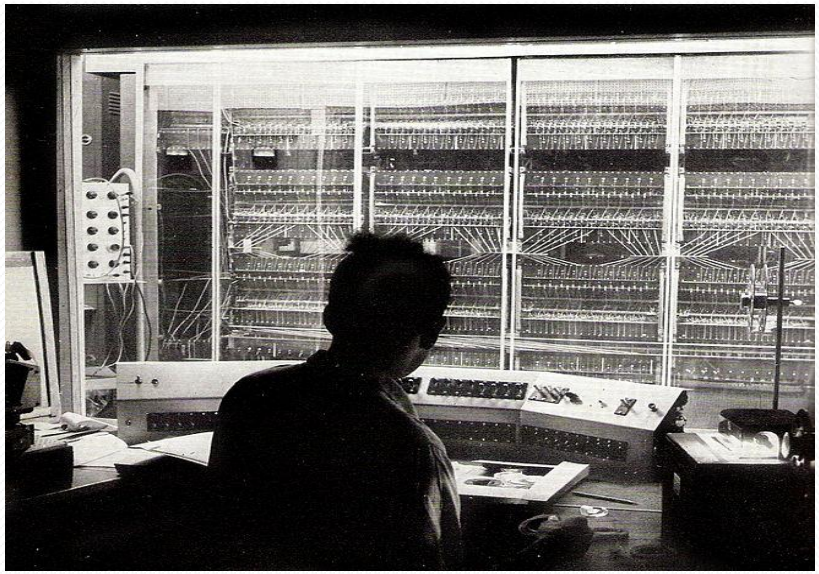
- reduction of energy cost
- reduction of used quantities of potable water
- increasing reliability of supply
- the most efficient use of production wells

developing the system

MEKOROT - internal process

- Use of existing component
- "Agile development methodology"
- dynamically and adaptively
- tight connection between developers and users
- all partners were defined as “a joined team”

M.B.T. 3



The heart of the system

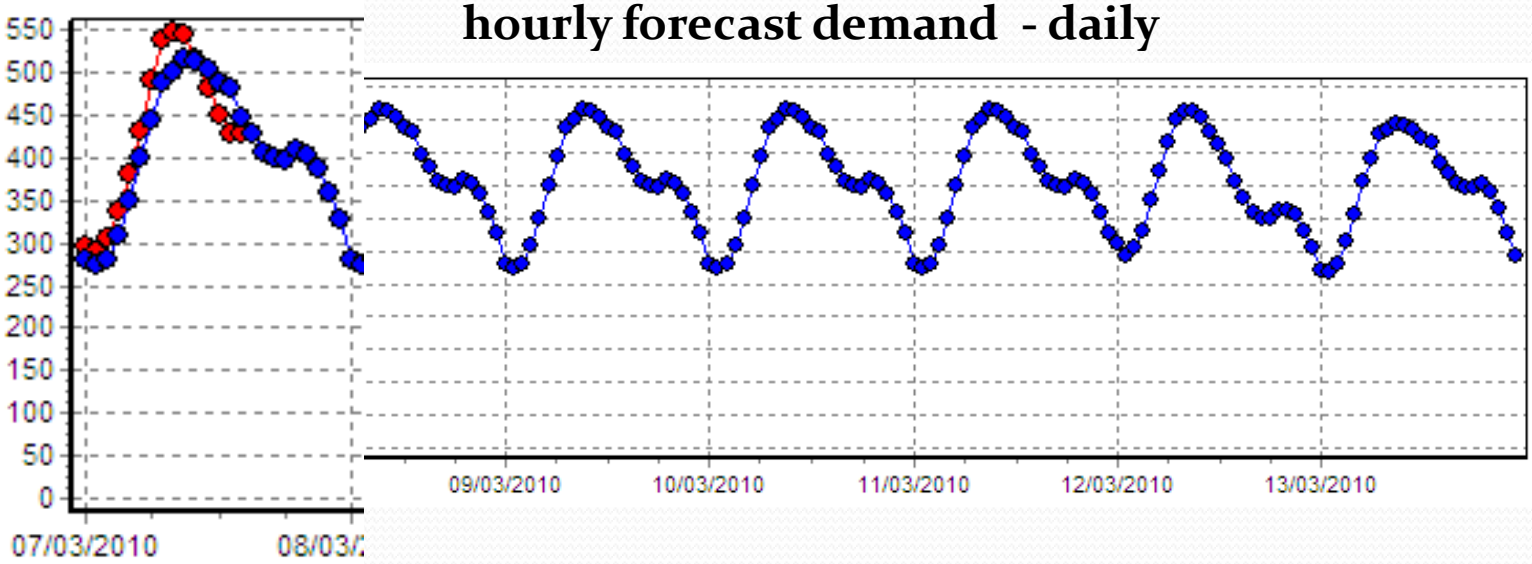
- a large scale optimization system "Almog"
- dual objective functions:
  - minimum energy costs
  - minimum use of potable water
- 177,000 decision variables
- 77,000 constraints

The system functions

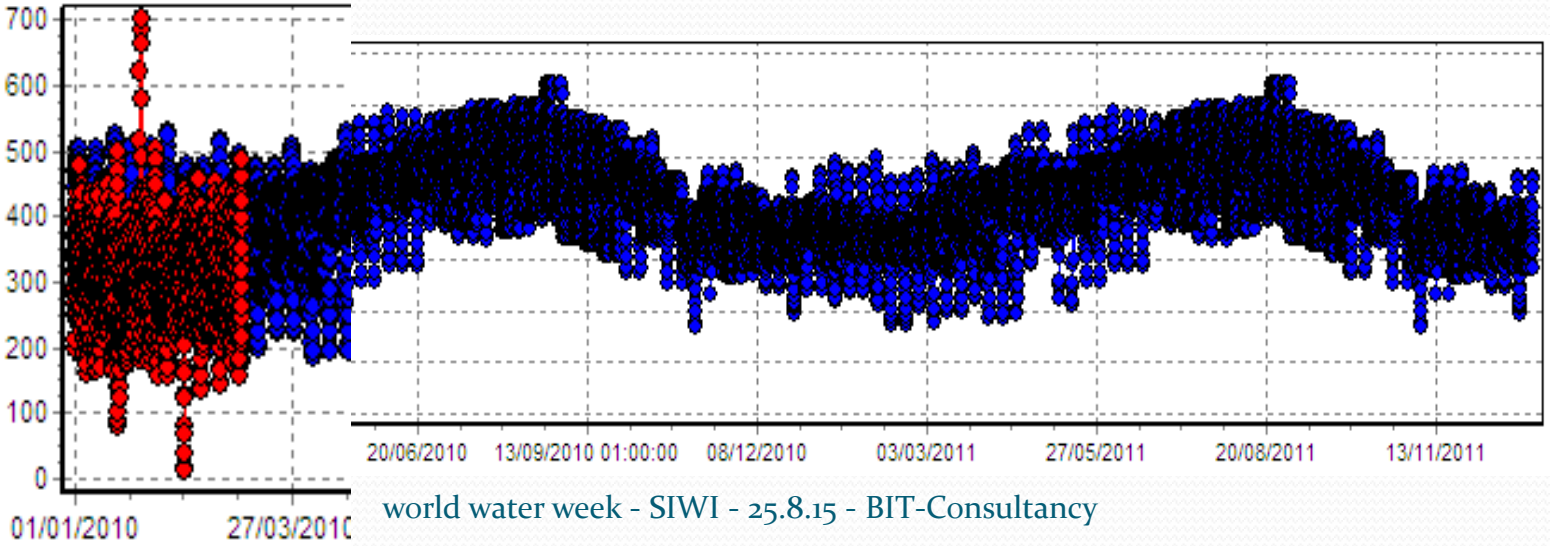
- dynamically collects measurements from all the plants
- forecast hourly demands at each operational region:
  168 hours and one year ahead
- defines the optimal planned operation of each plant
- gives operational instruction

demand forecast

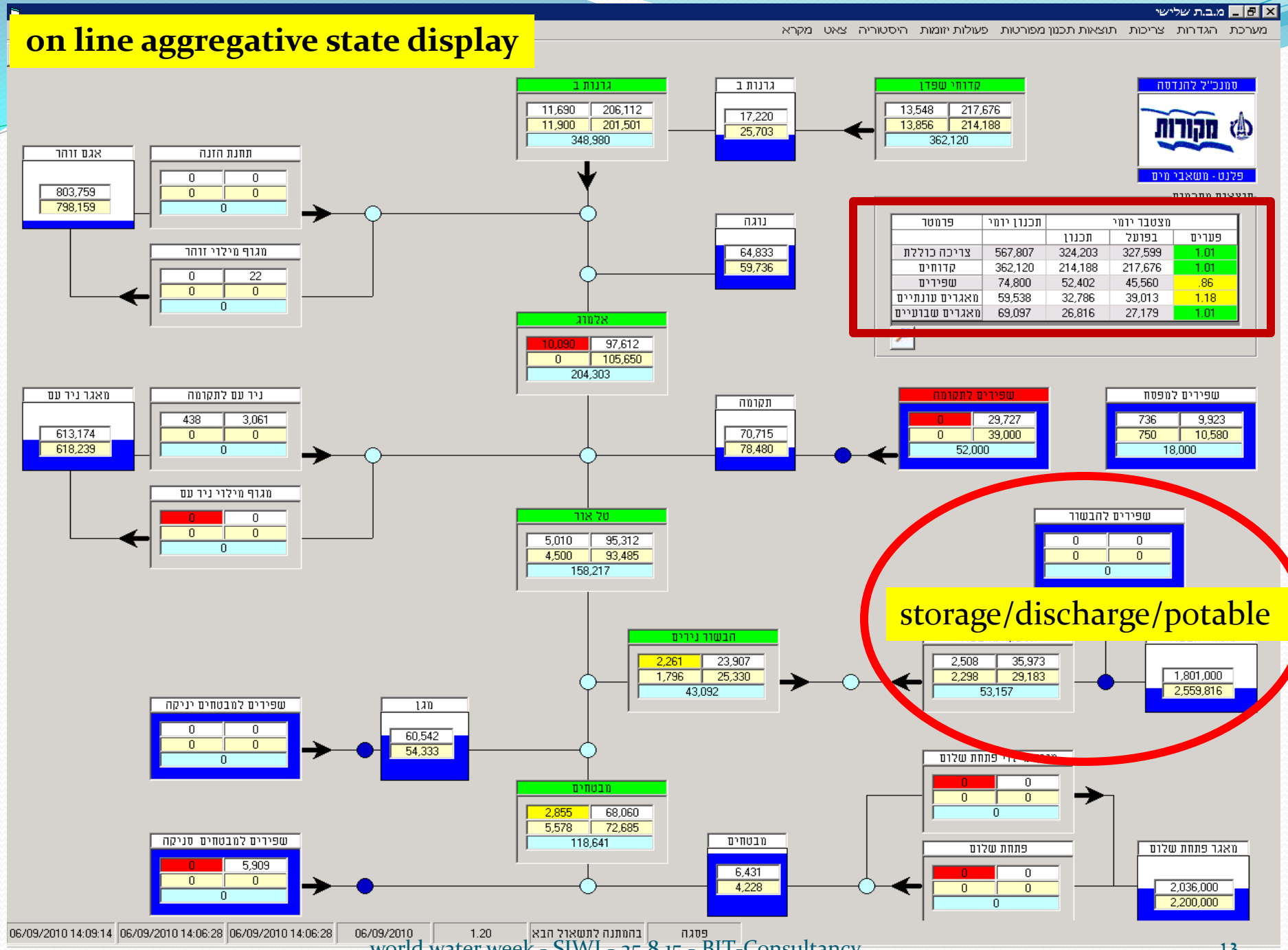
hourly forecast demand - daily



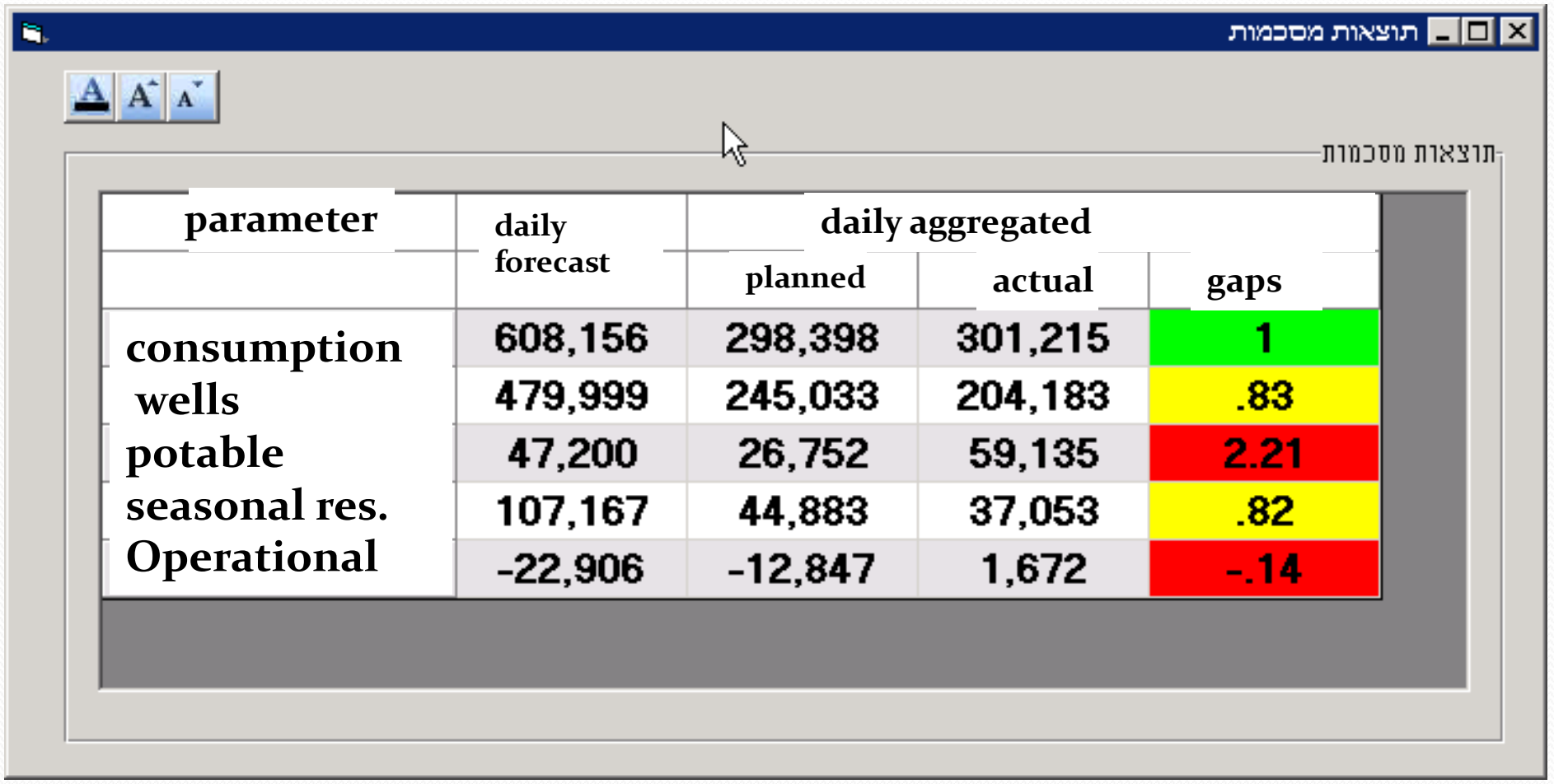
hourly forecast demand –long term



on line aggregative state display



summary table of on line aggregative state display



parameter	daily forecast	daily aggregated		
		planned	actual	gaps
consumption	608,156	298,398	301,215	1
wells	479,999	245,033	204,183	.83
potable	47,200	26,752	59,135	2.21
seasonal res.	107,167	44,883	37,053	.82
Operational	-22,906	-12,847	1,672	-.14

conclusions

M.B.T.-3:

- **Savings of 2.5 million US$ on energy**
- **Efficient use of production wells**
- **Efficiency in use of potable water**
- **Increasing reliability supply**
- **Coordinating the operation through several control centers.**