IUWM in Scarcity Conditions

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IUWM has been described extensively

– Procedural recommendations formulated
– Importance for good management analyzed
– Economic/financial impacts of not taking it into consideration evaluated
– Focus on Scarcity Situations

Source: Water Scarce Cities Initiative

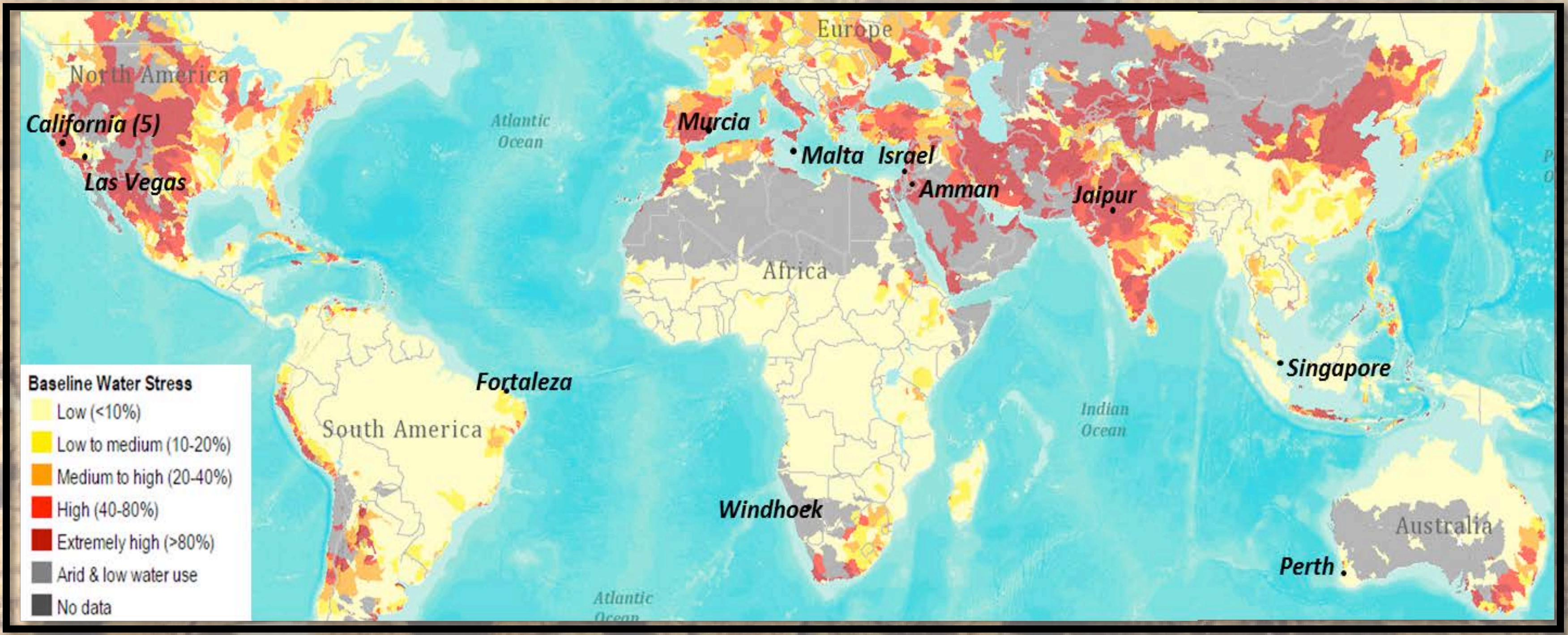
WATER SCARCE CITIES

http://www.worldbank.org/en/news/feature/2017/05/15/water-scarce-cities-initiative

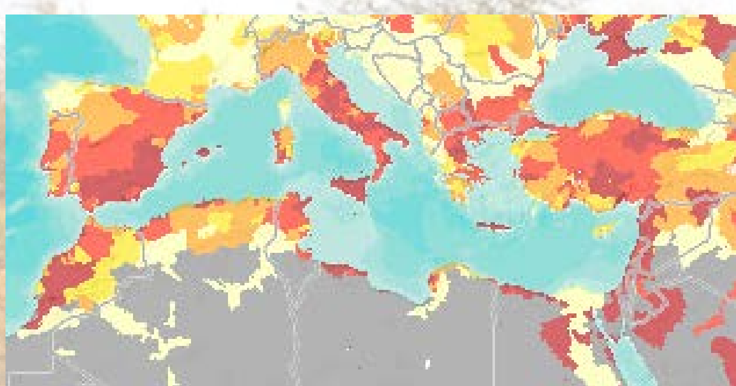
Your main contacts in the World Bank:

Stephane Dahan, Amal Talbi, Richard Abdulnour

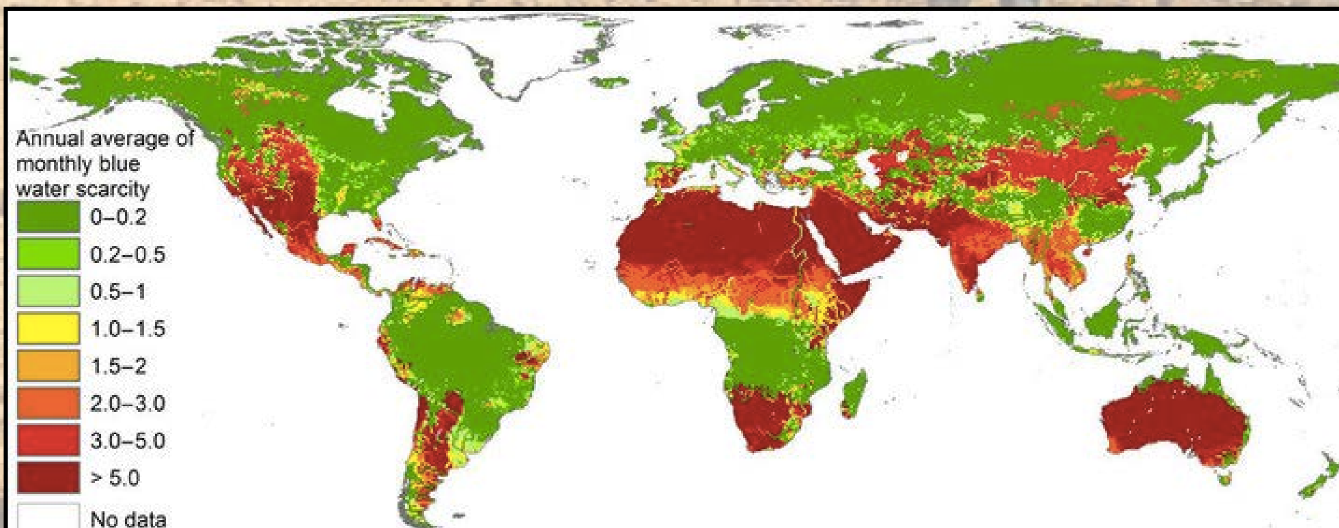
Water Scarce Cities Initiative
Case Studies



Scarcity, a Growing Challenge

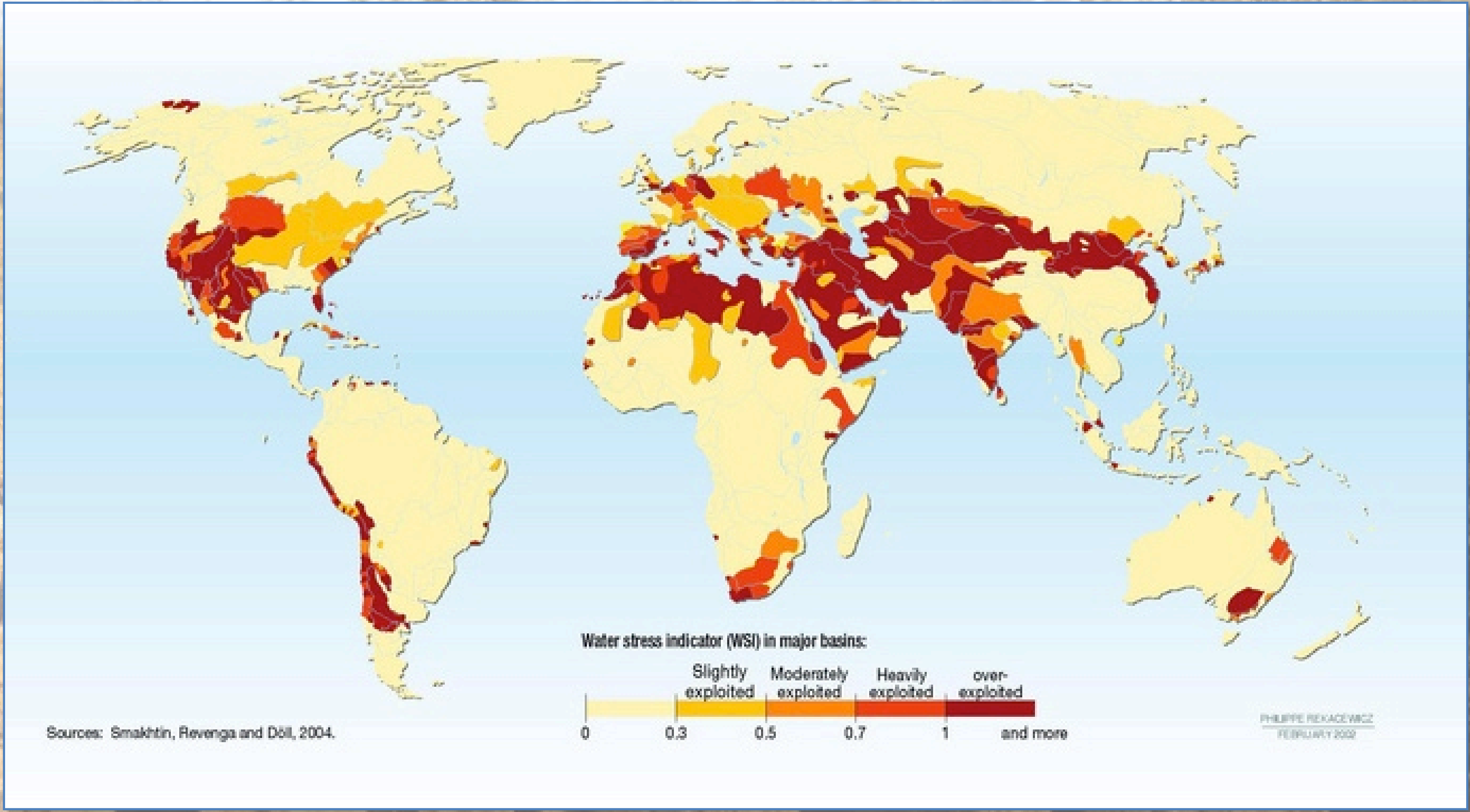


In 2050, per capita municipal consumption could be constrained to 70-85% of its current level due to diminishing water availability and competition with other users (mostly agriculture)

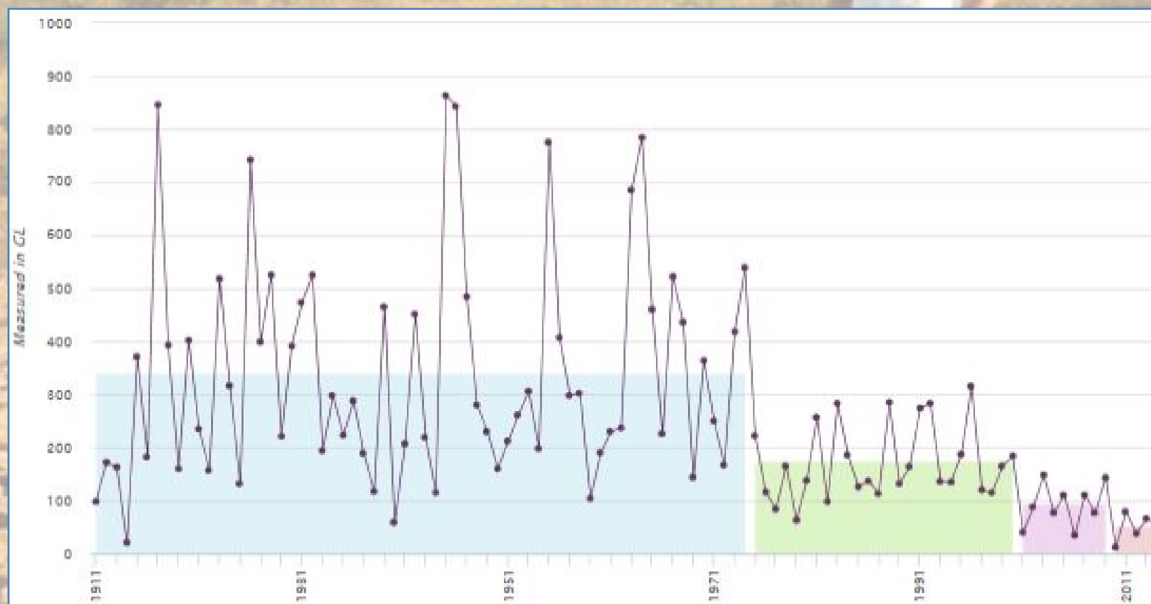


Water poverty level: 1000 m^3/p/y
Extreme water scarcity: 500 m^3/p/y

Overexploitation



Climate Change and Variability



Stream flows into Perth's reservoirs 1911-2016
[Source: Water Corporation website]

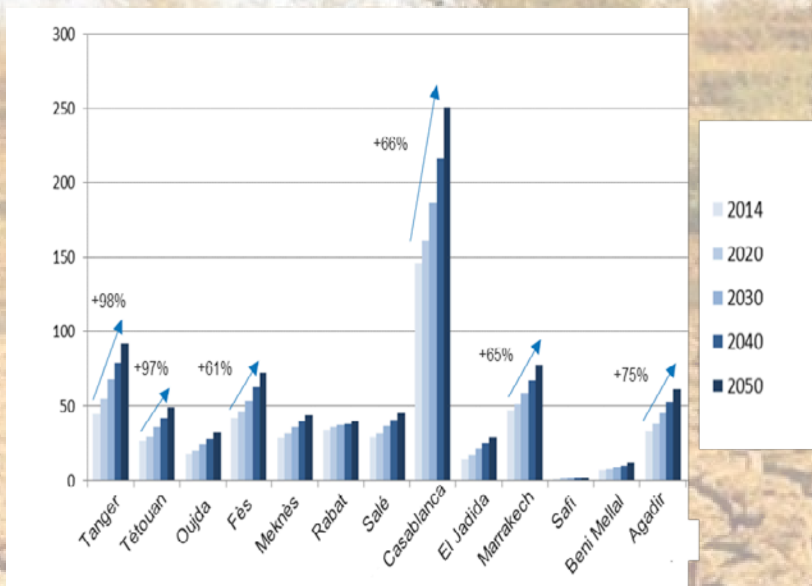
“Business as Usual” for a Water Utility Manager and related City Official

- How much water is available? Quality and Reliability
- How to produce and distribute safe drinking water to all, at lowest cost
- Ground/surface sources readily available first
- “*Big Pipe*” solution: external transfers [desalinization]
  - Everyone benefits/wins
  - Economic/political pressures unblocks funding (*Mexico*)
- Increasingly, how to collect wastewater and treat it before discharging, at lowest cost
  - Changing views: Urban water cycle vs. River basin/district
  - Responsibility linked to accrual of benefits (*Spain*)

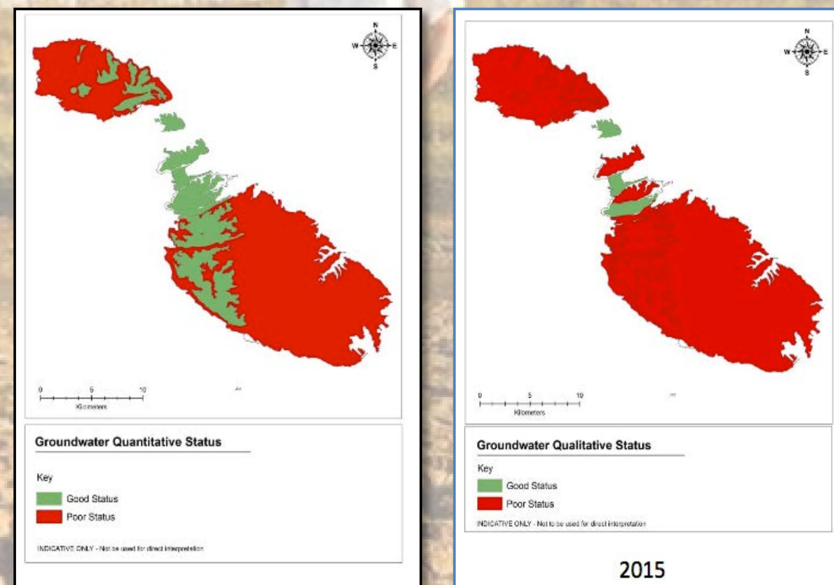
New Challenges complicate "Business as Usual"

- Information and financial pressures limit "Big Pipe" solutions
- Reduced availability of resources
  - Overexploitation
  - Climate Change variability
- Population growth and increasing demand (common in all cities, *Amman, Marrakesh, Singapore ...*)
- Competing users for same resources at the source (*Tajo-Segura, Jaipur, Singapore* ...)
- Deteriorating water quality (*Malta*)
- Increasing demands for Reliability of supply (invisible until something goes wrong)

Demand Increases while Quality and Quantity Decrease

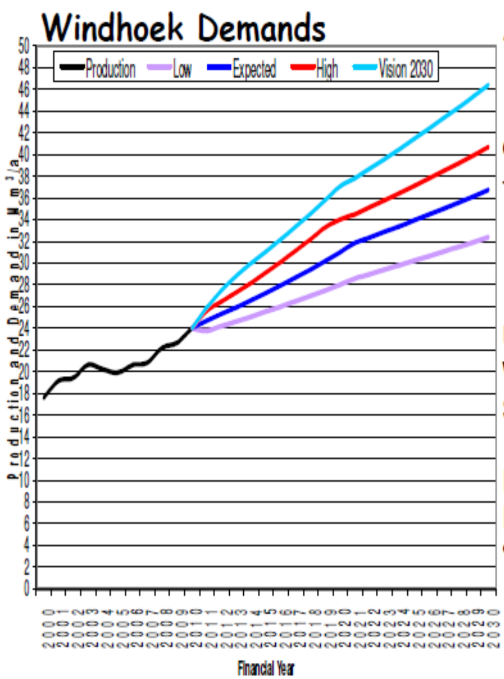


Moroco’s cities demand



Malta’s water quality evolution 2005-2015

Windhoek's Extreme Situation



Available Sources

Conventional Sources	Mm^3/a
Three dam system	17
Ground water Karst	2.8
Windhoek boreholes	1.73

UNCONVENTIONAL SOURCES

WDM:	30%+ realised
Savings since 1994	(+/-) 96

POTABLE REUSE (1968)

Plant capacity	7.6
% total supply	32%
	(7% unblended)

Change the Paradigm! New Principles

Ad-hoc solutions not valid anymore and inefficient: adopt an **Integrated Management** approach

Think **beyond the City Limits**: setup Institutions to operate at different scales

- Allow for "check and balances"
- Clear responsibilities for all the cycle

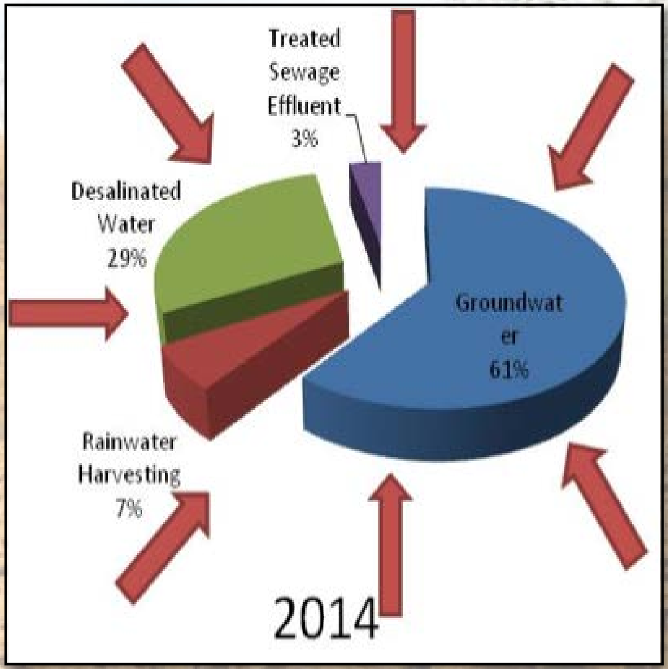
Diversify sources and improve reliability and independence

Plan for droughts and adopt a plan for gradual response

Participatory planning with civil society and private sector involvement

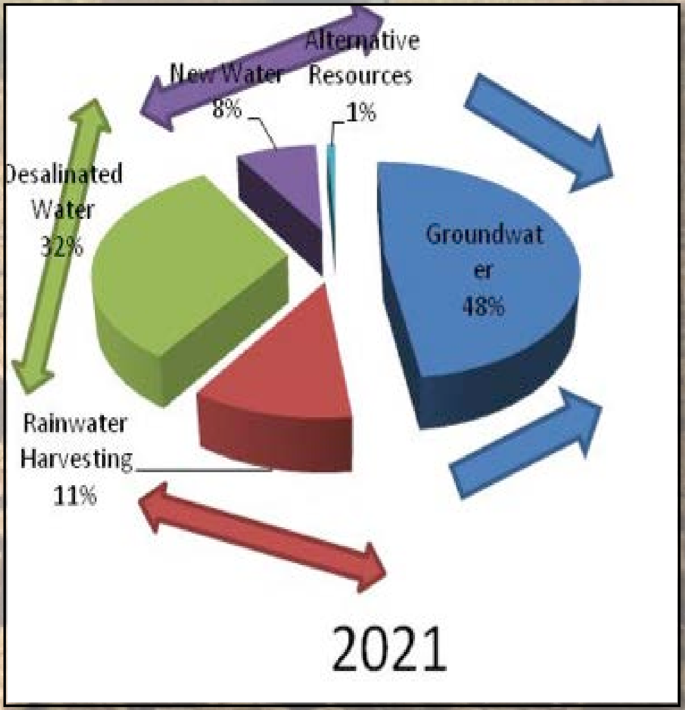
Demand Management is the cornerstone of any solution. It should include incentives, regulations and improved efficiency

Example from Malta*



1. Optimize Efficient Use of Water Resources through NRW management and demand management

2. Increase Non-Conventional Resources through seawater desalination, wastewater recycling, rainwater harvesting



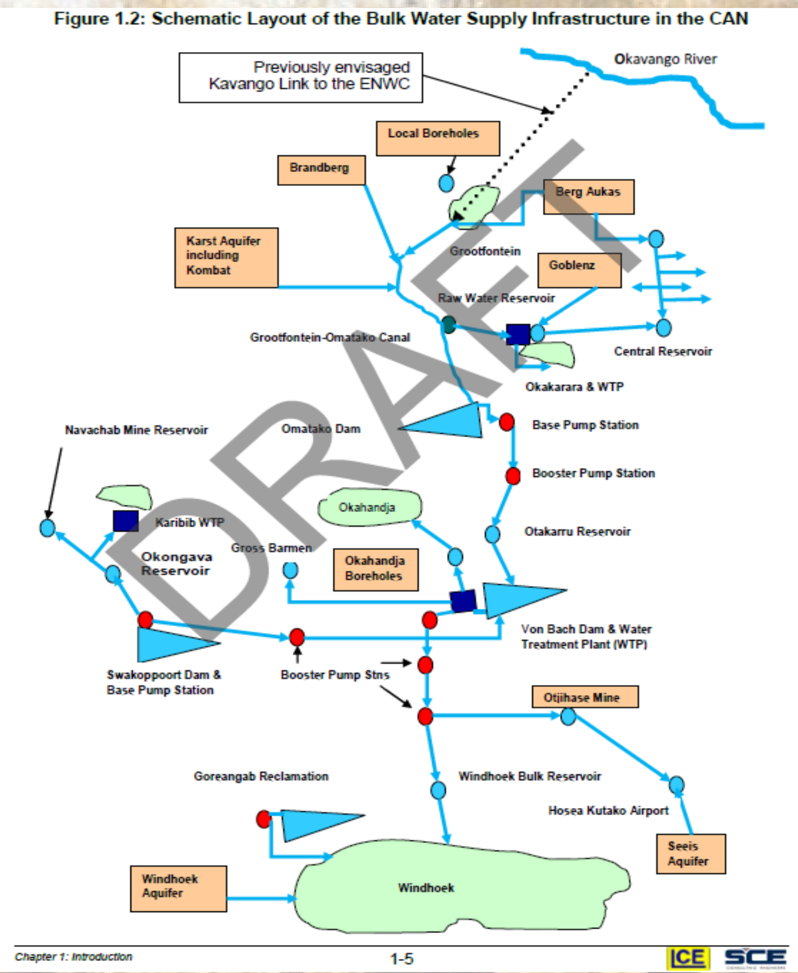
Source: Malta Energy and Water Agency
*Slide adapted from Meleesa Naughton's presentation in Gothenburg, 2017, on behalf of the Scarce Water Cities Initiative

Translating Principles/Paradigm into Plans/Programs/Actions (1)

1. Optimize Conventional Sources
    - Ground water management, underground reservoirs (*Windhoek*)
    - Surface sources (*Windhoek*)
    - Inter-basin transfers (*Windhoek, Murcia*)
    - Plan for droughts (*Barcelona*)

2. Non-Conventional Sources
    - Storm-water management (*Los Angeles, Tucson*)
    - Rain-water harvesting (*Traditional source*; *Tucson*)
    - Waste-water reuse ("New Water")
        - Direct vs. Indirect reuse (*Windhoek, Singapore, Amman*)
        - Potable vs. Non-potable reuse (*Murcia*)
        - End-of-Pipe vs. At-source Reuse (*San Francisco*)
    - Desalinization (*Malta, Singapore, Israel, Murcia*)

Windhoek. An example of Diversification of Sources



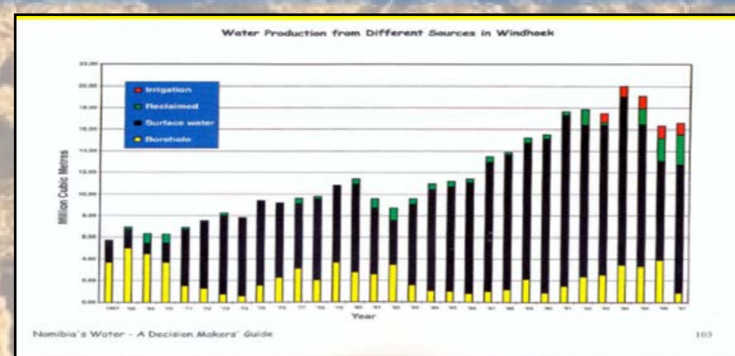
<u>Existing supplies:</u>

Windhoek aquifer ground water	N$ 4.80/m^3
NamWater Supply	N$ 9.00/m^3
Reclaimed wastewater	N$ 9.00/m^3
Reused wastewater (for irrigation)	N$ 6.30/m^3

<u>Additional supplies</u>

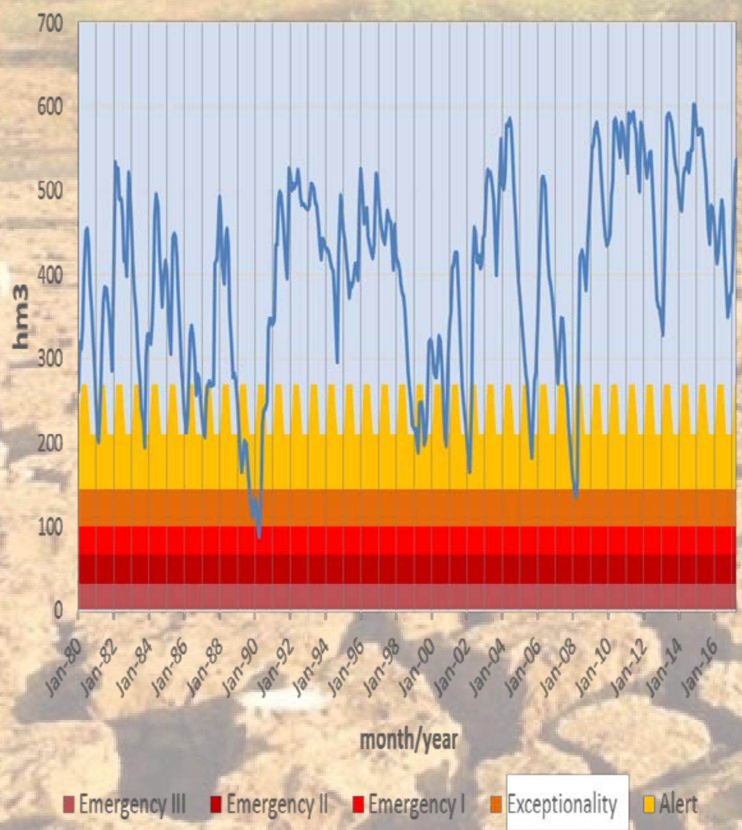
Okavango pipeline	N$ 45/m^3
Tsumeb aquifer	N$ 30/m^3
Aquifer Recharge	N$ 16/m^3
New Reclaimed wastewater plant	N$ 17/m^3
Desalination and pumping	N$ 40/m^3

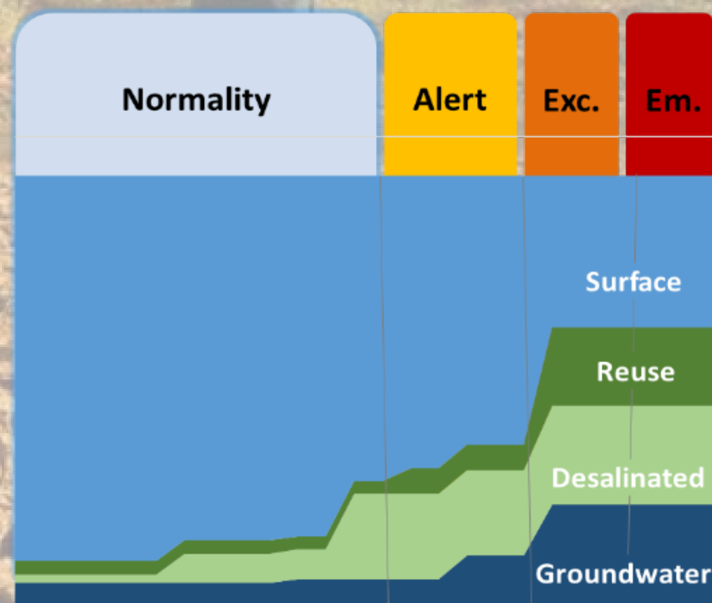
1 USD = 13.29 N$ Namibia's GDP per capita: 4,140 USD (2016)



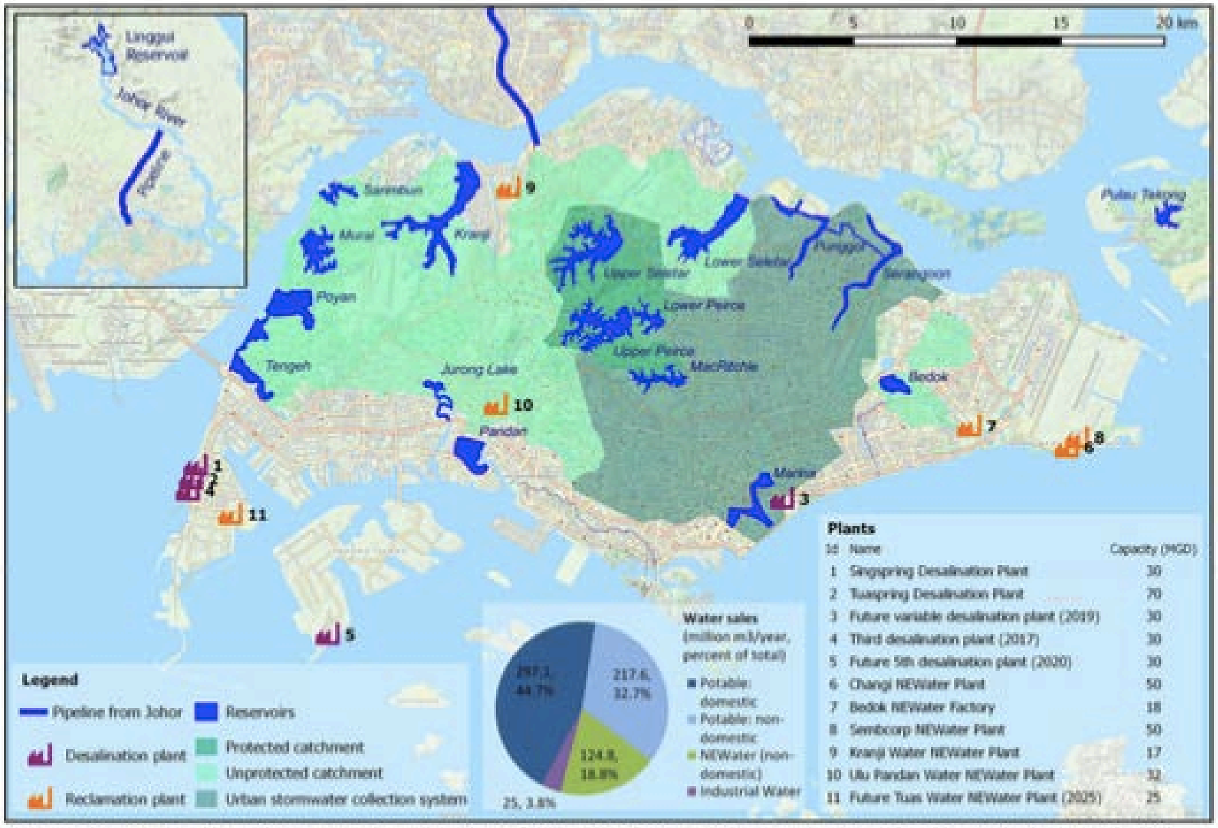
Preparing for Droughts is more than additional Pipes

Barcelona's Drought Response Thresholds





Diversify Sources and Use them Efficiently



Notes: Locations and years of future plants are approximate. Data sources: OpenStreetMap, Google Earth, Singstat and various media articles. Water sales data are for 2015.

Figure 1: Map of Singapore's water resources and water sales figures.

Energy Required in Production/Transportation

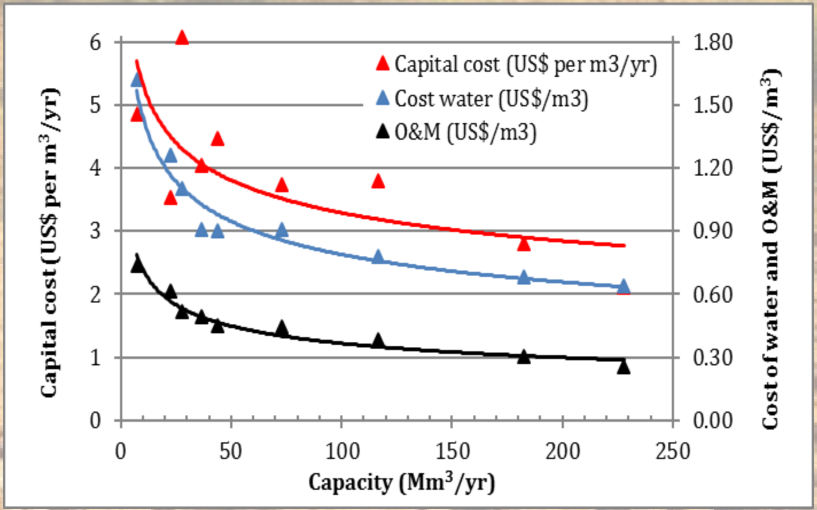
Local catchment (10-15%)
0.2 kW/h/m^3

Imported water (40-50%)
0.2 kWh/m^3

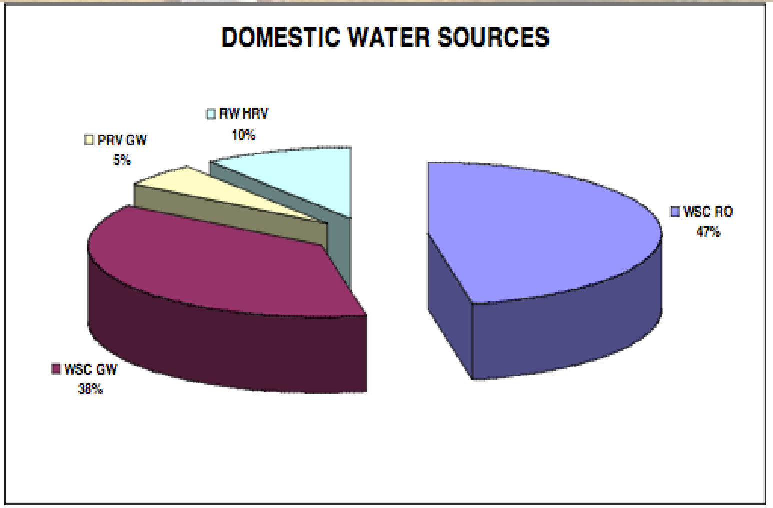
NEWater (20% -> 55%)
1.0 kWh/m^3

Desalination (25% -> 30%)
3.6 kWh/m^3

Desalinization is becoming Competitive



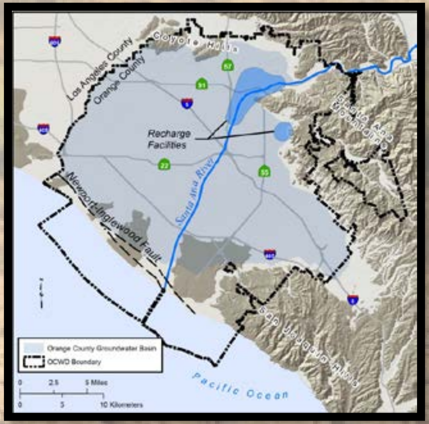
Unit cost rates of SWRO desalination plants on the Mediterranean Sea (World Bank, 2017)

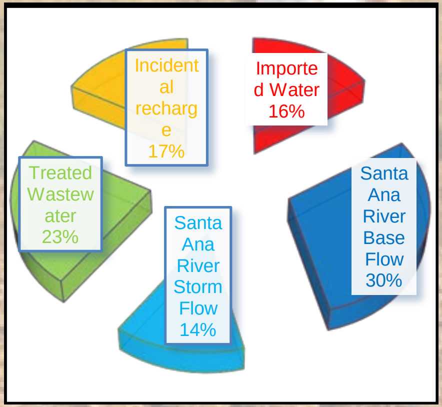


Water Supply in Malta. Distribution by source on average year

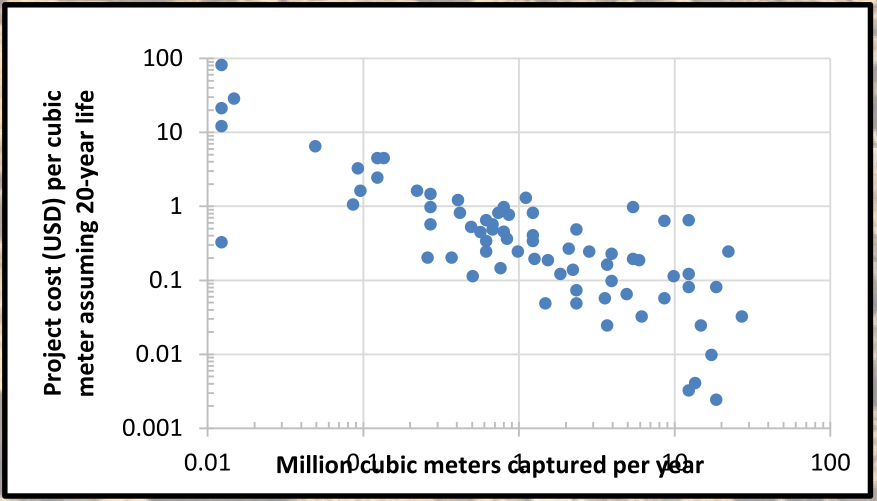
USA Rain/Storm Capture

Orange County

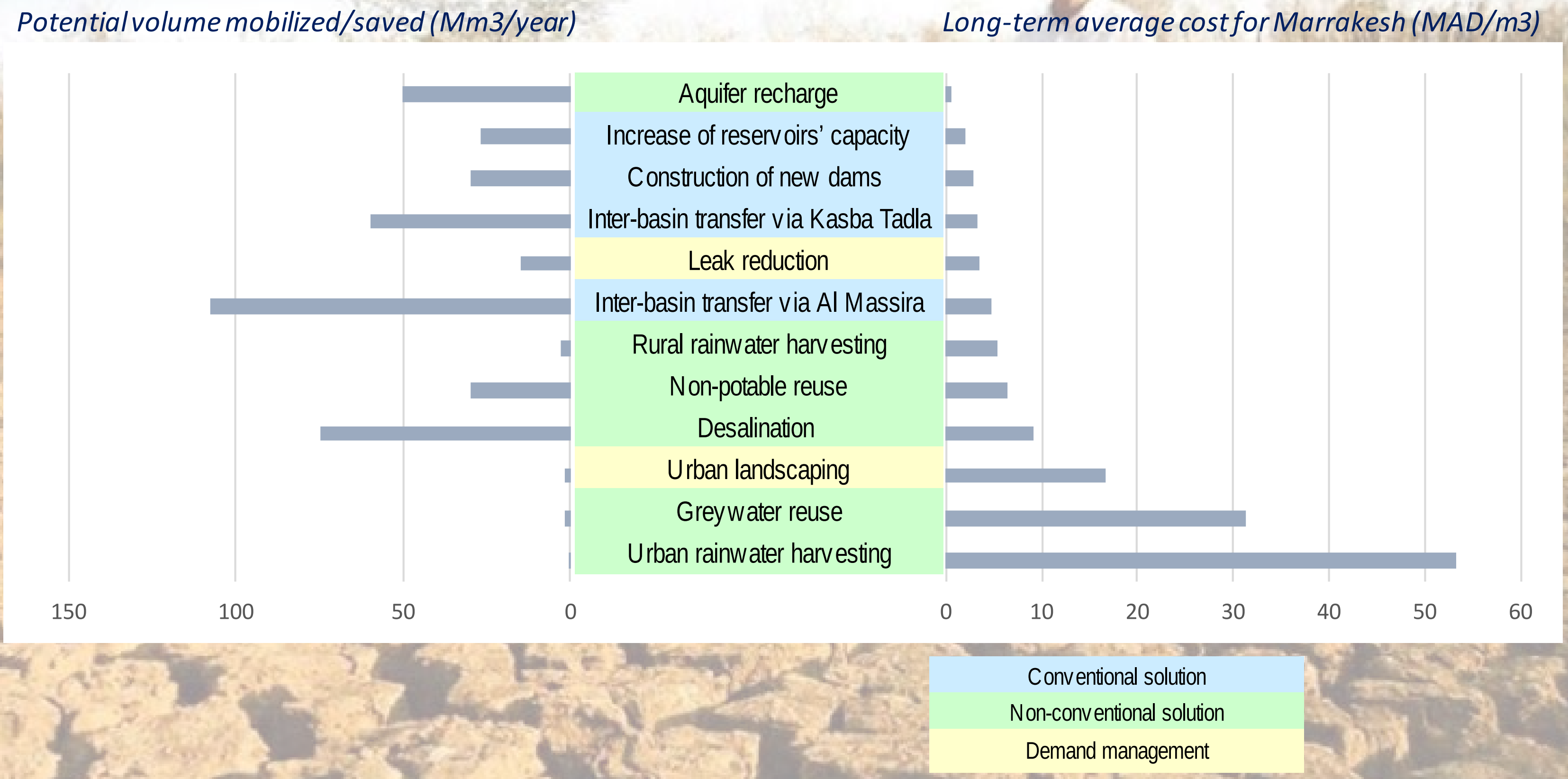




Overal: 600 lpcd
Residential: 363 lpcd



Cost and Yield Potential



Costs of measures and annual volumes of water generated for different options by 2050 in Marrakech

Translating Principles/Paradigm into Plans/Programs/Actions (2)

3. Demand Management

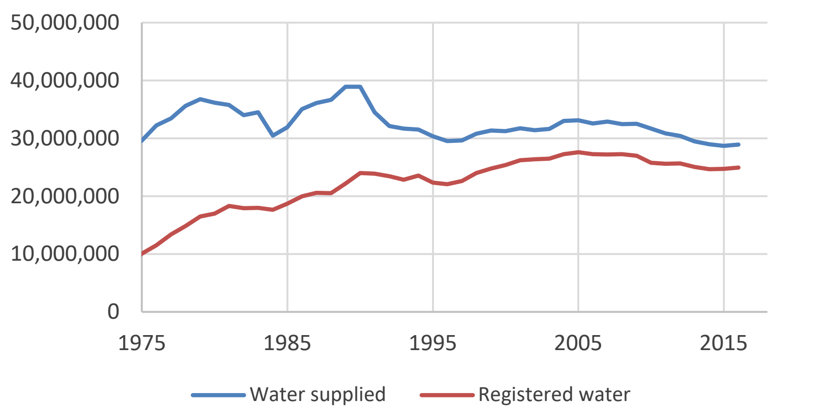
- Efficiency in the distribution: NRW/losses (*Jaipur, Singapore*)
- Conservation and Efficient use
  - Incentives (*Amman, Zaragoza*)
  - Water Pricing (*Malta, Europe's binomial/block, Irvine*)
  - Rules and enforcement
  - Advocacy (*Zaragoza*)

4. Manage Water at the Appropriate Scale

- Basin level management (*Murcia, Singapore, Malta*)
- "Virtual Transfers"
- "Water Banks" (*Colorado Nevada, Arizona, Kern*)
- Local water markets (*Reus*)

Demand Management Impact and Tools

Murcia's NRW Control Program



Irvine's Demand Management Program

Sample bills

Residential Customer Bill Sample Comparison

Bill # 1 - The Inefficient Customer (55 m^3)

Dates of Service		Meter Reading	Units Used
7/10/17 - 8/09/17		3550-3605	55 m^3
USAGE - LOW VOLUME	14	$ 0.48	$ 6.72
USAGE - BASE RATE	16	$ 0.60	$ 9.60
USAGE - INEFFICIENT	11	$ 1.44	$ 15.84
USAGE - WASTEFUL	14	$ 4.26	$ 59.64
WATER SERVICE CHARGE			$10.30
SEWER SERVICE CHARGE			$25.75
Your water budget for this bill		30 m^3	
Bill calculation based on		1214 m^2	
TOTAL WATER & SEWER CHARGES			**$ 127.85**

Bill # 2 - The Efficient Customer (30 m^3)

Dates of Service		Meter Reading	Units Used
7/10/17 - 8/09/17		3550-3580	30 m^3
USAGE - LOW VOLUME	14	$ 0.48	$ 6.72
USAGE - BASE RATE	16	$ 0.60	$ 9.60
USAGE - INEFFICIENT	0	$ 1.44	$ 0.00
USAGE - WASTEFUL	0	$ 4.26	$ 0.00
WATER SERVICE CHARGE			$10.30
SEWER SERVICE CHARGE			$25.75
Your water budget for this bill		30 m^3	
Bill calculation based on		1214 m^2	
TOTAL WATER & SEWER CHARGES			**$ 52.37**

For a residential customer using 30 m^3 of water, the average monthly increase in the water and sewer bill is $1.05

Malta's NRW reduction program

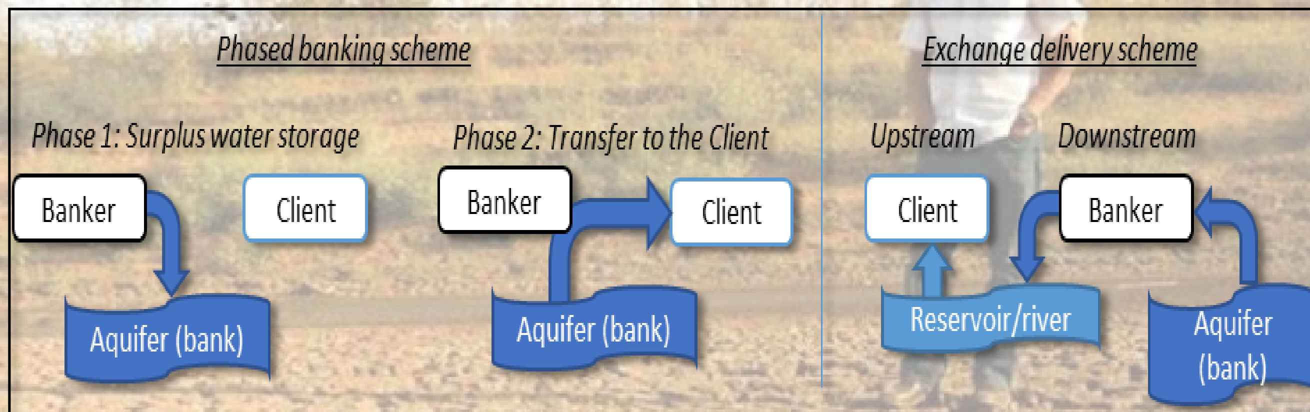
Network leakage was reduced from 3,900m^3/h (ILI of 20) in 1995 to 395m^3/h (ILI of 1.9) in 2015.

Urban water demand today is <60% of what it was in 1994.

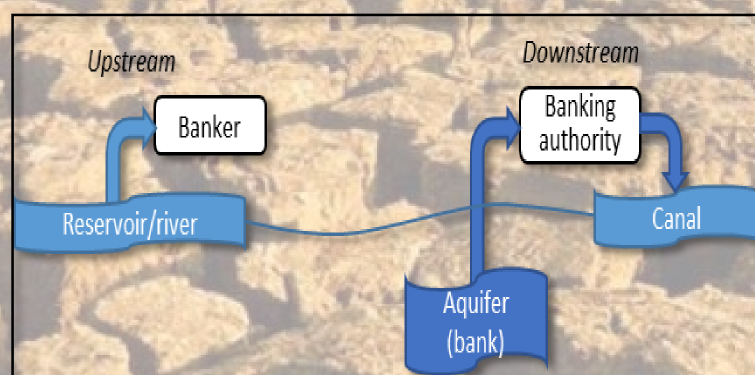
Jaipur's NRW Pilot Program

Sector	NRW		Consumption (lpcd)		
	Before	After	Before	After	%
1	63%	30%	845	235	-72
9	53%	23%	394	205	-48

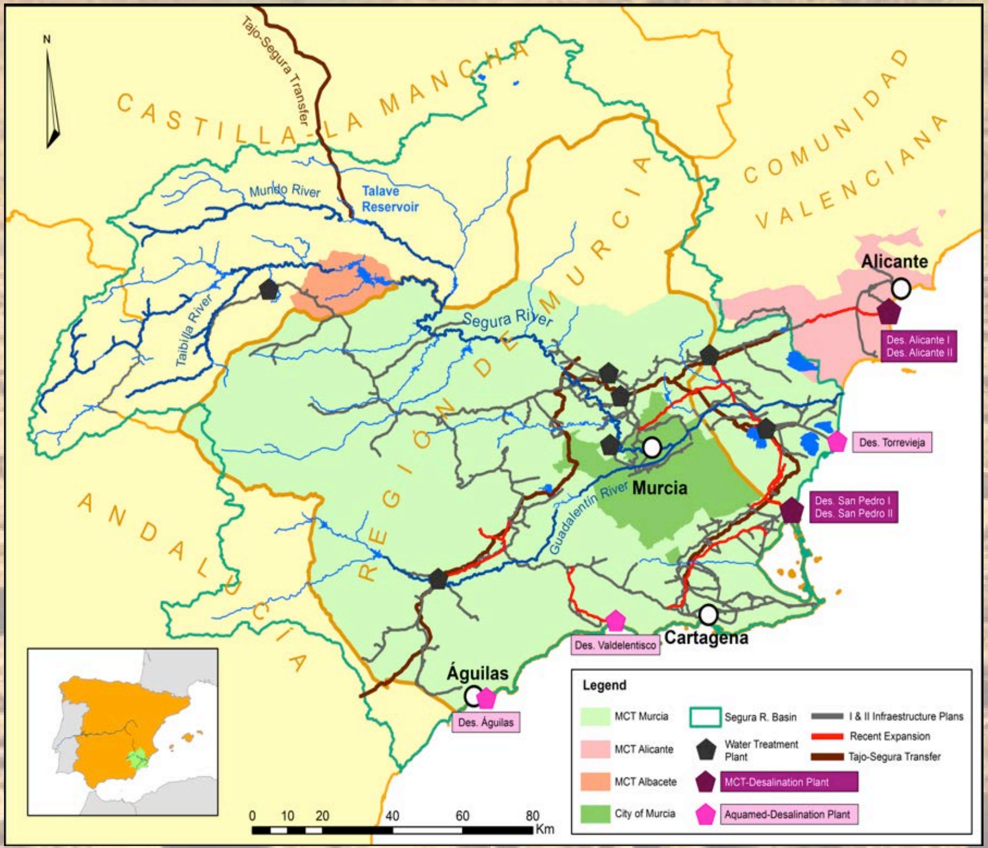
Innovative WRM



Virtual Transfers



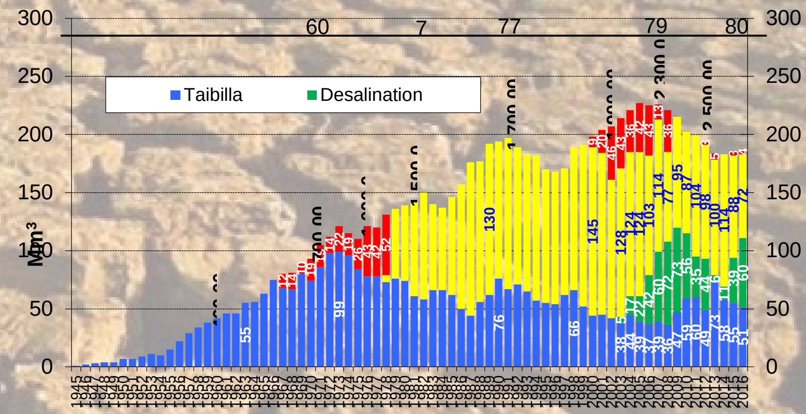
Water Managed at a Scale beyond the City Limits. Murcia's Example



Basin Authority that allows for checks and balances between competing users

Responsibilities for waste water treatment and reuse well defined

Sources diversified to allow exchanges and flexible and efficient management



Main Messages

- Business as usual is not longer possible and inefficient. Better adopt “New Paradigm” before emergency. “Water Scarcity” is here to stay
- Integrated management is the key element of the “New Paradigm”
- Institutional setup at proper scale is needed to apply an integrated management
- Non-conventional, independent, sources are becoming competitive to the “Big Pipe” solution
- Demand management is possible and must be part of the equation