“Energy and Water” links in the provision of Water Services
Case Study: Malta

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Introduction

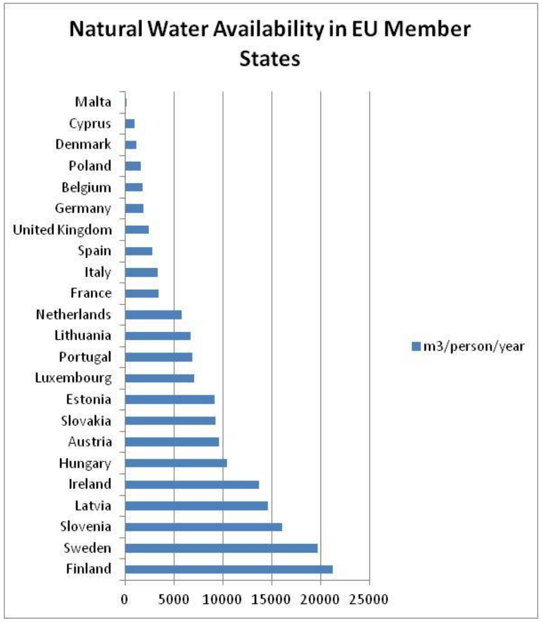
National Policy Framework

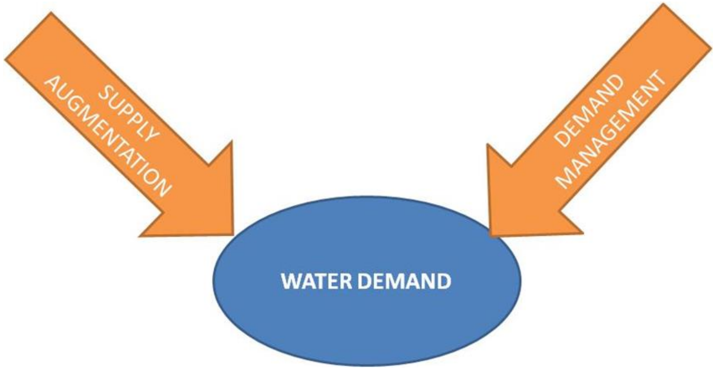
Malta is the Member State in the European Union with the least availability of natural water resources.

Freshwater availability is well below the 500m^3/year which the UN defines as the limit of absolute water scarcity.

Malta has therefore developed a water management framework based on the conjunctive use of water demand management and water supply augmentation measures.

Hence Malta recognizes the fact that its natural water resources (if used sustainably) are not sufficient to meet national demand, and hence the production of alternative (non conventional) water resources is a necessity.





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Introduction

Water Energy Nexus

Duopoly:

(i) Water for Energy Production

- Hydropower
- Cooling
- Floating RES

(ii) Energy for Water Production

- Sea Water Desalination
- Wastewater Treatment
- Water Reclamation
- Distribution

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Historical Context

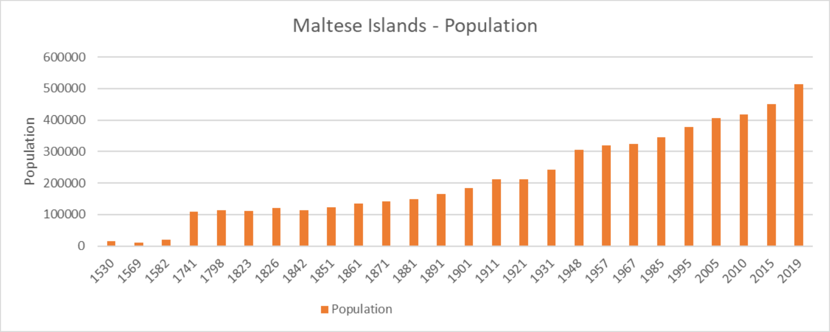
Traditionally Malta's water supply was dependent on groundwater – the only naturally renewable freshwater resource in the islands.

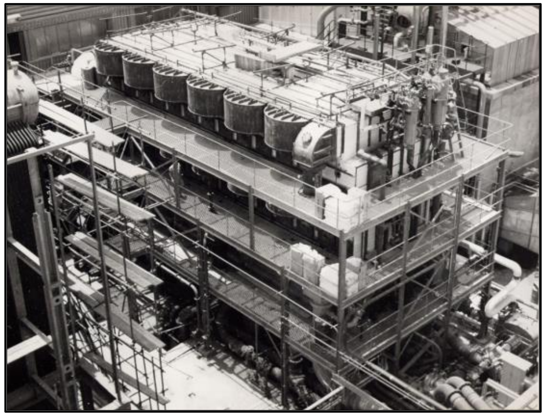
But, a steep population increase during the last two centuries, led to a continuously increasing water demand.

By the 1960's it was already event that groundwater on its own – was not sufficient to meet demand. First investments in commercial scale sea-water desalination – Multi-Stage Flash Distillation Plants.

But, the oil crises in the 1970's led to an increase in the price of water production – once more shifting production to groundwater.

By the early 1980's the aquifers were collapsing, leading to high salinity levels. Production was reduced, and with no alternative supplies, and this led to widespread water rationing.





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Historical Context

1982 saw the commissioning of the Ghar Lapsi Sea-Water Reverse Osmosis Desalination Plant. With a production capacity of 20,000 m^3/day, at that time was one of the largest commercial scale RO plants in the world.

To address water demand, additional desalination plants were commissioned:
Marsa – 1983 – 4,500 m^3/day (brackish-water)
Tigne – 1986 – 15,000 m^3/day
Cirkewwa – 1988 – 18,600 m^3/day
Pembroke – 1994 – 54,000 m^3/day

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Historical Context

…… total water production was till not sufficient to meet municipal demand.

By 1995, the total water production capacity had reached around 52 Million m^3/year or 350 liters/capita/day.

The energy required for the production and distribution of drinking water exceeded 12% of the national electricity demand.

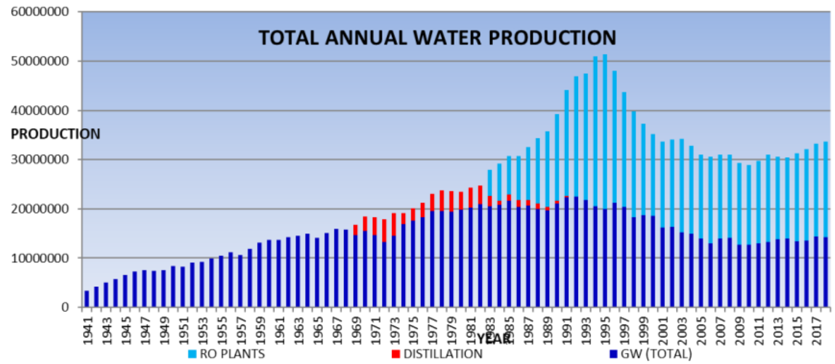
And the most energy consuming activity in households was the water supply.

Why?

The continuous change in pressure due to cuts in the water supply led to a deterioration in the distribution network. By 1995, leakage levels were estimated to have reached 60% of the total water supplied in the distribution network.

Over 25 million m^3 were being lost through network leakages every year.

The situation was not sustainable.



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Historical Context

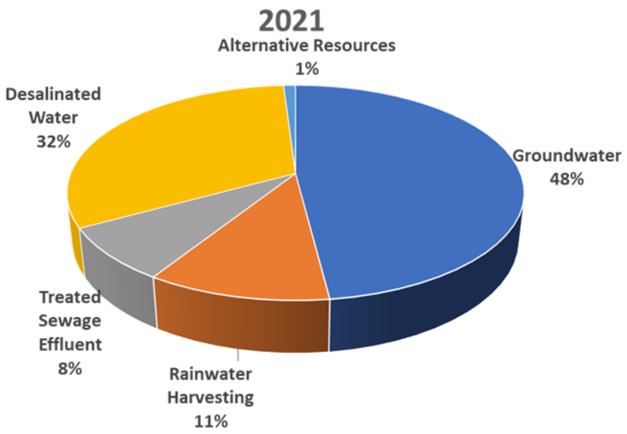
It became increasingly clear that water supply augmentation measures alone could not address Malta’s water challenge.

Water supply augmentation measures had to be accompanied by water demand management measures.

Factors such as:
- Supply Diversification (Non Conventional Water Resources)
- Water Efficiency (National and User Level)
- Energy Efficiency

gained increasing importance in the water management framework.

And this approach still forms the basis of Malta’s water policy today.

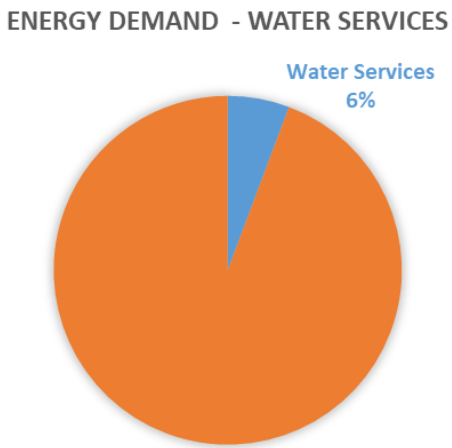


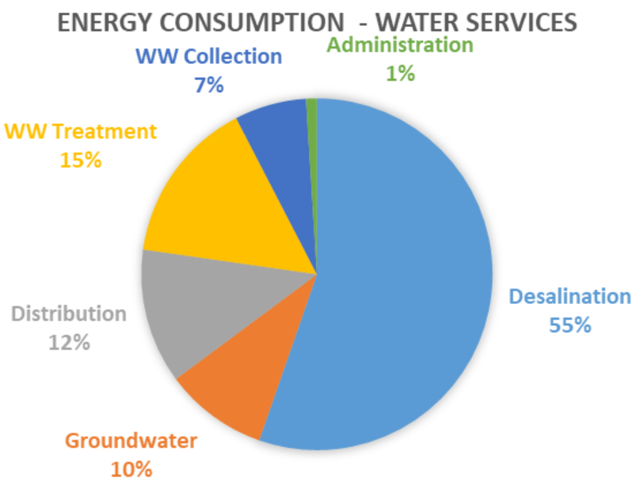
Linking Energy and Water

Within a context of water production and distribution and wastewater collection and treatment, the energy requirements for the delivery of water services is an important factor for the national energy demand.

The provision of water services today accounts for 6% of the total national electricity demand.

Production of water is by far the main user of energy, in particular due to the use of sea-water desalination plants which account for around 60% of the total production of potable water.



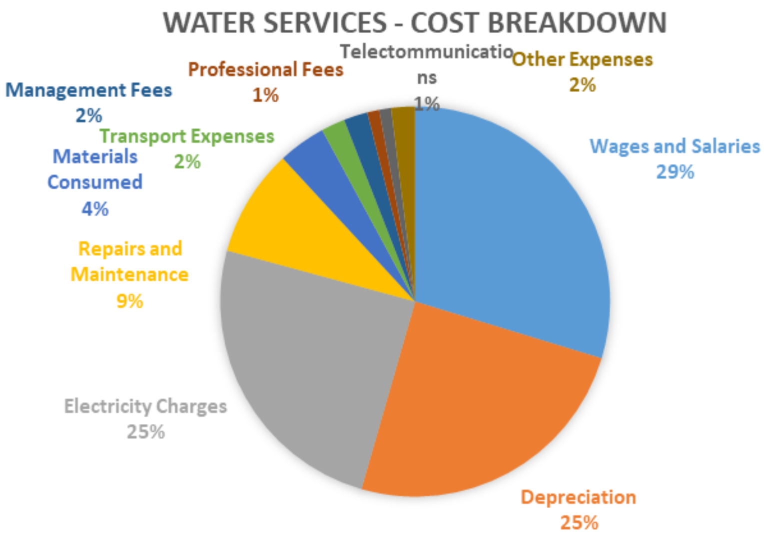


Linking Energy and Water

Energy costs are therefore one of the important cost items in the accounts of the water services provider.

Energy charges account for around 25% of the total costs of the water utility.

Invariably, energy efficiency becomes an important consideration in all aspects of water services provision; in particular when one looks at the financial sustainability of water utilities.



Desalination

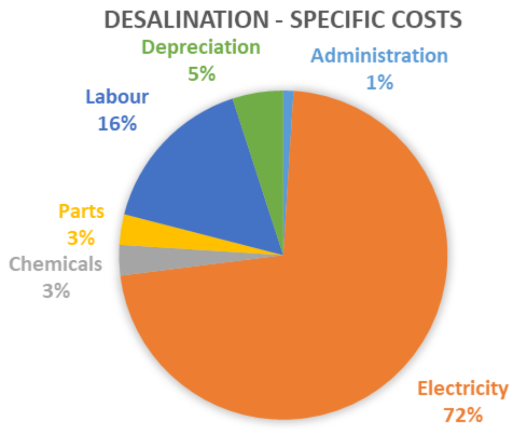
The biggest challenge in operating desalination plants is to control the energy used in converting seawater into potable water.

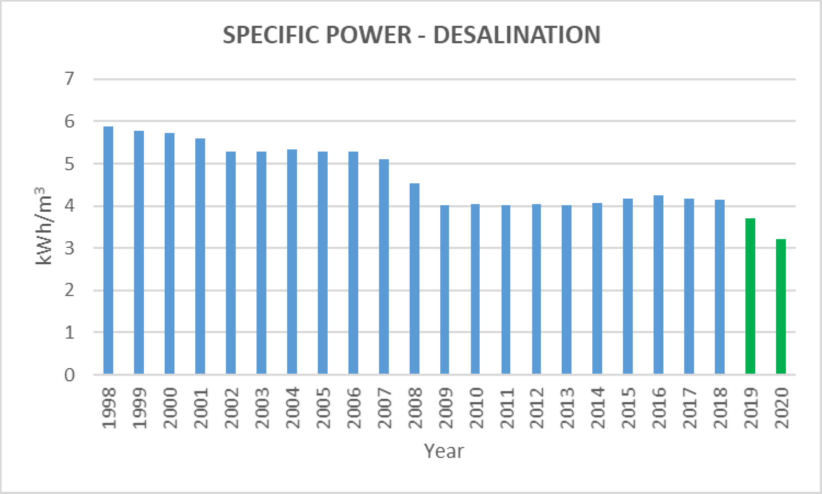
Energy Recovery:

RO takes place in the membranes at a recovery rate of 40-45%. The reject amounting to 55-60% is fed back to the system to recover mechanical energy. Energy recovered can be up to 35-40% with old technology and 50-55% with latest technology.

Management System:

In-house real time decision making system for the production of potable water at the highest levels of efficiency, thus guaranteeing production of potable water at minimum resource cost.





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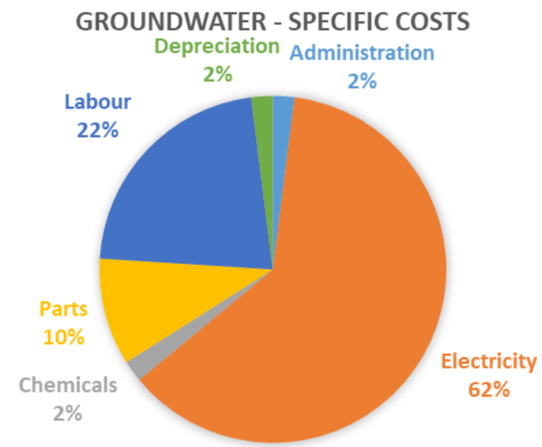
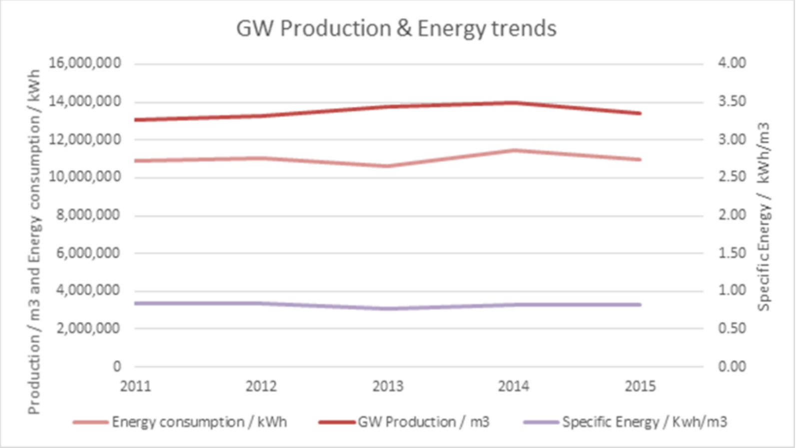
Groundwater

The specific energy required to produce 1m^3 of water from groundwater sources has remained relatively stable over the years at a level of around 0.8kWh/m^3.

Limited margins for improvement exist, given that primarily energy use depends on pump-efficiency and groundwater depth.

Distributed abstraction (necessary due to sea-water intrusion) also limits efficiency margins. High yield Pumping Stations exhibit lower specific energy requirements than boreholes.





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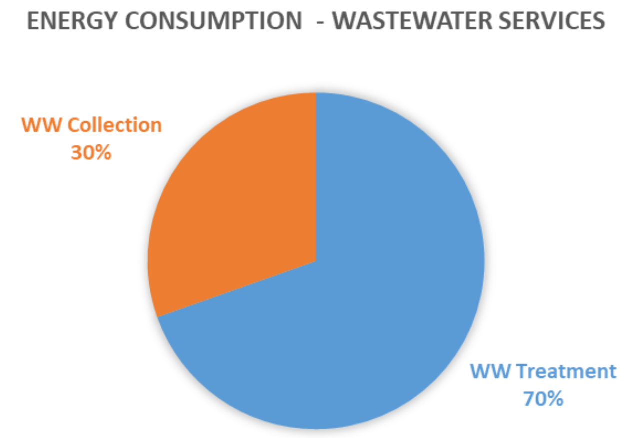
Wastewater

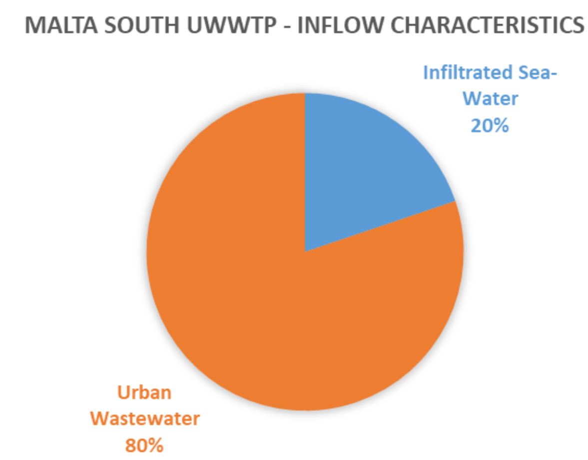
Protection of the quality of urban wastewater is reflected in lower energy requirements at the Urban Wastewater Treatment Plants.

Hence current focus on the upgrading of sewer network to reduce sea-water infiltration which results in additional energy requirements for:

- Pumping of additional volumes of water, and
- Treatment of high salinity sewage prior to discharge to the marine environment

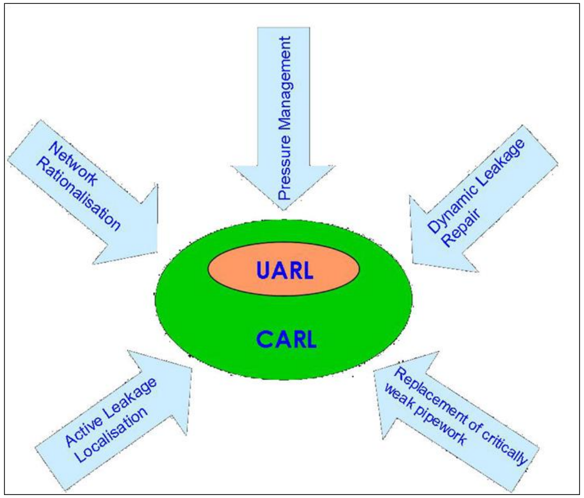
The energy requirements for treating wastewater with a salinity of 12,500µS/cm as compared to a baseline of 5,000µS/cm increase by 75%.





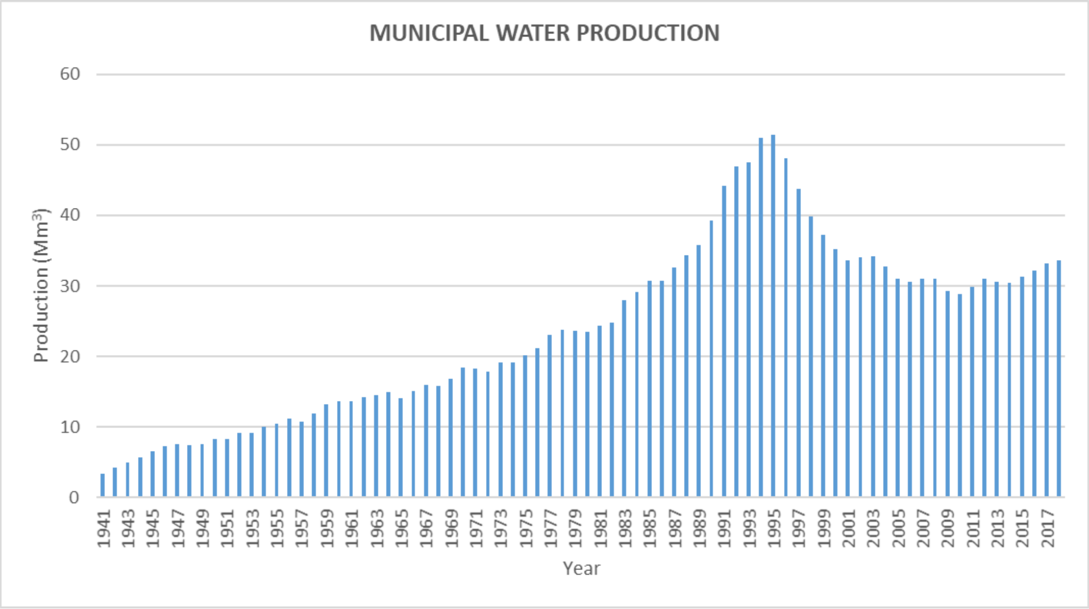
Demand Management

Water Demand Management (water efficiency) also leads to energy savings (energy efficiency) as it results in lower volumes of water moving in the urban water cycle.



At national/regional level, distribution network leakage identification and control is the most effective measure to optimise the effective use of water.

Leakage management in Malta resulted in a reduction of around 40% of municipal water demand over a 15-year period.



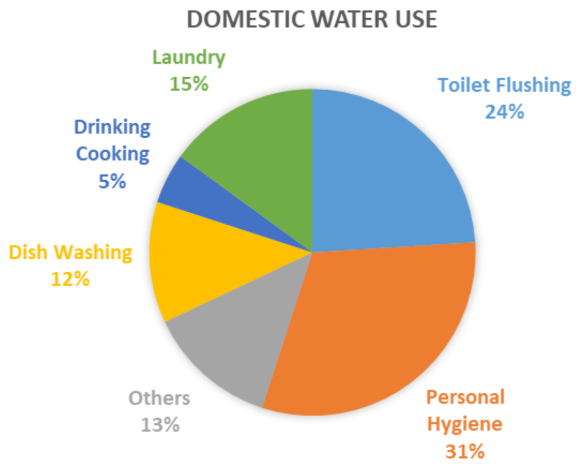
Demand Management

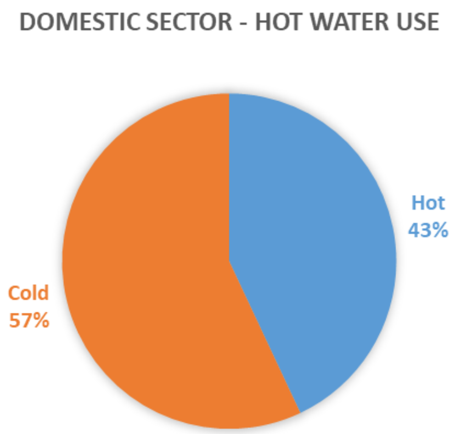
Demand Management Measures are also important at the level of the user.

Domestic water consumption in Malta stands at around 17 million m^3 pa. This amounts to an average daily consumption per person of around 115litres.

Grey-water reuse (shower to toilet) schemes have the potential to reduce water use by around 25%.

Efficiency measures addressing water consumption (aerators, water efficient showers and appliances etc) also result in energy efficiency due to a lower use of heated water.



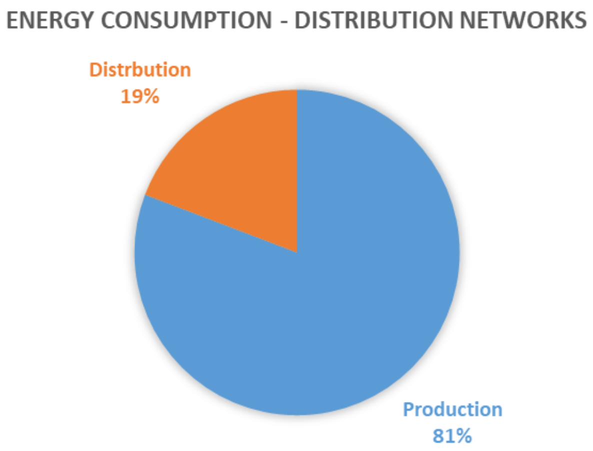


Distribution

Distribution network management also presents an opportunity for the application of energy efficient measures.

Frictional losses in distribution mains usually result in around 0.5bar (5m) dynamic pressure for a good network and up to 6 bar (60m) for a high friction network.

The energy required to lift $1m^3$ of water, 1 meter in 1 hour in efficient systems thus amounts to 30Whr. In inefficient systems (high frictional losses in pipes) this could increase up to 360Whr.



Net Zero Impact

A deep transformation of the role of a water utility, primarily through the inclusion of water reuse in its service portfolio.

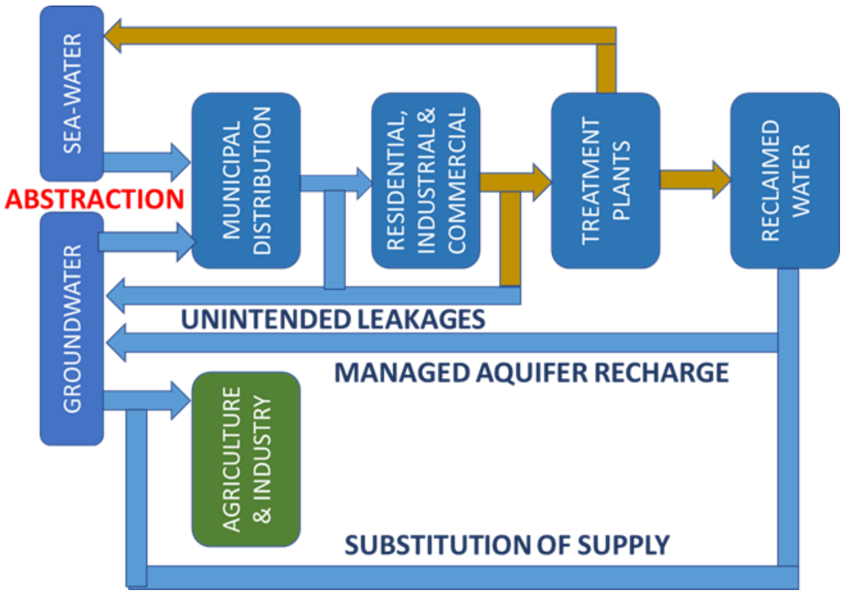
(i) Ensuring Security of Supply (so effectively meeting demand)

But

(ii) With the least impact on the water environment by giving back at least an equivalent volume to that abstraction from the aquifer systems

And

(iii) Increasing consideration of energy use within the whole water services cycle



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Net Zero Impact

Main Objectives:

- Reducing the environmental impact of water services provision on the water environment

- Providing consumers with a better quality (including taste) water supply

And

Giving the top spot for energy consumption in the home to the fridge!!

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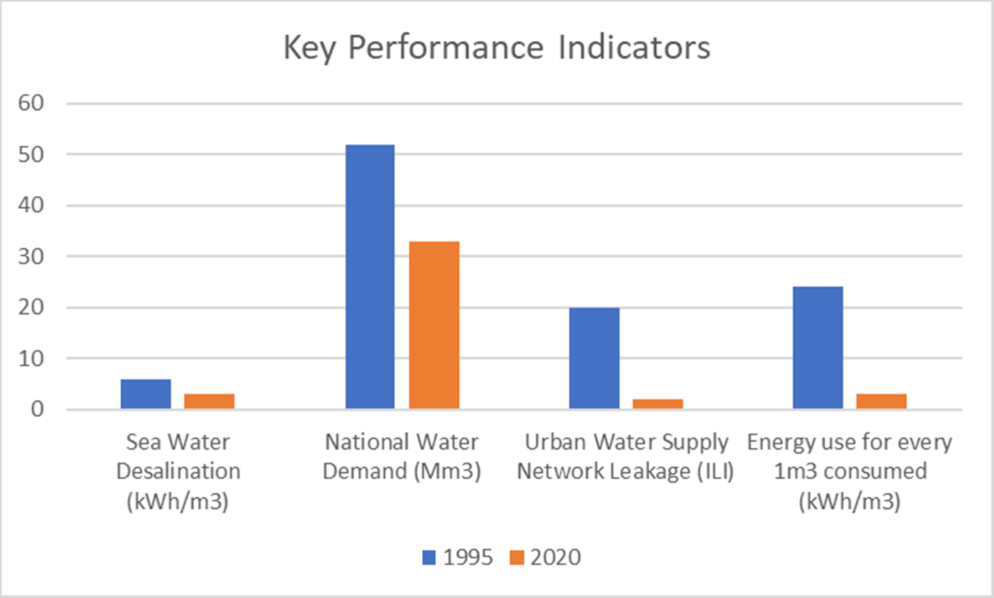
Key Performance Indicators

Significant reduction in the national water demand through increased efficiency in water use.

Improved operations leading to a significant reduction in the energy requirements for water services provision.



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Conclusion

Energy efficiency plays an important role in the future planning of water utilities, in particular to ensure their financial sustainability and lower their environmental impact.

Energy efficiency can be applied at various operational levels:

- Water production
- Water distribution
- Wastewater collection
- Wastewater treatment

Indirect measures (ex. through water demand management) also present important opportunities to optimise energy use in water services provision.

Hence comprehensive management frameworks are required operating within the whole urban water cycle to ensure the effective use of energy in water services provision.

Conclusion - SDGs

Importance of ensuring that our approach is comprehensive and sustainable.

The Sustainable Development Goals present an opportunity for the development of a tool to assess the cross-sectoral nature of policies.

Important to note that the role of water in the SDGs is not limited to SDG6.

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Conclusion – SDG Label

Thank you for your attention

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