

Dimensioning Desalination Units using RES

A multi-parameter analysis for three arid islands of South Aegean Sea, Greece

Background

The current situation regarding the water supply on the arid islands of Greece is problematic as regards the water quality and quantity. There is significant lack of water on several islands and this is **mainly** dealt with **aquifer ships** which transport vast amount of water. In 2007 the Hellenic Ministry of Shipping paid **4,91 €/m³** for Dodecanese which is a cluster of 26 islands and **8,32 €/m³** for Cyclades another cluster of 33 islands. Water is also supplied through drilling and wells but it is of very low quality with increased salinity. Rainwater constitutes another solution but it not a sole one due to the intermittency of rainfall. Furthermore, there are several desalination units under operation consuming vast amount of energy in the already congested island energy systems. There is significant opportunity to meet the existing and future water and energy demand in a sustainable way, since the Greek islands are endowed with abundant of Renewable Resources.

The Research Questions

- How does the new legislative framework for combining RES and desalination function?
- How can it be applied in 3 characteristic island cases?
- Compare Water Production cost with the current water cost on the islands

RES legislation framework RES/2010

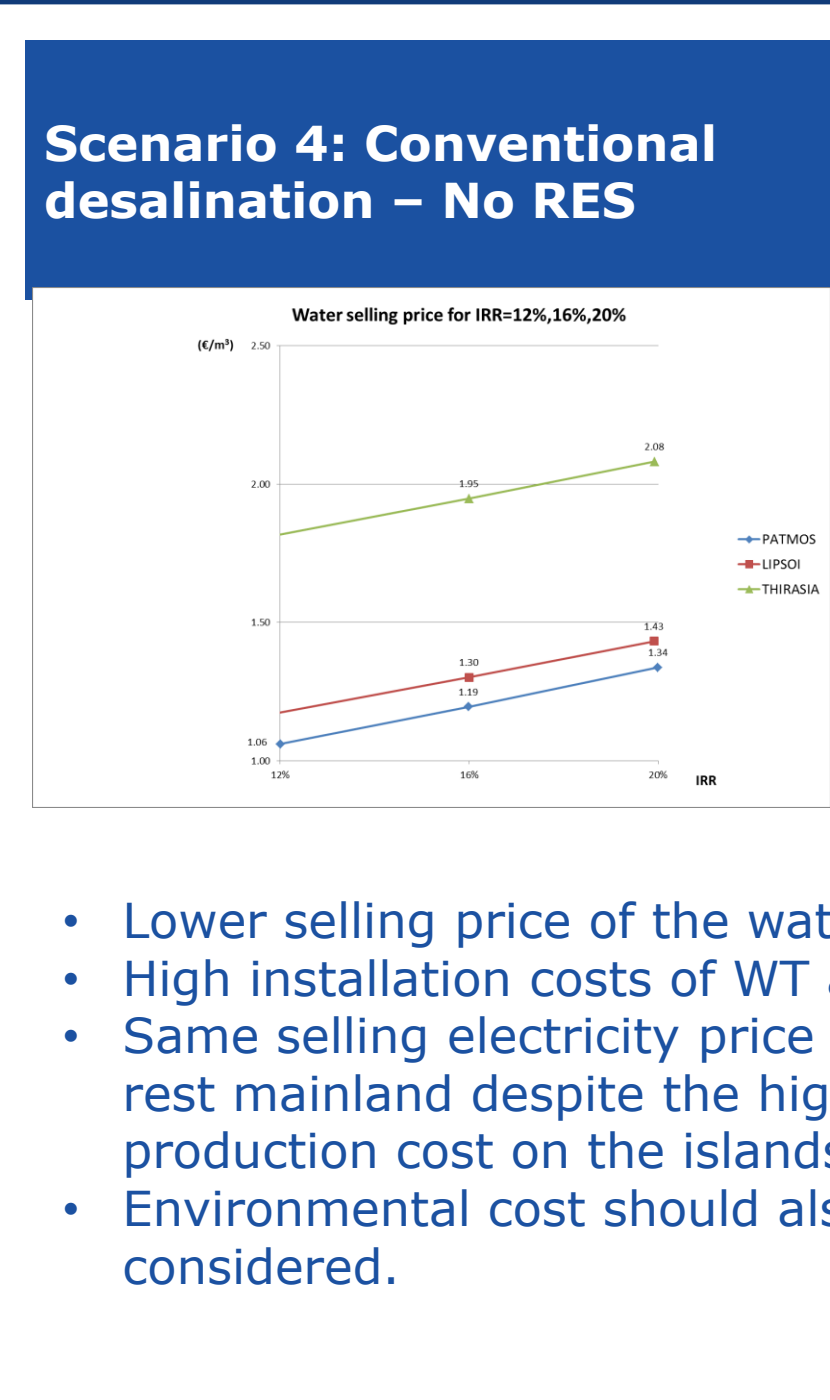
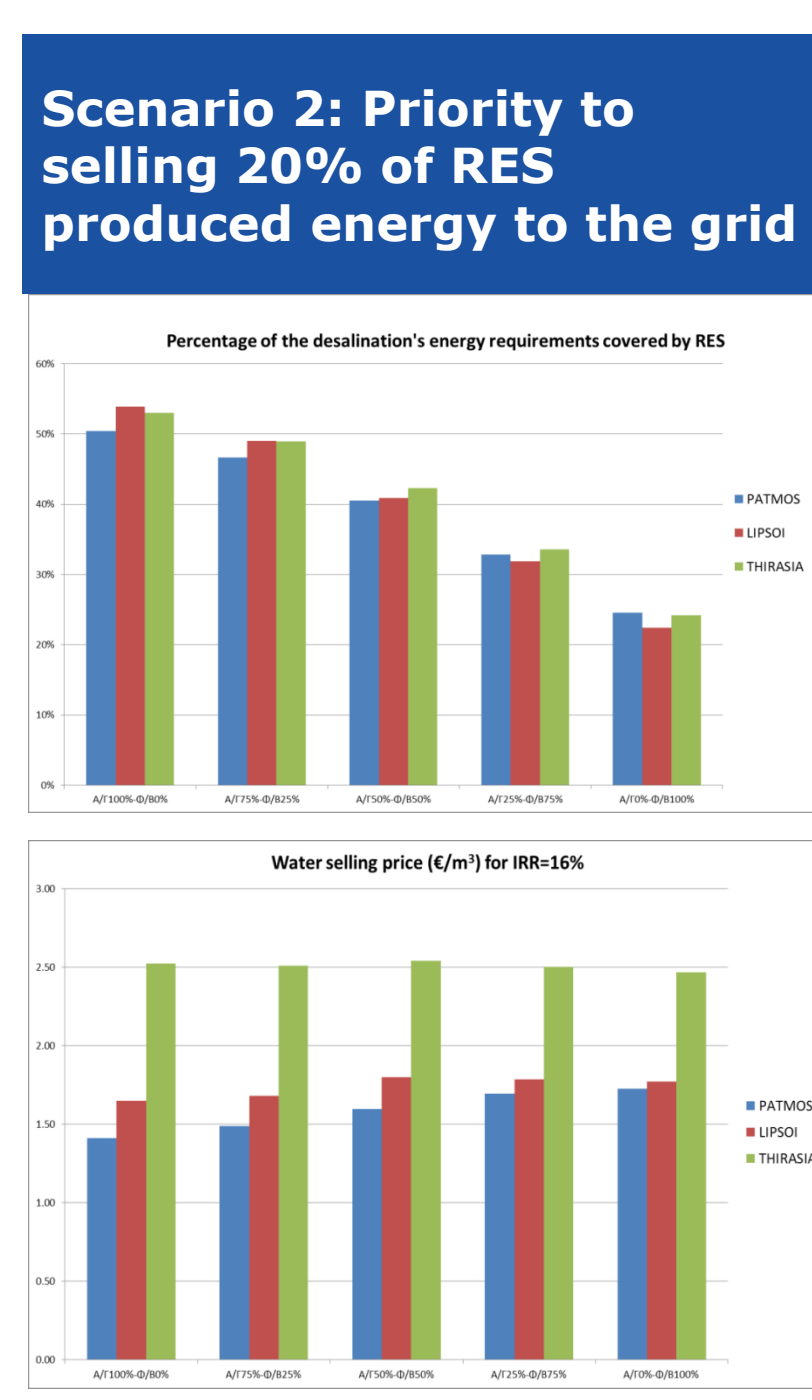
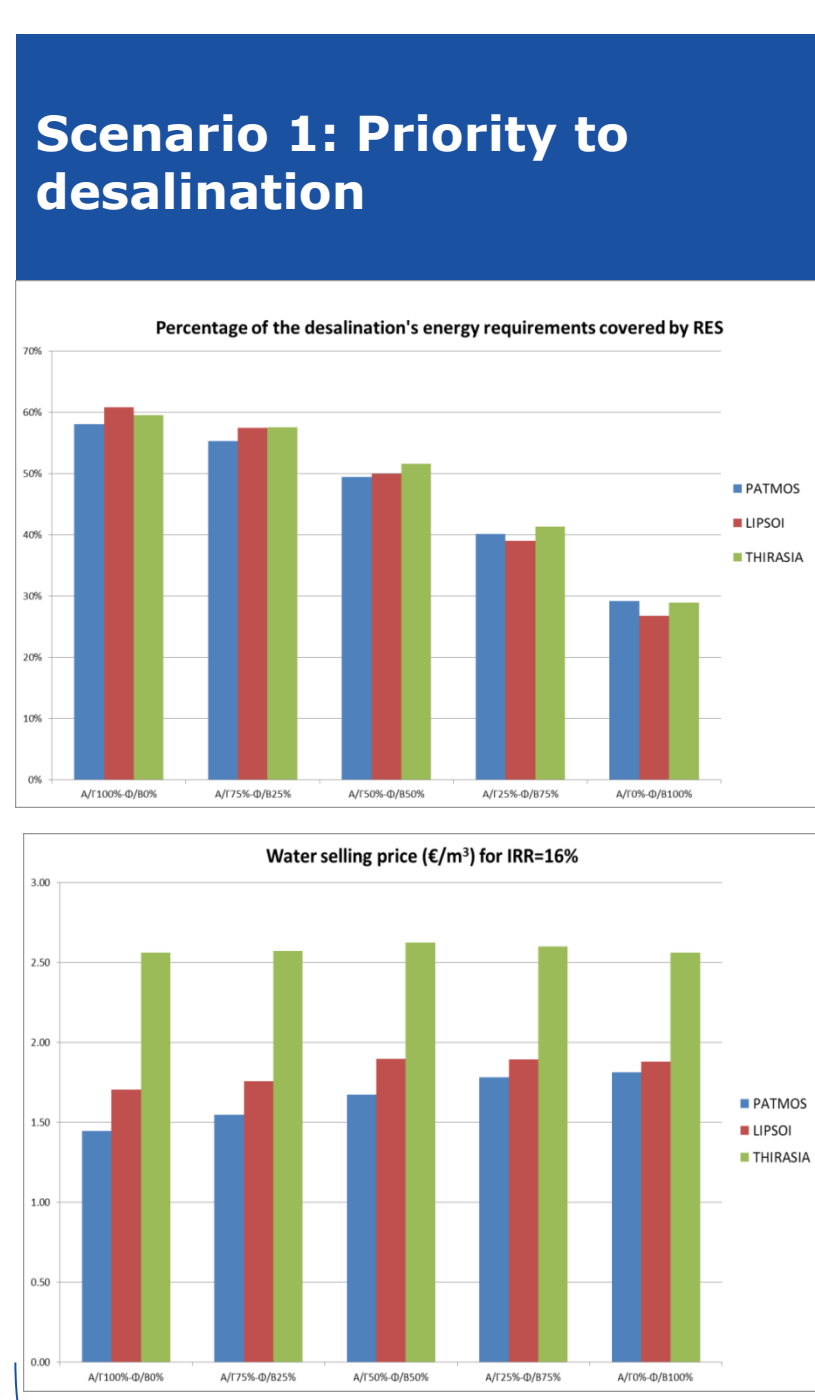
- The applications for RES installations combined with desalination unit installation are satisfied **as a top priority**, if the RES nominal capacity does not exceed the **25%** of the desalination unit power capacity
- The produced electricity from RES is balanced **on an hourly basis** with the energy consumed by the desalination unit
- The surplus of the electrical energy is supplied to the grid at a maximum **20%** of the produced power on an hourly basis.

Multi-parameter analysis

- >3 islands (Patmos, Lipsoi, Thirasia)
- >4 scenarios regarding the RES law interpretation
- >Scenarios for RES penetration
- >Critical figures:

- Produced Water Cost
- Percentage of desalinations' energy requirements covered from RES
- Percentage of unused energy produced from RES
- Economic-investment indicators

Scenarios and Results...




- Lower selling price of the water
- High installation costs of WT and PVs
- Same selling electricity price with the rest mainland despite the higher energy production cost on the islands
- Environmental cost should also be considered.

Valuation of the work and conclusions...

- Optimized solution for larger islands is the installation of WT while additionally Solar PVs can be installed
- In smaller islands the RET unit selection is not that clear since the installation cost per kW of smaller WT is significantly higher in comparison with the larger ones Solar PVs are competitive
- The water selling price is expressively lower than the transported water cost
- Planning and design tool for the Ministry of Environment, Energy and Climate Change as well as the Ministry of Shipping

A Research Initiative in cooperation with:

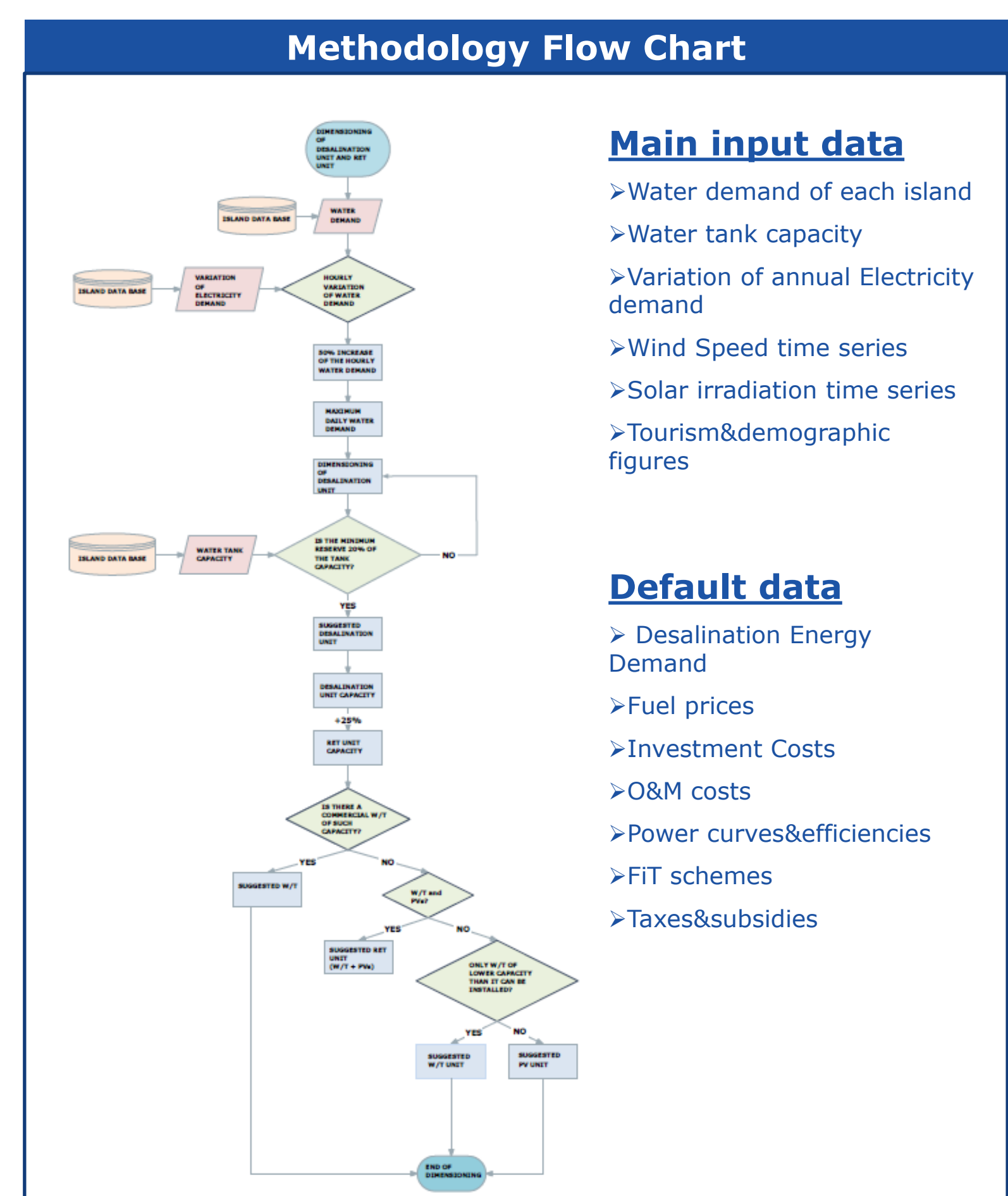
Milos Paradigm

- Capacity: 3.360 m³/day
- Covers all the water demand of the island
- Electricity demand comes from Wind Energy production
- Wind turbine 850 kW derated at 600 kW

Aquifer ships transport vast amount of water annually

The Methodology

- Dimension desalination unit-s that cover the total water demand of 3 characteristic islands
- Dimensioning of RET unit-s that supply part of the produced energy to the desalination unit
- Economic-investment assessment of the project



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ISLANDS	TRANSPORTED WATER QUANTITY (m ³)	PREDICTED CAPACITY (m ³)	DESALINATION UNIT CAPACITY (m ³)	TOTAL CAPACITY (m ³)	RET UNITS
PATMOS	253.600	419.736	4×500	2.000	1 W/T 330 kW and P/V 86 kW
LIPSOI	40.900	88.168	4×100	400	1 W/T 50 kW and Φ/B 33 kW
THIRASIA	18.000	23.276	4×25	100	P/V 20,8 kW

ISLANDS	WPC (€/m ³)	Water selling price (€/m ³) for IRR=16% and PBP about 6,5 years
PATMOS	1,17	1,59
LIPSOI	1,41	1,88
THIRASIA	2,18	2,57