European Commission

CO-OPET
Support initiative for the Organisations for Promotion of Energy and Transport Technologies

Work package no. 7:
Water and Power co-generation
in the Mediterranean islands and coastal areas

Seawater desalination exploiting waste heat from local diesel power plants

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WP 7 - Objectives

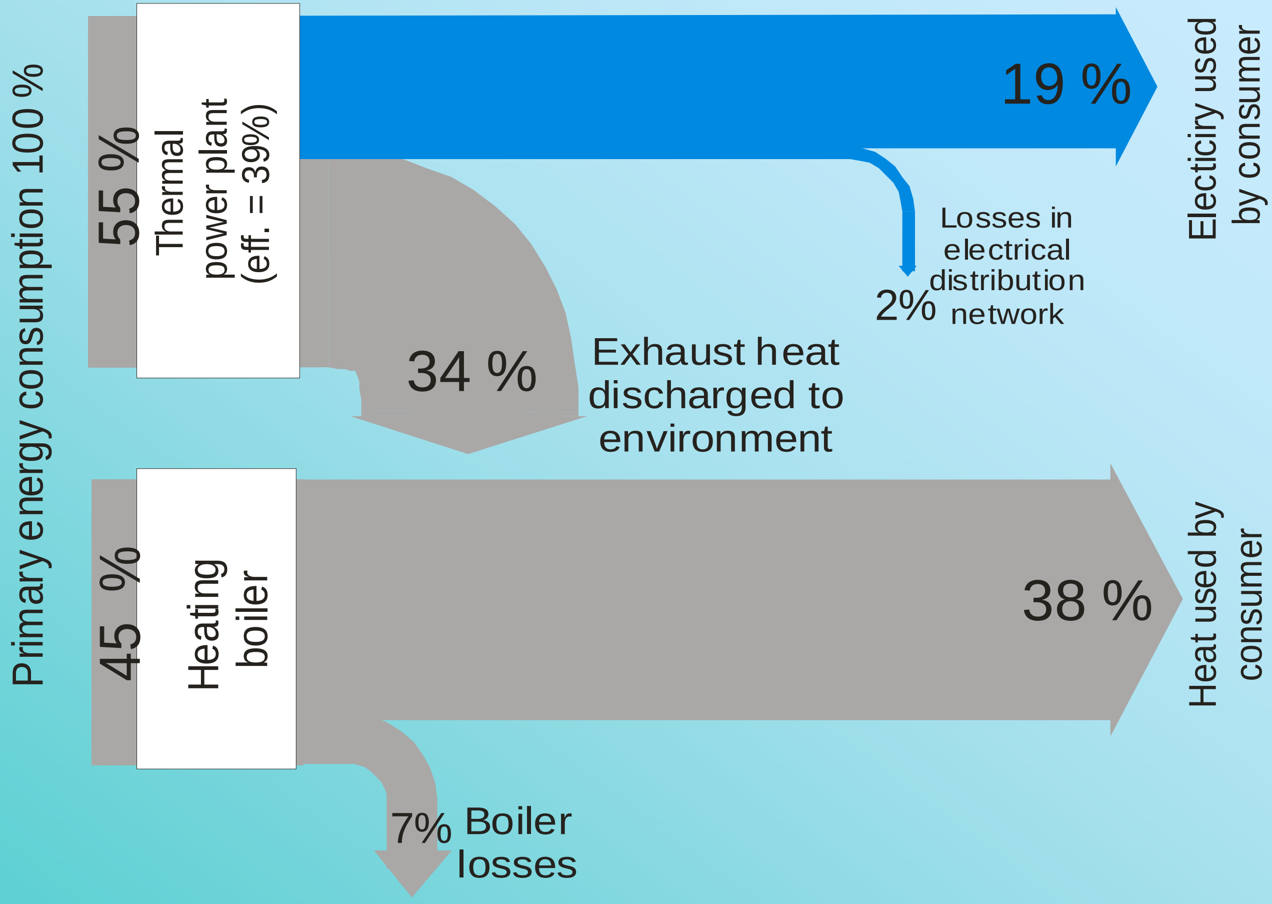
- Human communities living in hot and arid areas, or on islands in the sea, usually are in bad need for both water and power.
- Combined Heat and Power generation (CHP) is usually not easily feasible in hot climates since there is no sufficient heat demand.
- So why not produce instead water and power by exploiting the otherwise wasted exhaust heat (or waste heat) from thermal power plants to drive thermal seawater desalination (distillation) systems?
- In large-scale applications in Saudi Arabia and in the Arab Gulf Emirates, this is a common and well proven practice.
- The aim of the Work Package is to promote the use of such technologies in small-scale stationary applications on islands not connected with the main electricity network of the country.

Separate Power and Heat production

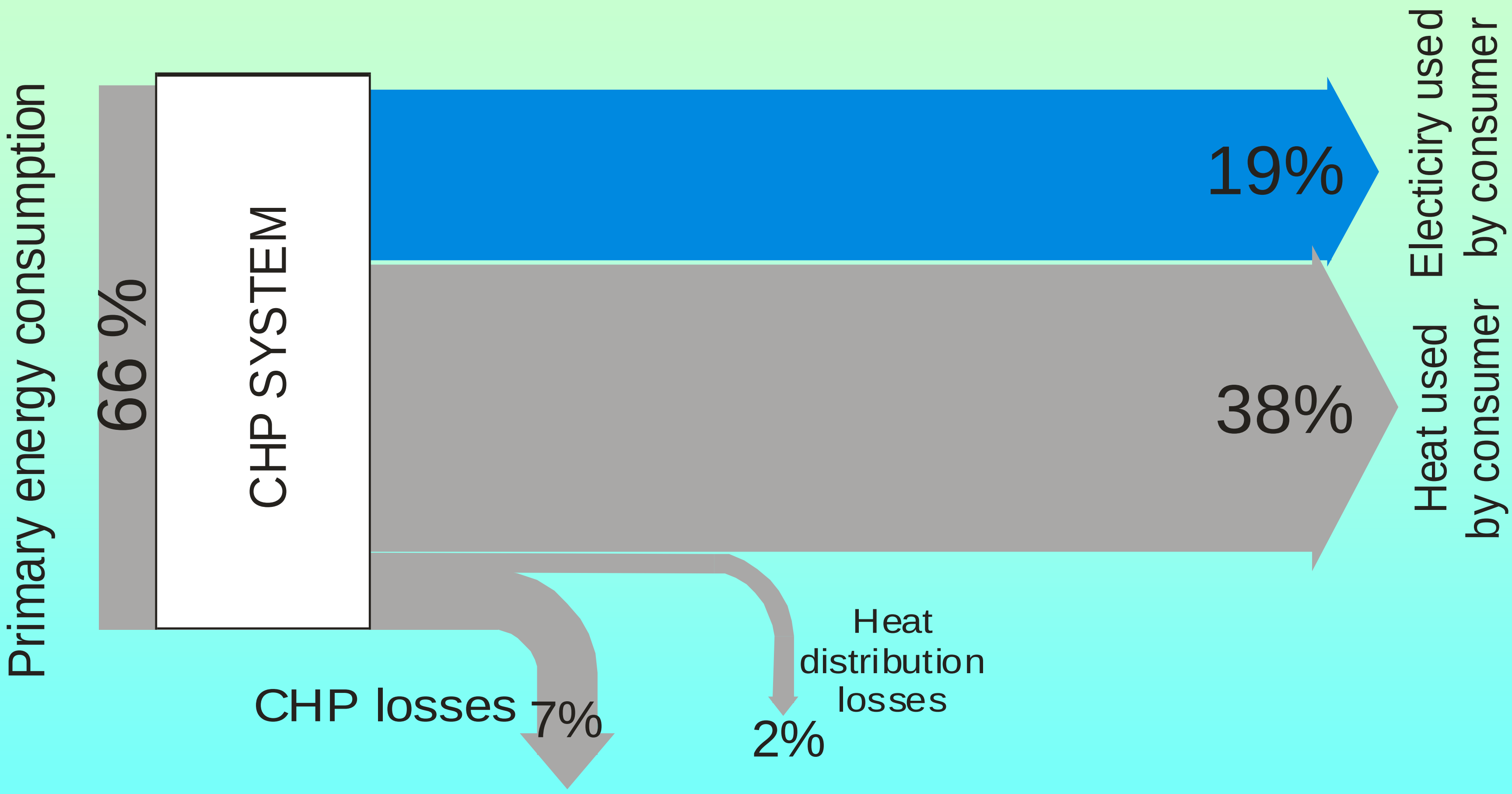
What we usually do:

Produce electricity in large power plants

Produce Heat in our domestic boilers



Combined Heat and Power (CHP) generation

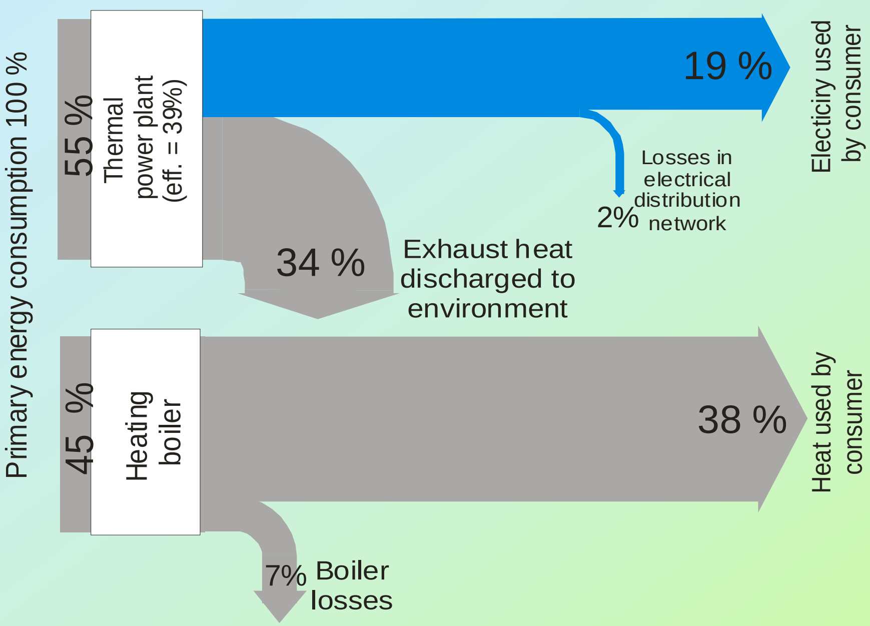


Primary energy source saving: 30-35%

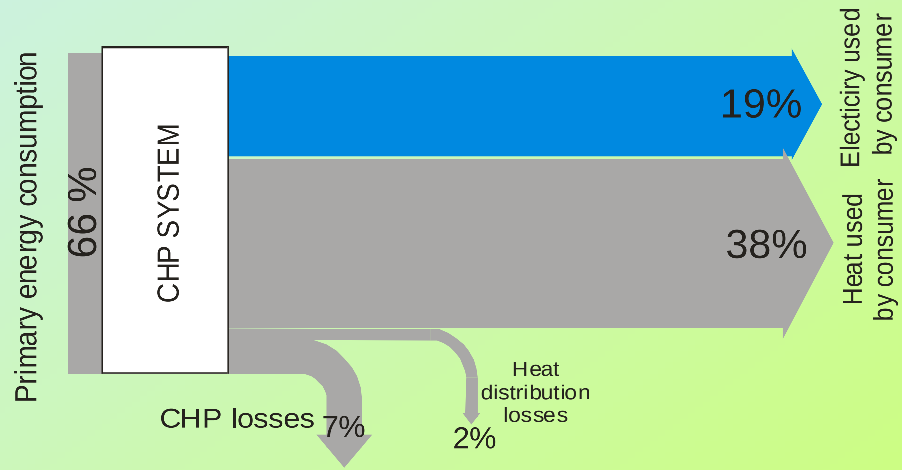
(in comparison to separate generation, maintaining same final energy uses)

Comparison:

separate Power and Heat



CHP

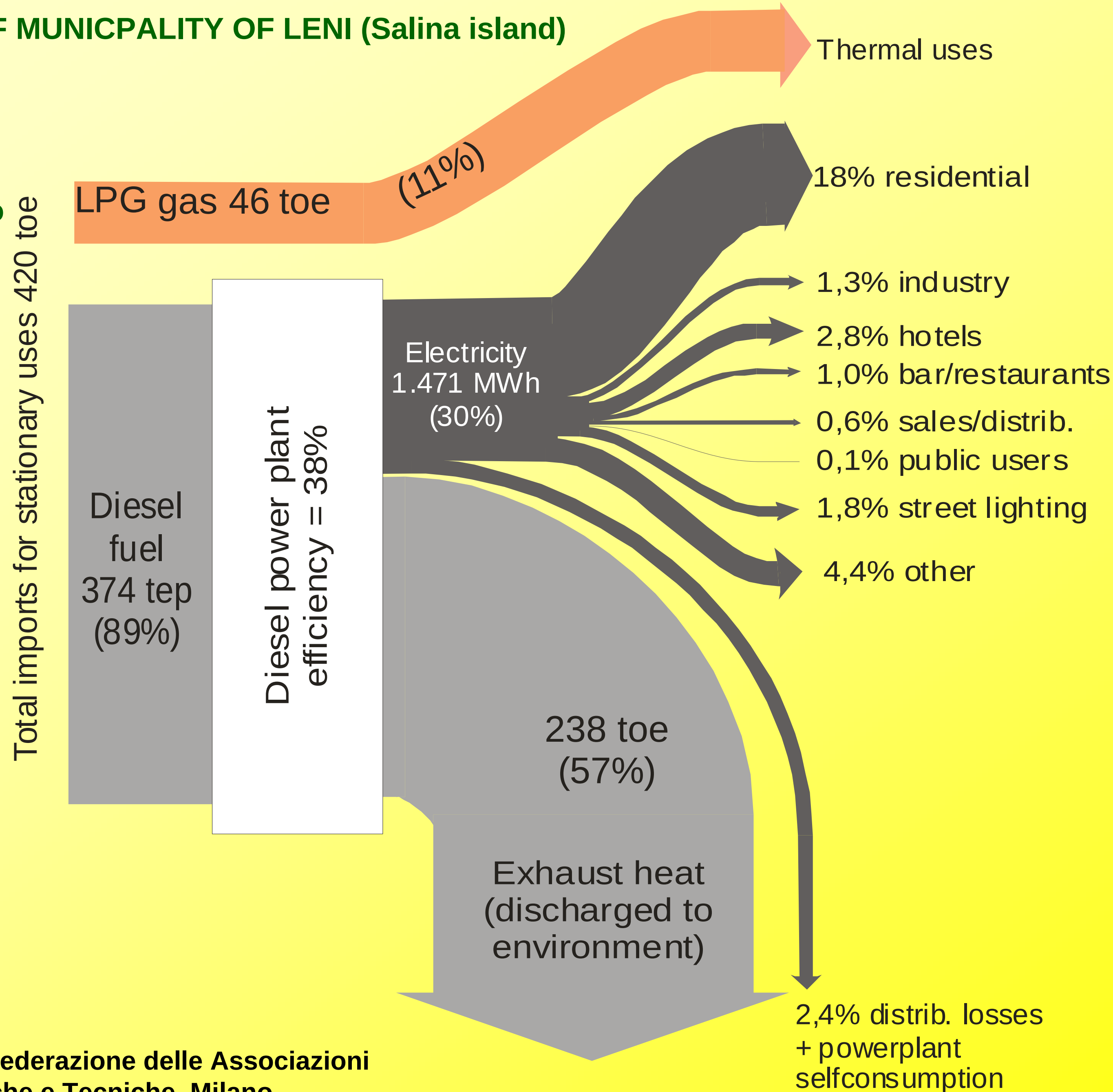


Primary energy source saving: 30-35%

(maintaining same final energy uses)

ENERGY BALANCE OF MUNICPALITY OF LENI (Salina island) (650 inhabitants)

(excluding transports) (percentages related to imports of primary energy source)



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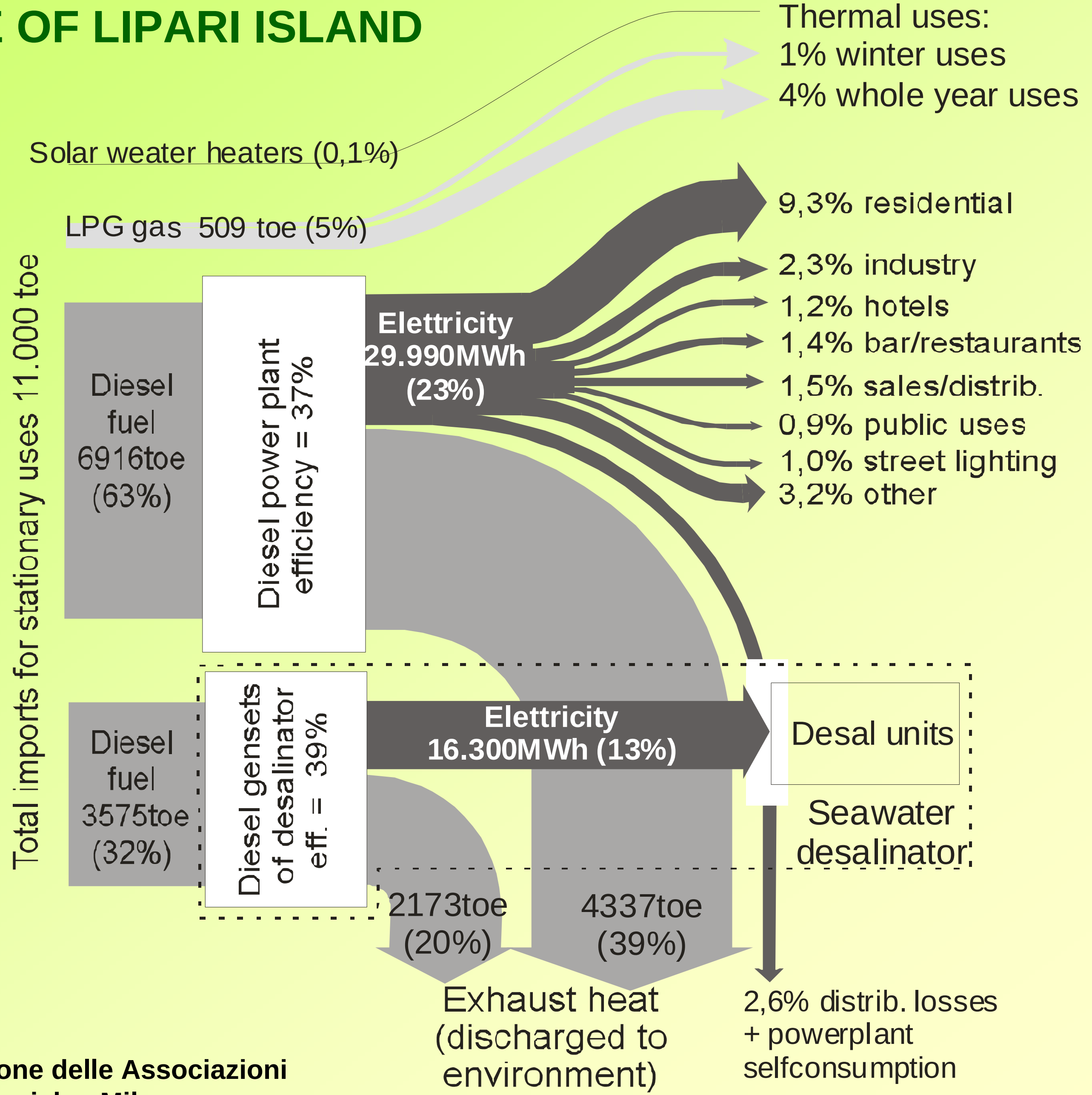
ENERGY BALANCE OF LIPARI ISLAND (Sicily)
Year 2000
(9.000 inhabitants)

(excluding transports)
(percentages related to imports of primary energy source)



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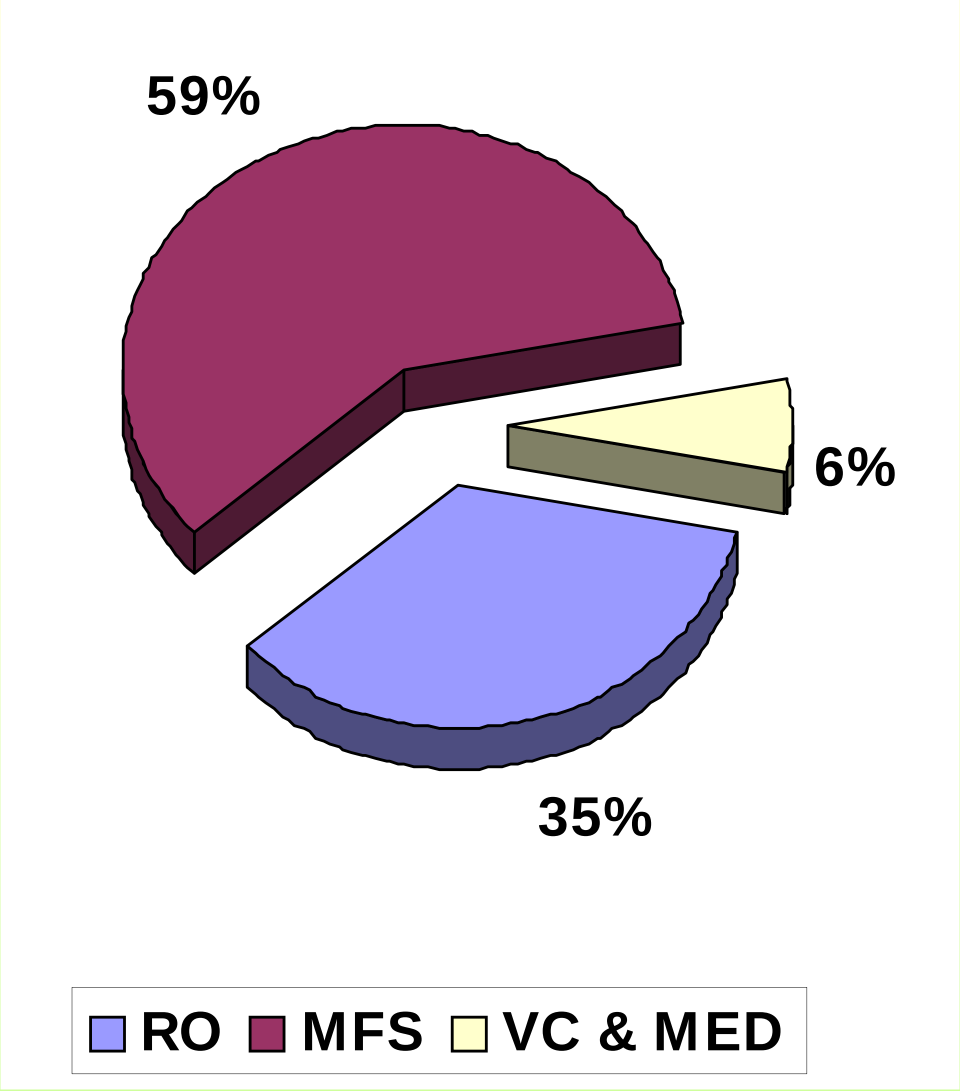
Investigated desalination technologies

	Process		Sea-water	Maintenance requirements	Size range per production unit (m^3/day)	
					min	max
Membrane processes	Electrodialysis Reversal	EDR	**NO**	↗	0	30.000
	Brackish Water Reverse Osmosis	BWRO	**NO**	↗	0	10.000
	Seawater Reverse Osmosis	SWRO	yes	↗	0	10.000
Thermal processes	Multiple Effect Distillation	MED	yes	↘	2.000	20.000
	Multiple Effect Distillation with thermo-compression	MED-TC	yes	↘	2.000	20.000
	Multiple Stage Flash - Brine recirculation	MSF-BR	yes	↘	4.000	75.000
	Mechanical Vapour Compression (all electric)	MVC	yes	↘	100	3.000

World market shares of desalination technologies



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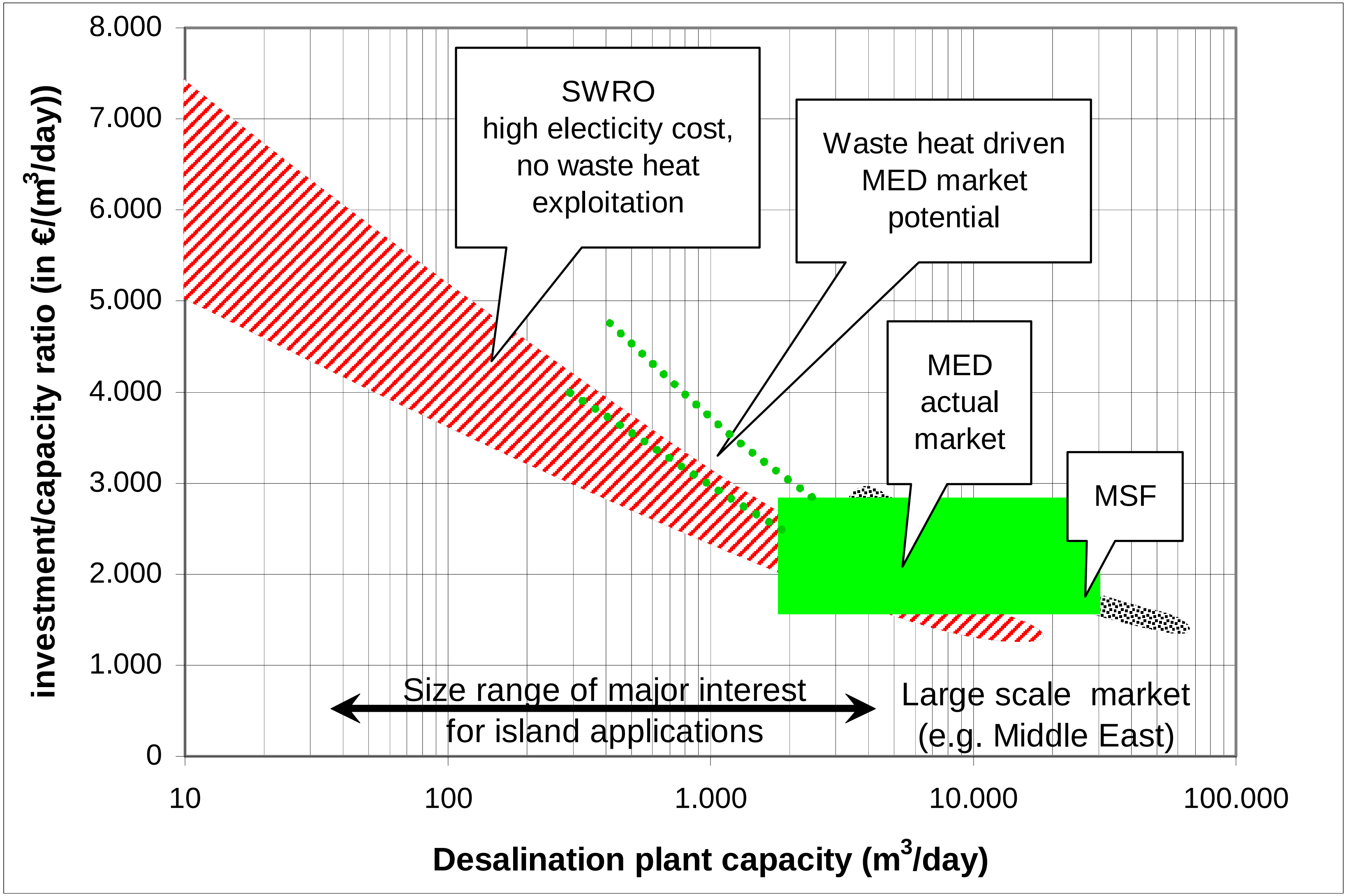
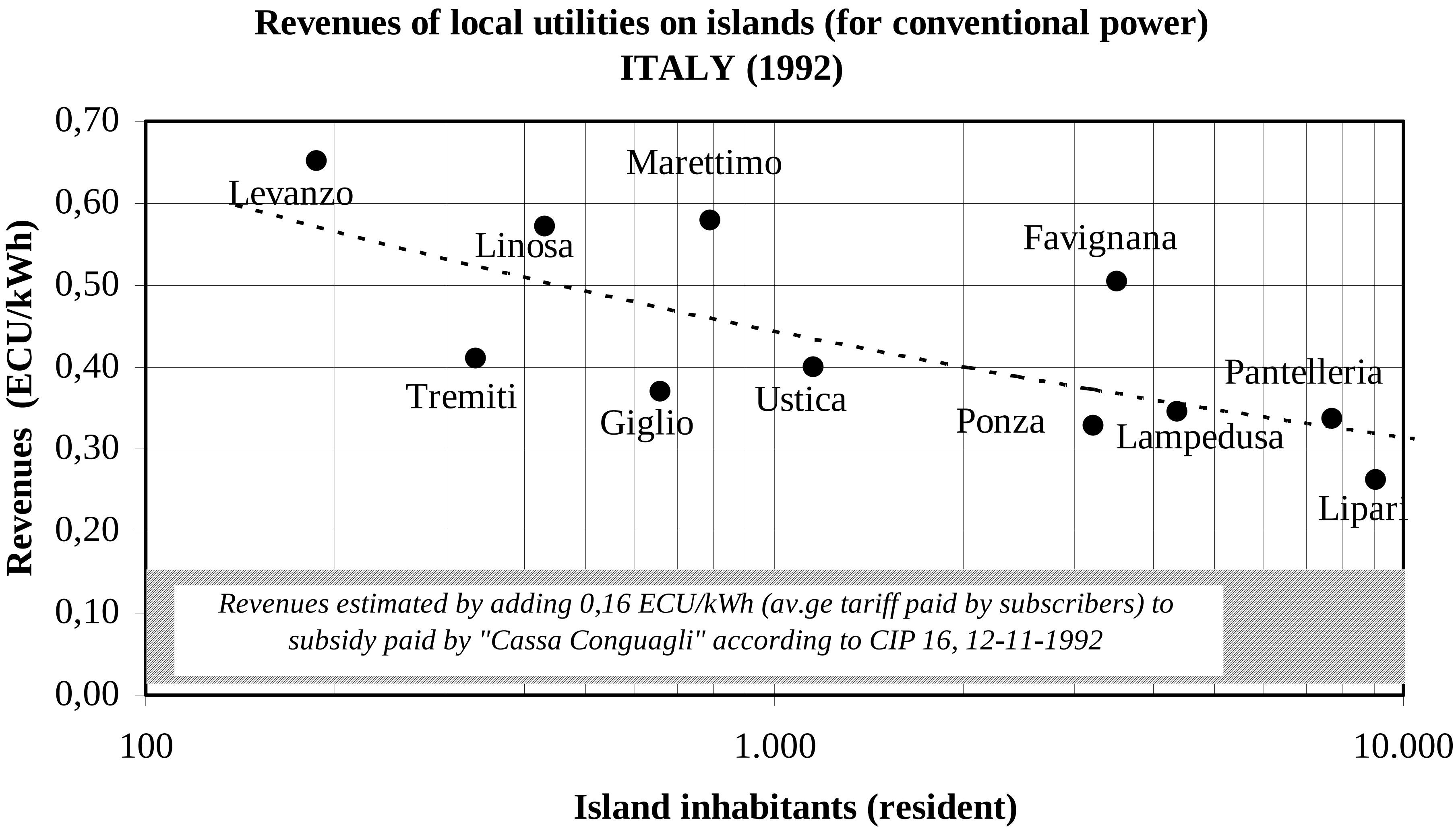
Typical specific investment costs of desalination technologies

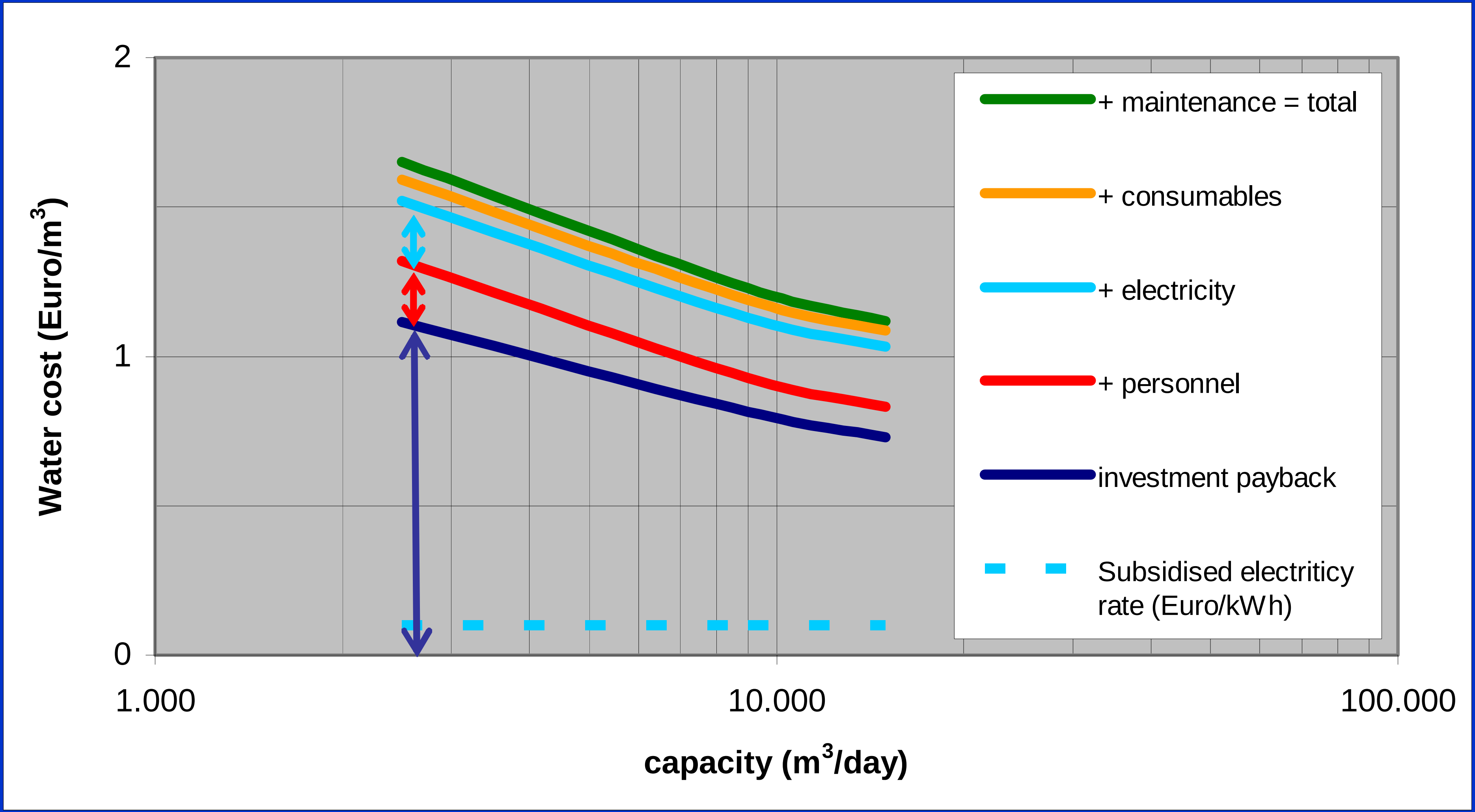


Note: each 1 m^3/day satisfies the potable water needs of 3-5 inhabitants (Europe)



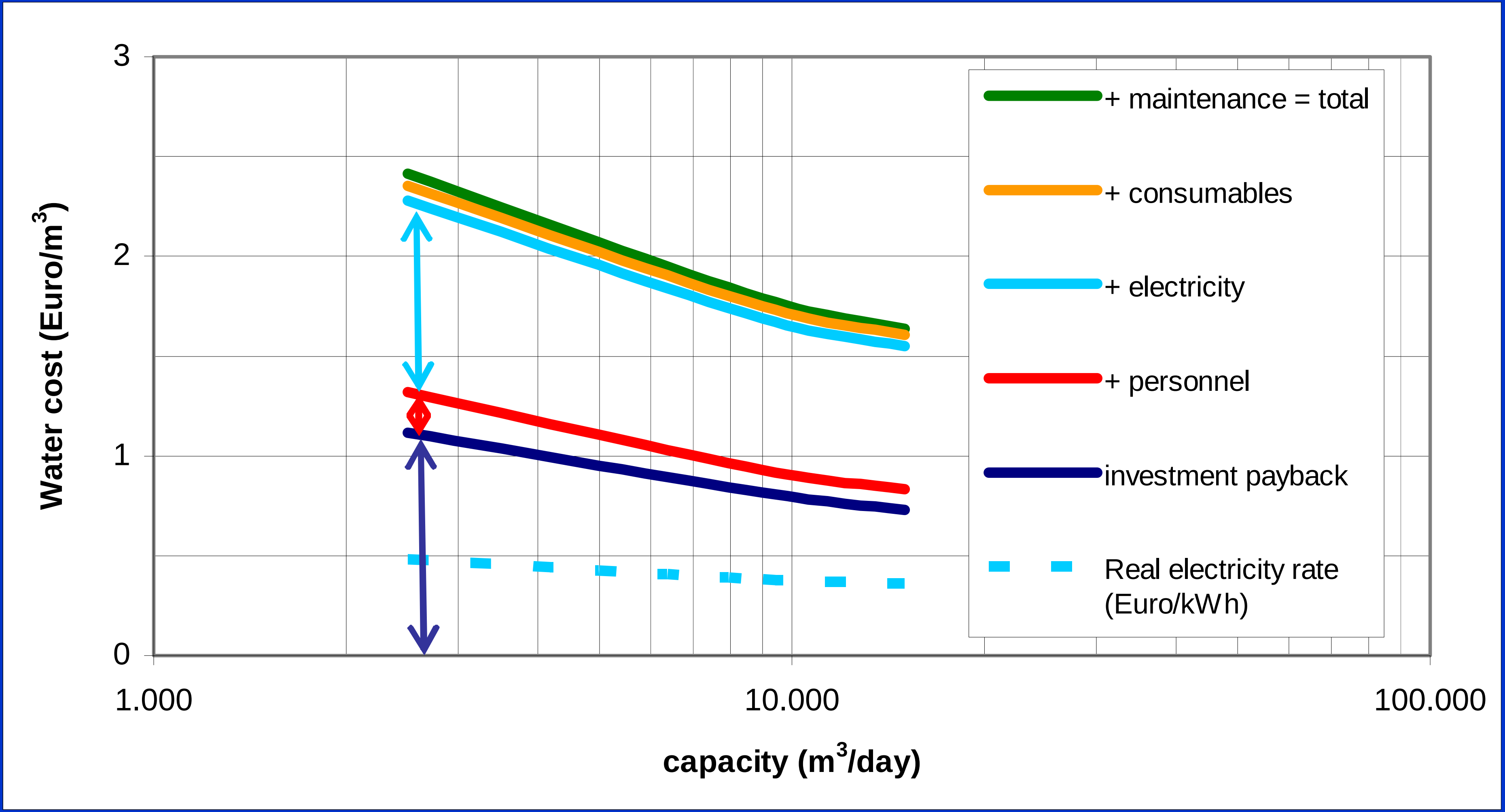
Source: Final report "Renewable Energies on Mediterranean Islands", EC DG XII - APAS - RENA CT94-004 (1996)

MED + COGEN – Waste heat driven MED - Typical cost structure of produced water considering a subsidised electricity tariff of 0,10Euro/kWh



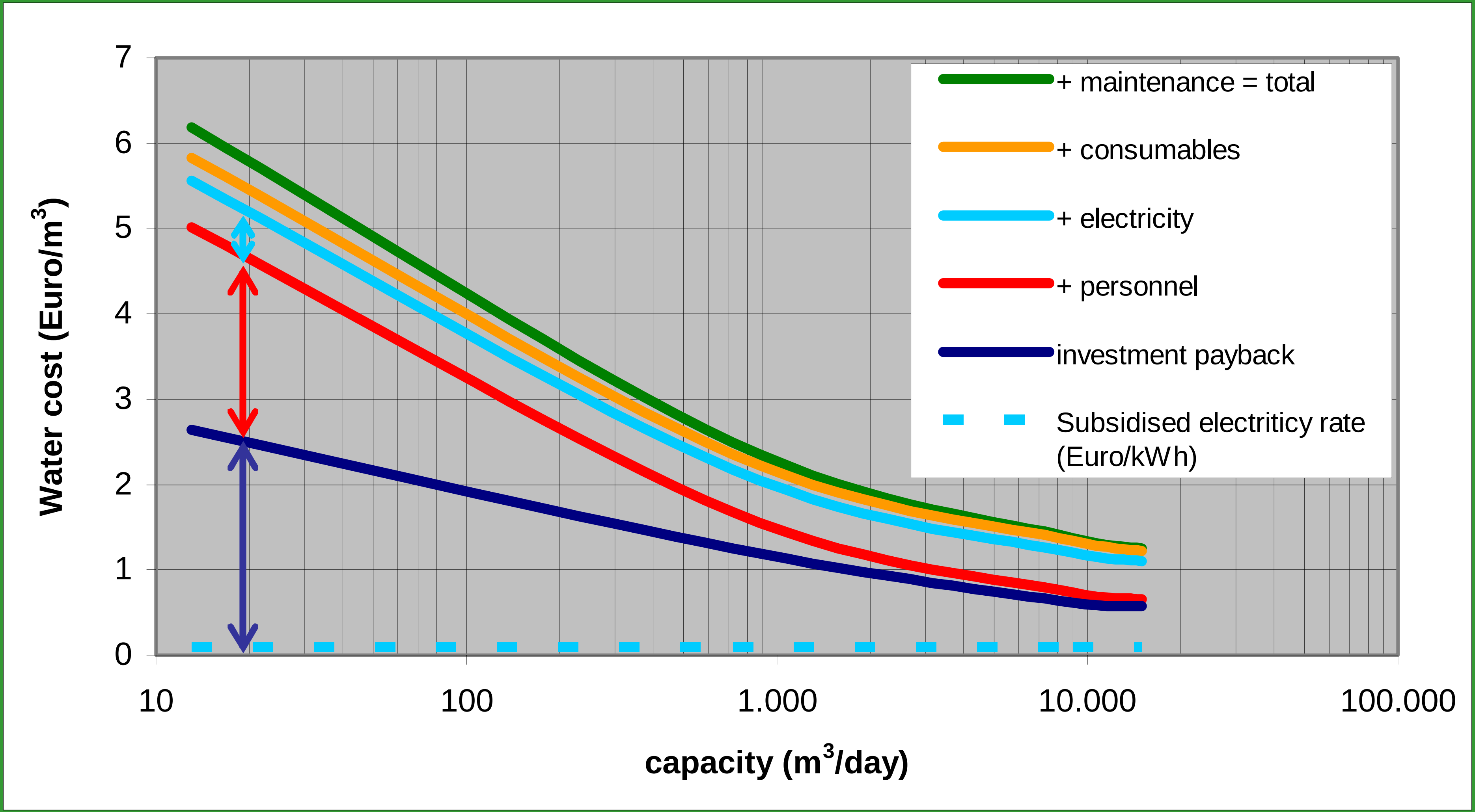
Note: each 1m3/day satisfies the water needs of 3-5 inhabitants (Europe)

MED + COGEN – Waste heat driven MED - Typical cost structure of produced water considering the real cost of electricity on small islands



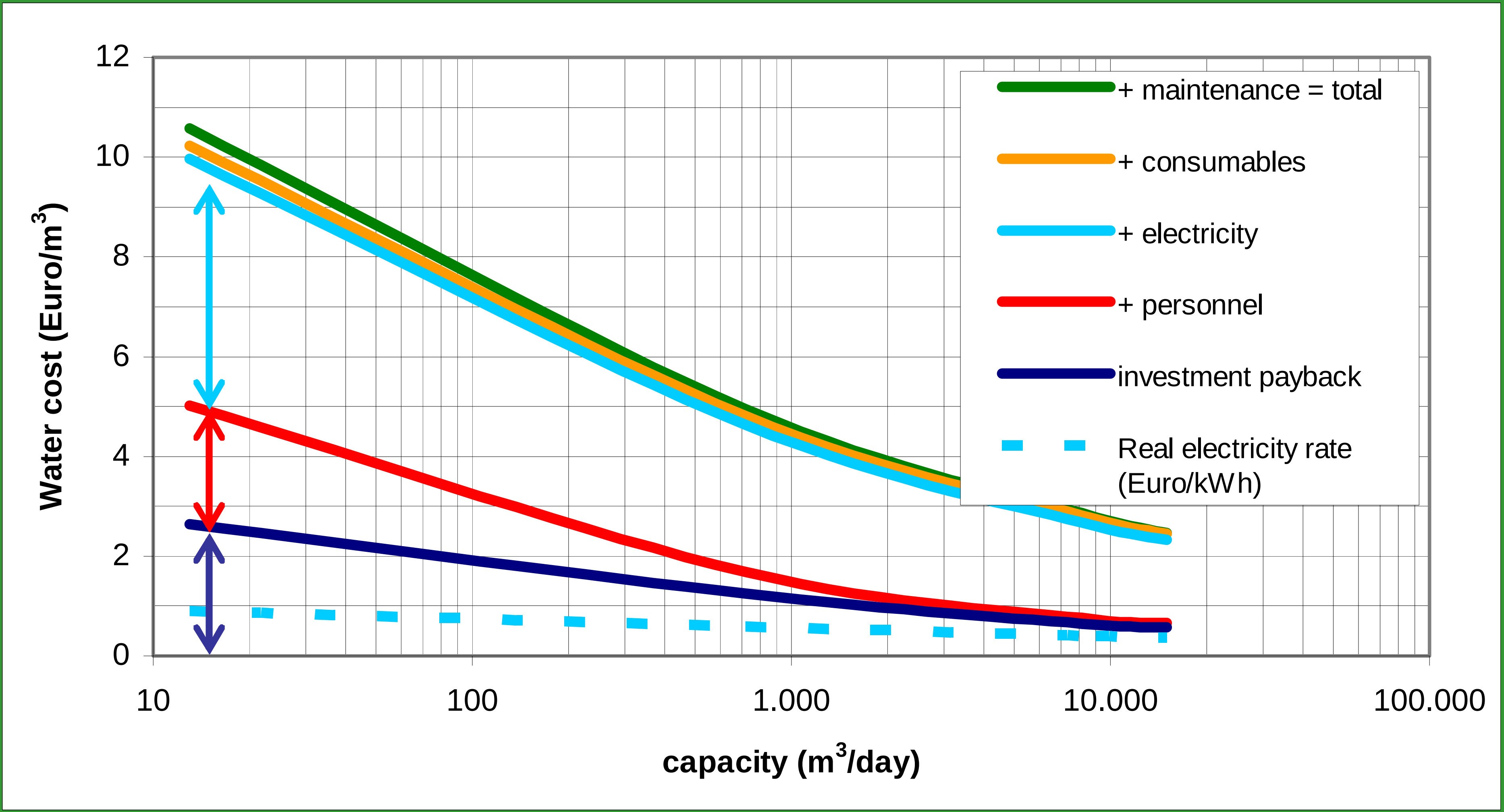
Note: each 1m3/day satisfies the water needs of 3-5 inhabitants (Europe)

SWRO – Typical cost structure of produced water considering a subsidised electricity tariff of 0,10Euro/kWh



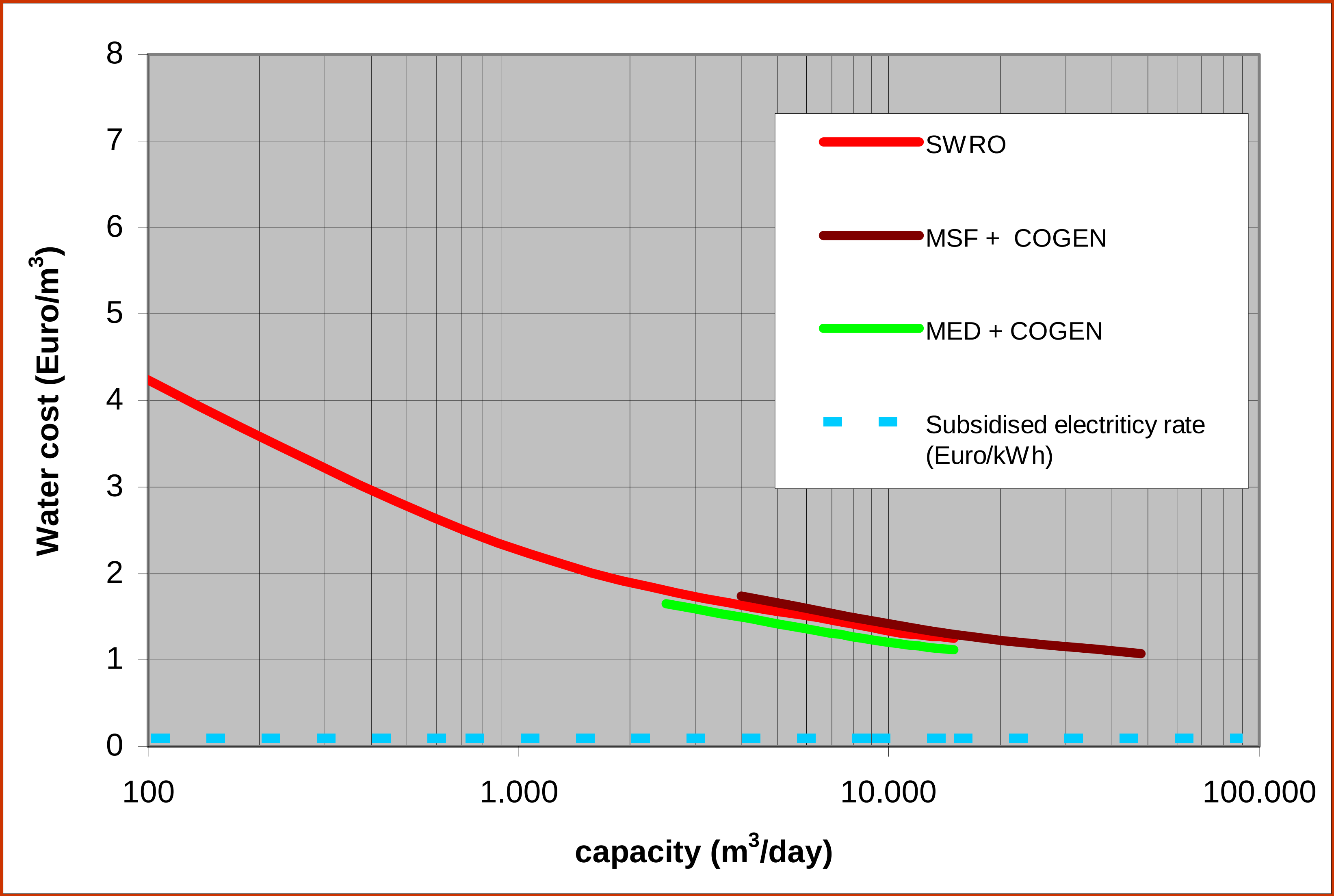
Note: each 1m3/day satisfies the water needs of 3-5 inhabitants (Europe)

SWRO – Typical cost structure of produced water considering the real cost of electricity on small islands



Note: each 1m3/day satisfies the water needs of 3-5 inhabitants (Europe)

Comparison between overall costs of produced water considering a subsidised electricity tariff of 0,10Euro/kWh



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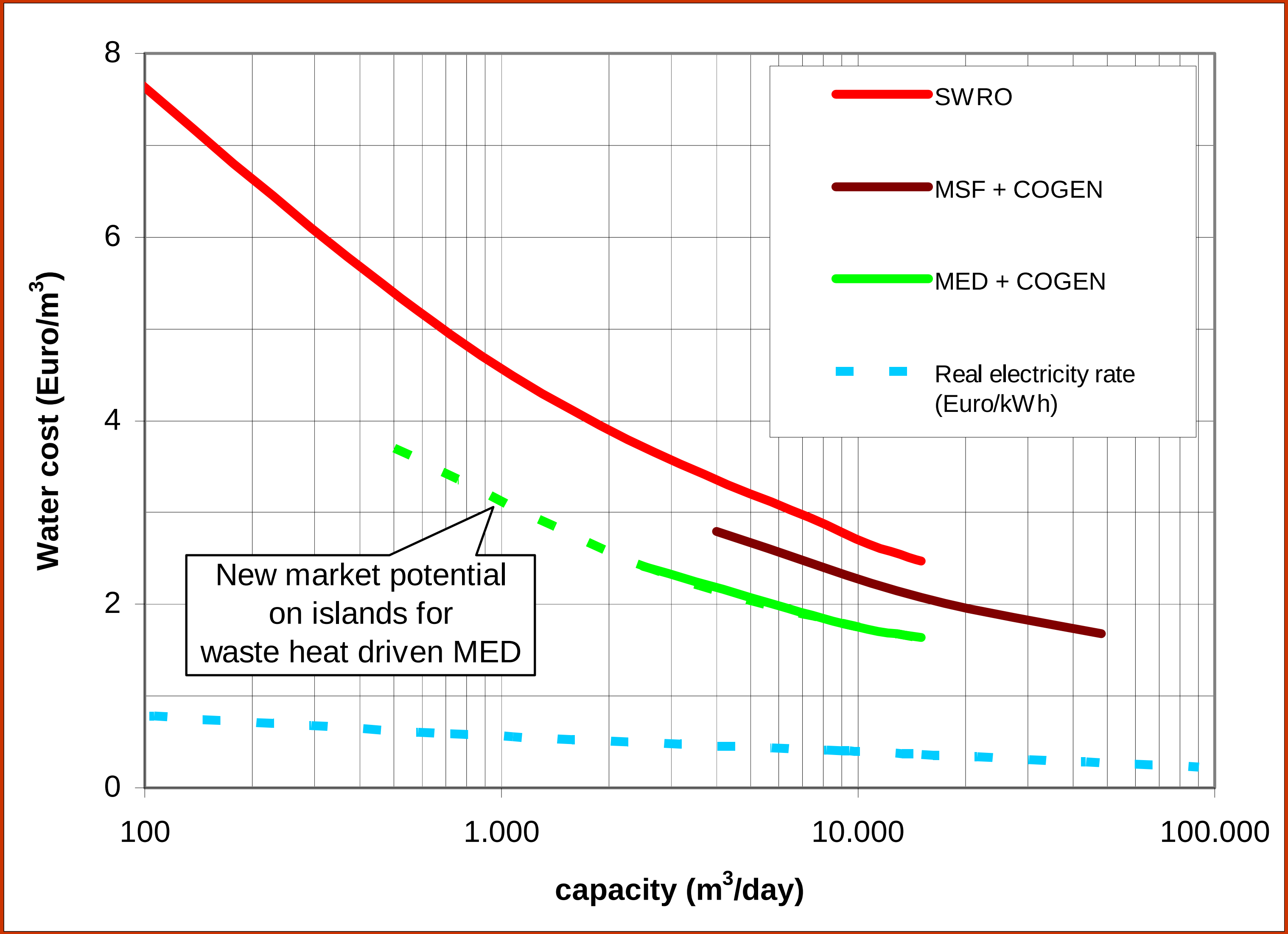
Comparison between overall costs of produced water considering the real cost of electricity on small islands



Note: each 1m3/day satisfies the water needs of 3-5 inhabitants (Europe)

Conclusions

- Thermal desalinations systems exploiting waste heat from a power plant are common for large scale applications in the middle east

- On italian islands there are some few inefficient MVC desalination systems using electricity, or else, like in Greece, only SWRO systems

- On islands there are no thermal desalination system using waste heat

Why are there no plants on islands ?

- Exploiting waste heat for seawater desalination produces marked advantages in terms of:
  - Energy efficiency and overall saved energy
  - Overall economics (at macro scale)

- So why is this mature and commercial technology not applied on islands?

- The answers lies in the difference between macro-economy and micro-economy

Subsidised consumer tariffs for electricity and water end-up to become an **Environmentally Harmful Subsidy**

Definition of subsidy:

"any measure that keeps prices for consumers below market levels, or for producers above market levels"

Consequence: Inefficient allocation of public spending (money of taxpayers / consumers)

The issue is NOT to eliminate subsidised consumer tariffs on islands. The question is how to open subsidy mechanisms to allow for

innovation and fair competition