AN ENVIRONMENTAL LIFE CYCLE STUDY OF THE LARNACA WASTEWATER TREATMENT PLANT

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Introduction

- Different WWTPs have different performance characteristics and generate different direct impacts on the environment.
- LCA has been used to explore the sustainability of wastewater systems since the mid 1990s

WWTPs

a priori considered as environmentally friendly

Impacts due to raw materials and energy

Aim of the study

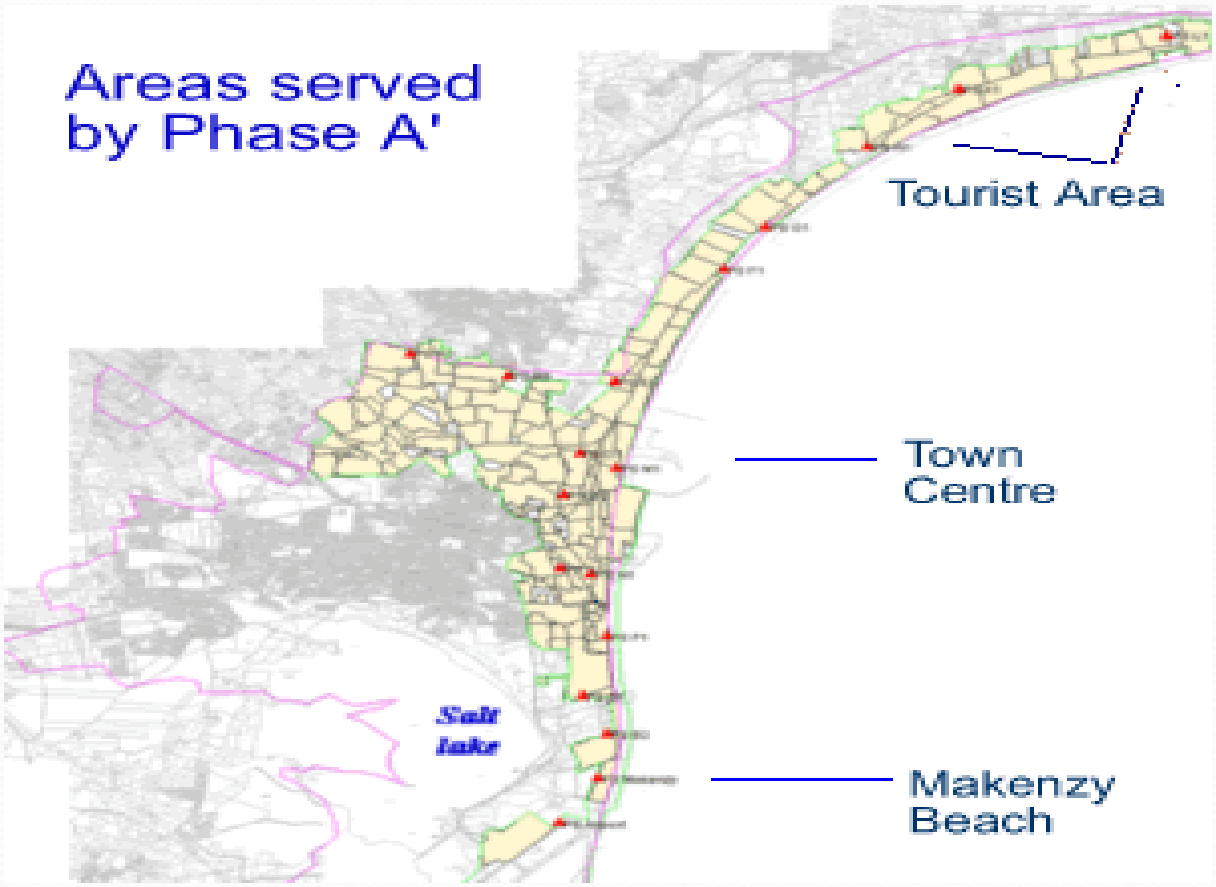
- The environmental LCA of the operation of the Larnaca municipal WWTP in Cyprus during 2005-2007.
- In addition, two proposed extension schemes for the WWTP will be compared in terms of LCA.

Functional unit

The annual input of wastewater in the WWTP.

- Operation 2005-2007: 6,762 m^3/day
- Extension of the plant: 18,000 m^3/day.

Larnaca sewage system



WWTP 2005-2007

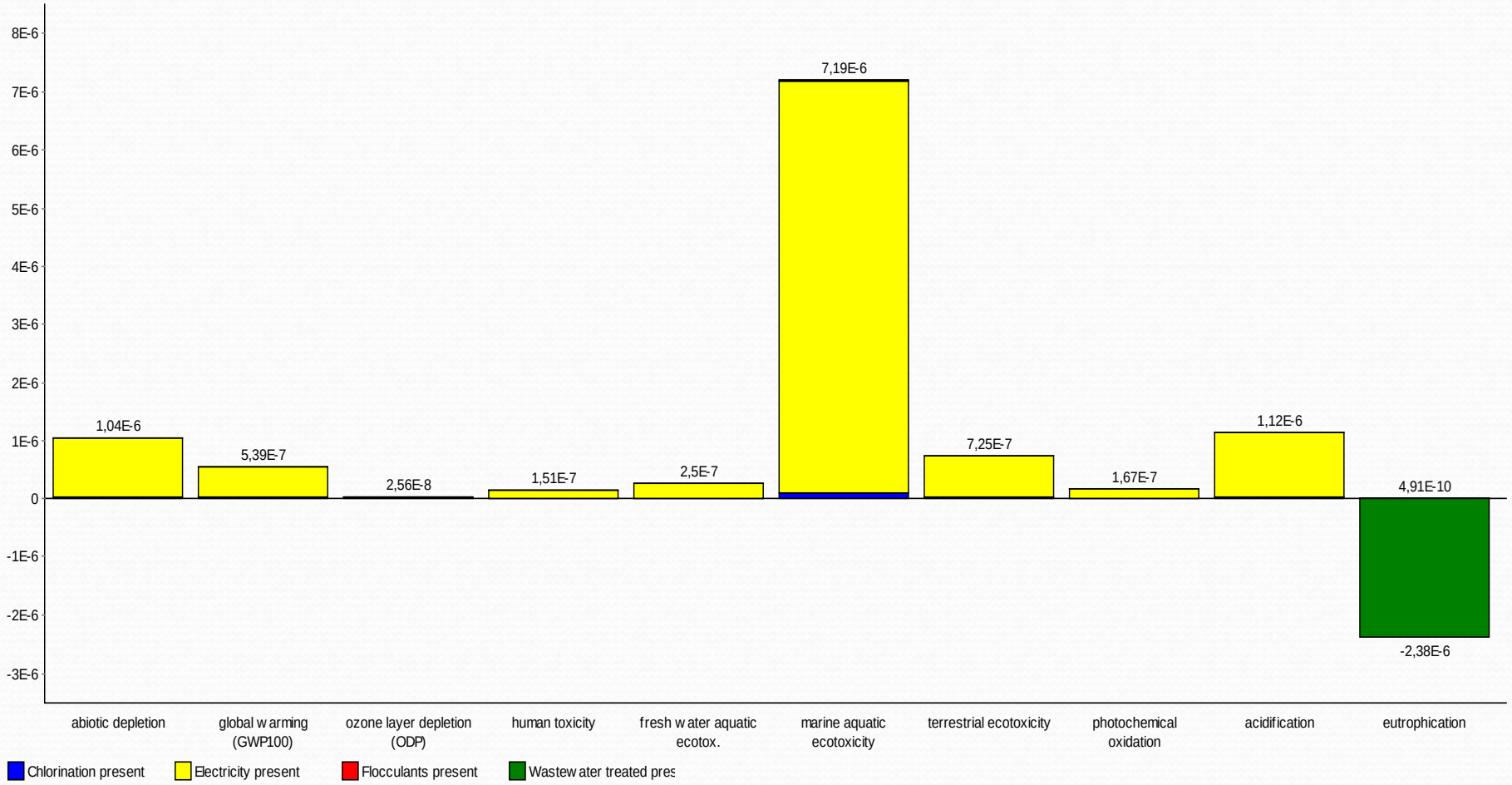
- Primary stage: Incoming WW -> inlet chamber -> screening unit -> grit removal tank.
- Secondary stage: WW along with returned activated sludge -> two oxidation ditches -> secondary settlement tanks
- Secondary effluent: stored in large storage lagoons
- Tertiary treatment: sand filters + chlorination

- Reclaimed water is utilized for irrigation
  - Hotel gardens and local football fields.
  - Silage and corn plantations (neighbouring communities)
- Excess sludge -> sludge thickener -> aerobic digestion units -> sludge drying beds/dewatering unit
- Dried sludge applied free of charge on local fields for soil improvement

Life cycle inventory

	Unit	Input	Output
Wastewater	m^3/day	6,762	
Chlorine	kg	55,000	
Polyelectrolyte	kg	5,404	
Electricity consumption	KWh	2,755,665	
Space requirement	m^2	21,000	
BOD	mg/L	311.5	19.7
COD	mg/L	703.8	69.0
SS	mg/L	194.8	34.1
N-NH3	mg/L	68.3	19.5
TP	mg/L	60.2	6.6

Normalisation



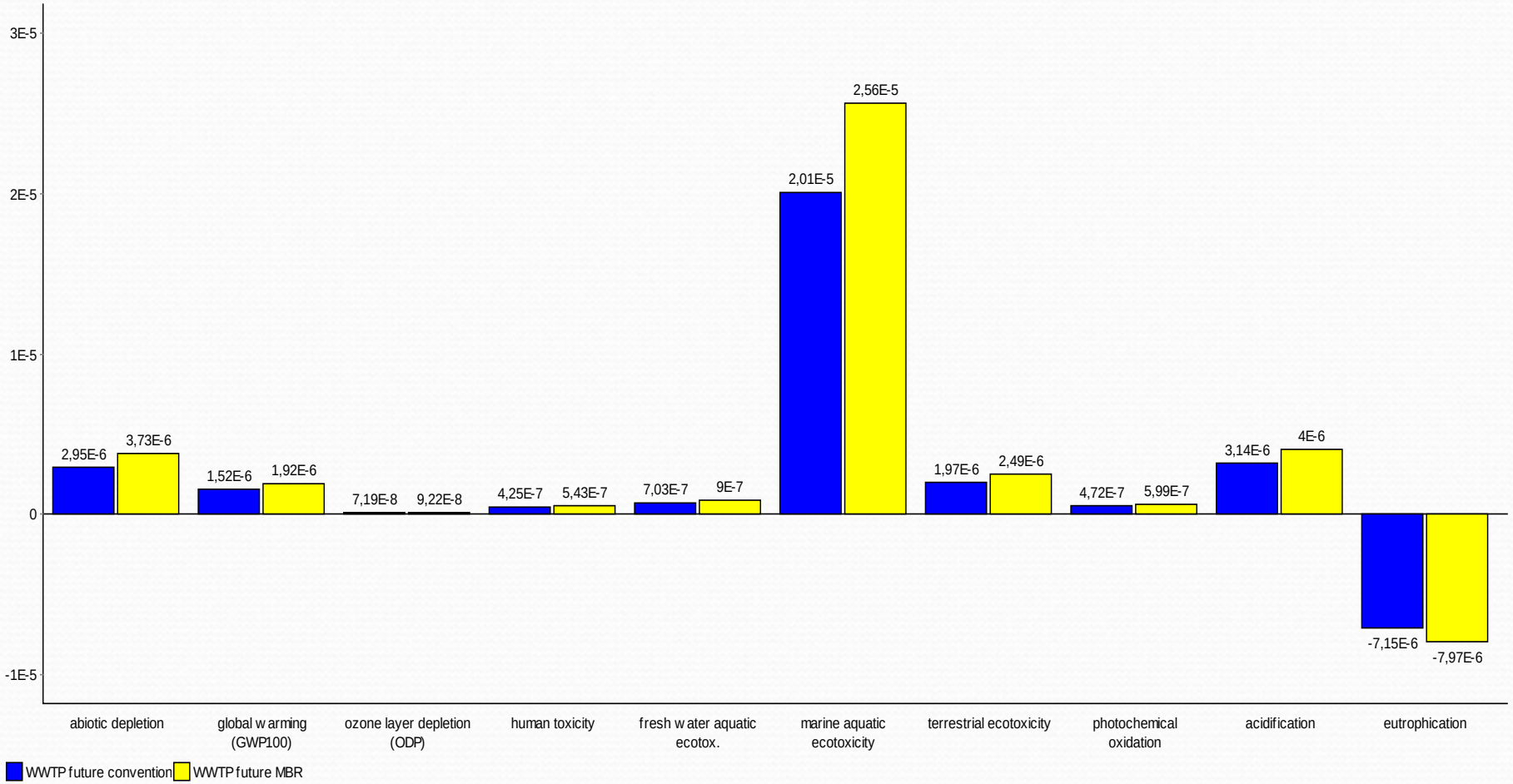
Analyzing 1 p assembly 'WWTP present'; Method: CML 2 baseline 2000 / West Europe, 1995 / normalization

WWTP extension alternatives

- Activated sludge treatment with primary sedimentation, conventional aeration and anaerobic sludge digestion, and
- Membrane bioreactor (MBR) system operating as extended aeration.

	Units	AD	MBR
Inputs (Infrastructure)			
Concrete (reinforced)	m^3	10,110	9,130
Earthworks	m^3	47,500	40,500
Space requirement	m^2	85,000	65,000
Electricity	KWh/y	9,093,194	9,905,879
Polymer consumption	Kg/y	13,689	12,726
Chlorine consumption	kg	52,560	6,570
Land requirement	m^2	85,000	65,000
Outputs			
Energy generation	KWh/y	1,366,694	-
BOD	mg/L	12.5	3
COD	mg/L	26.2	6.3
SS	mg/L	17.5	0
TP	mg/L	0.9	0.09

Normalisation (2 alternatives)



Comparing 1 p assembly 'WWTP future conventional' with 1 p assembly 'WWTP future MBR'; Method: CML 2 baseline 2000 / West Europe, 1995 / normalization

Conclusions

- The operation of the Larnaca WWTP has a positive impact on the alleviation of the eutrophication resulting from untreated WW in water bodies.
- The operation of the WWTP 2005-2007, impacts adversely the following categories:
  - marine aquatic ecotoxicity, acidification,
  - abiotic depletion, terrestrial ecotoxicity , global warming.

Conclusions

- Electricity is the main contributor in all of these environmental impacts
  - In Cyprus it is generated via crude oil.
- The MBR system is anticipated to generate more impacts compared to the conventional AD system.
- The positive environmental credit in terms of reduced eutrophication is also greater for the MBR system.

Conclusions

- Our results also showed that the WWTP infrastructure has a negligible effect on the environmental impacts.