ΙΕΝΕ

6ο Ενεργειακό Συμπόσιο Κύπρου,

4η Δεκεμβρίου , Ξενοδοχείο Hilton Park, Λευκωσία

ENERGY EFFICIENCY AND SOLAR ENERGY FOR SUSTAINABLE CITIES IN CYPRUS

Professor Despina Serghides

The Cyprus Institute
RESEARCH·TECHNOLOGY·INNOVATION
Smart Isle Urban
URBAN EUROPE
European Commission
Smart Cities Member States Initiative
Ίδρυμα Προώθησης Έρευνας

Contents

1. Introduction

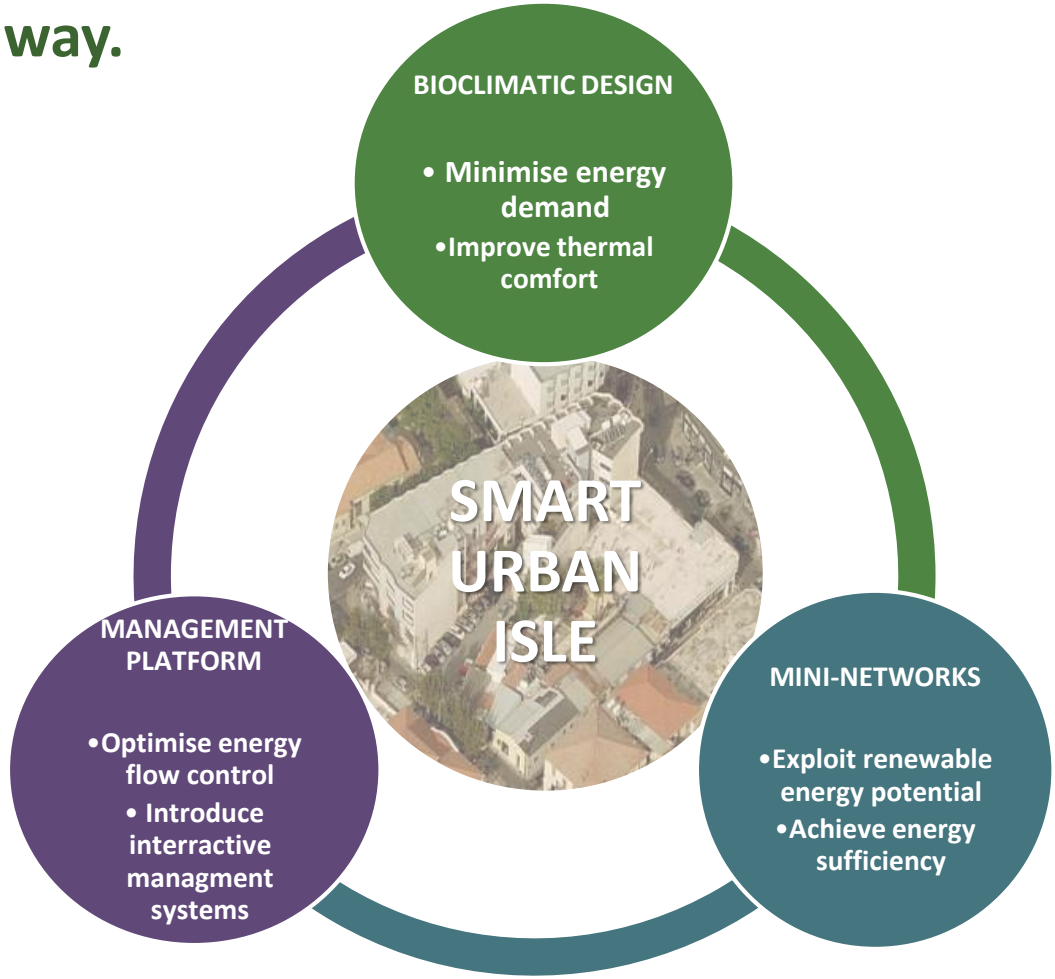
Urbanisation and Energy

- ***Energy is the main parameter that determines the quality of life in cities as well as their environmental quality.***
- ***In Cyprus the buildings are responsible for 30% of the total energy used in the country, and in particular account for 80% of total electricity consumption.***
- ***Urbanization dramatically affects energy consumption.***

With rapid urbanisation, sustainability in Cities nowadays is more crucial than ever

2. Aim and Objectives –SUI Project

Aim: **Move forward with the urban energy savings and reduce CO2 emissions. Based on a three cornerstones procedure, propose a whole new urban planning that allows cities to grow in a sustainable way.**



3. Methodology

1. The energy consumption and the CO2 emissions associated with a typical urban Isle from the city center of Limassol were investigated and are showcased

2. The shortcomings are identified

3. A set of scenarios aiming to improve the energy efficiency, to utilize solar energy and reduce the CO2 emissions are proposed.

   The scenarios include, bioclimatic measures and the introduction of RES towards reducing the CO2 emissions

4. Evaluation of the results and conclusions

4. Case Study - Status Quo

general information

THE NEIGHBOURHOOD

Urban isle characteristics

Location: **Limassol,** Old town centre

Uses: retail stores and education, cafeterias, wine and cocktail bars.

Total built area: 5,400 m2

Non-residential buildings: 12

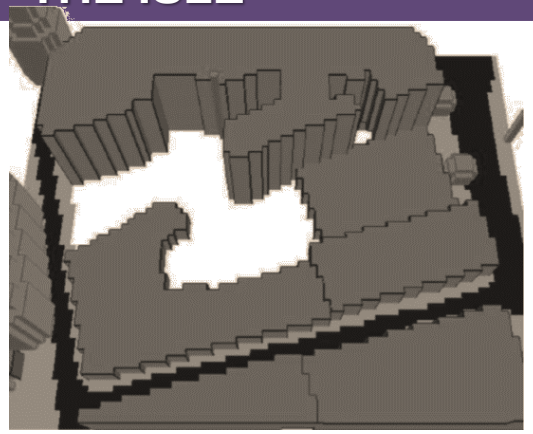
The Public Building: University Administration building

Construction: 1979

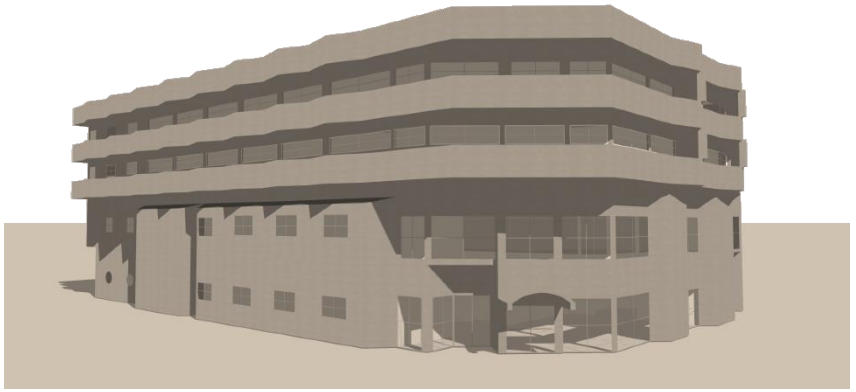
Renovations: 2011 & 2015

Description: 3-storey building. It is equipped with all kind of services. It includes approximately 60 workplaces, a lecture room and 2 meeting rooms.

THE ISLE



THE BUILDING



4. Case Study - Status Quo

the building

COMFORT

Thermal Comfort

Thermal comfort (PPD<10%) observed only in 1st and 2nd floor:

Season	Temperature (°C)	Relative Humidity (%)	Air velocity (m/s)
Winter	21.6	42	0.05
Summer	26.3	53	0.06

Air quality

Reported poor ventilation, in the ground floor and mezzanine.

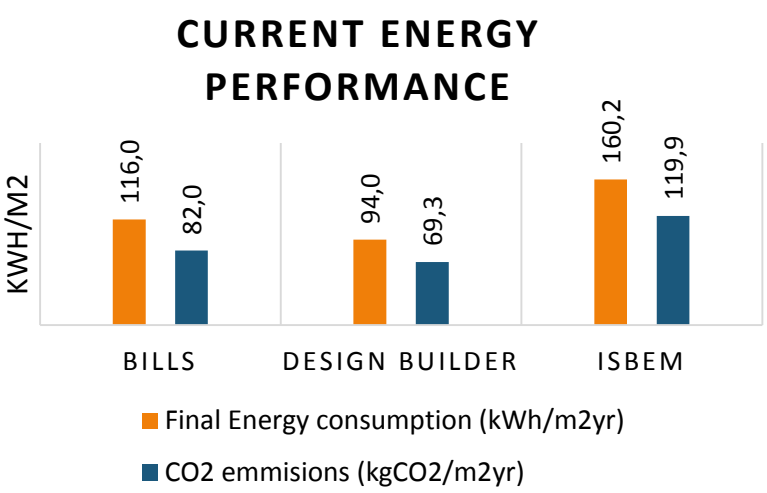
Acoustic Comfort ✓

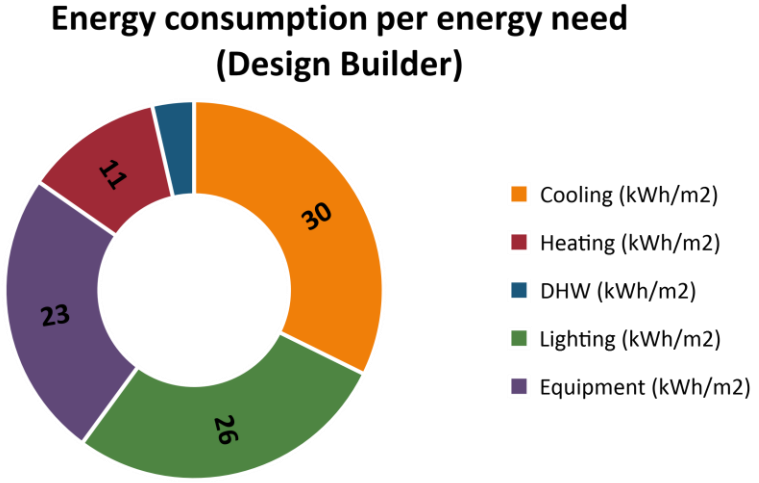
Sound intensity level 45dB - 60dB

Visual Comfort ✓

The average lighting in summer 731lux and in winter 534lux

ENERGY CONSUMPTION

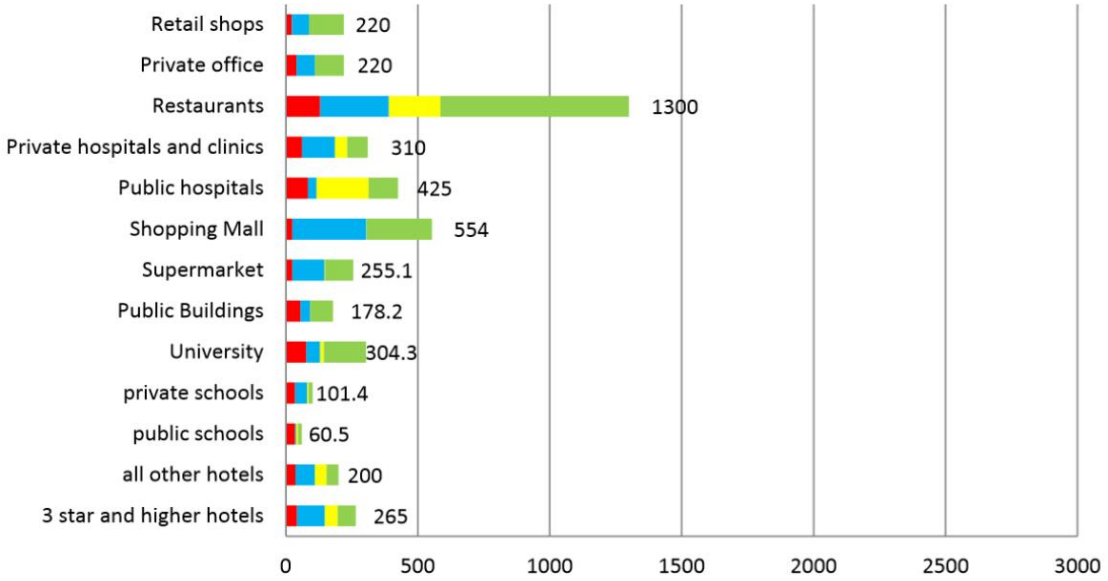




4. Case Study - Status Quo

the area

Annual final energy consumption (kWh/m2yr) per building use in Cyprus



ENERGY CONSUMPTION

Basic function	Nr. Of UNITS
Office (university admin)	1
Educational (labs)	1
Small supermarket	1
Café/Bar	5
Services (locksmith, printing centre)	2
Retail (clothing,jewllery, electronics)	7
Empty	4

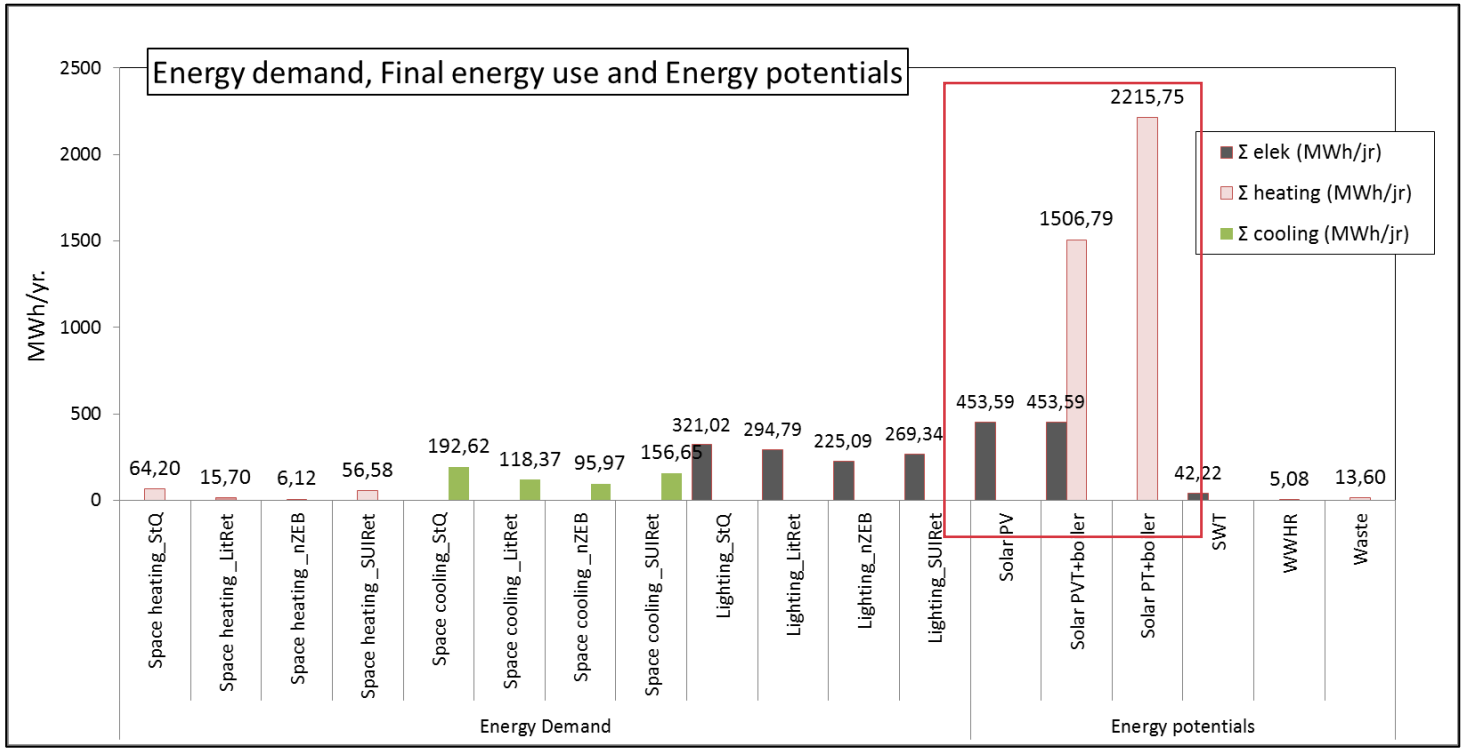
577 (MWh/yr)

Area Total 980 (MWh/yr)

4. Case Study - Status Quo

renewable energy potential

Overview of total potentials per source		
Sources	Electricity potentials [MWh/yr.]	Heating potentials [MWh/yr.]
PV panels	454	
PVT	454	1507
ST		2216
SWT	42	
Waste		13.6
Sewage		5



4. Case Study - Status Quo

Energy profile & CO2 emissions

SUI Energy Profile_ Limassol CO2 emissions (kgCO2/m2)		SUI Energy Profile_ Limassol final energy (kWh/m2)
Building		Building
80		116
Area		Area
142		220

181.5 kWh/m2yr → Final energy consumption 980 MWh/yr

119kg CO2/m2yr → Final CO2 emissions 643 tons of CO2/yr

4. Case Study - Status Quo

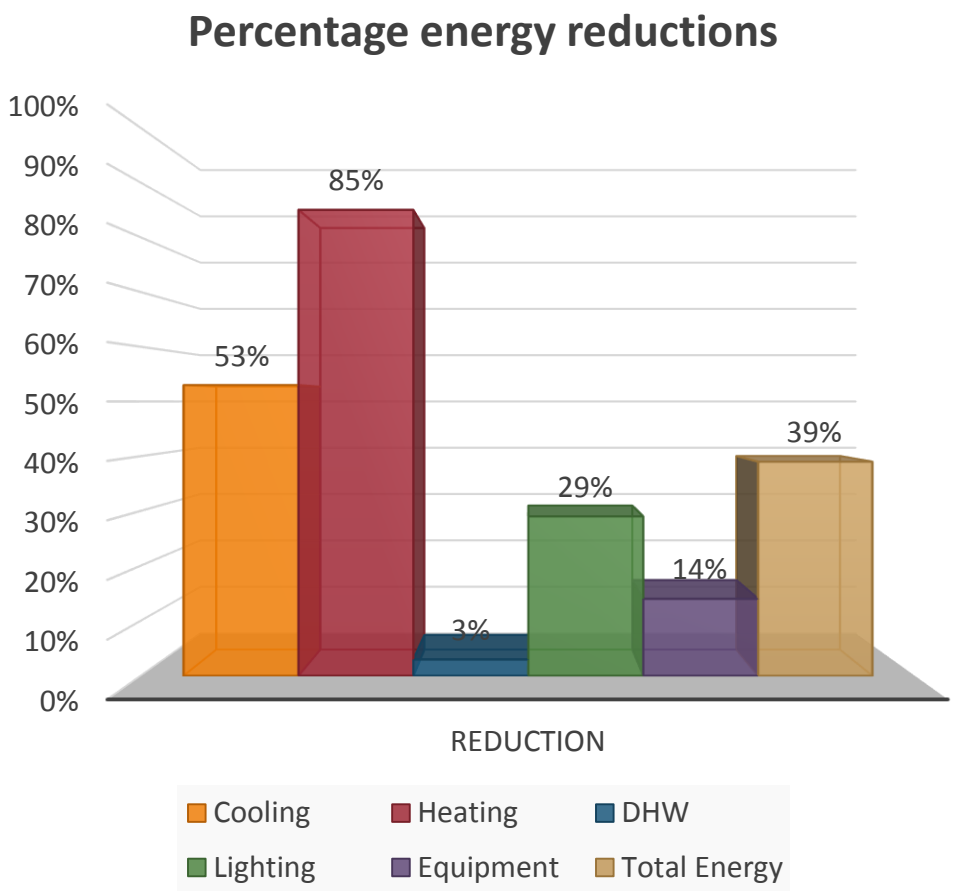
Shortcomings and potentials

- **Energy performance deficiencies**
- **High energy consumption** in buildings due to the poor energy performance of the building's envelope
- **Minimum onsite renewable energy** production.

- Up to **2216MWh/yr potential** in production from **RES**

5. Case Study - Scenarios

building



Smart ZEB Scenario

1. Replacement of the air-conditioning of the ground floor and mezzanine with ones of SCOP 5.5 and SEER 6.5
2. Replacement of existing light bulbs with LED throughout the building
3. Control the indoor temperature
4. Cool paint for the roof
5. Add window film shade in the single glazed windows
6. Add 120m2 PV panels on the roof and 24m2 on the south wall

Total Energy Reduction 40%

CO_2 emissions reduction: 57%.

5. Case Study - Scenarios

Building Renovation and Mini Network concept

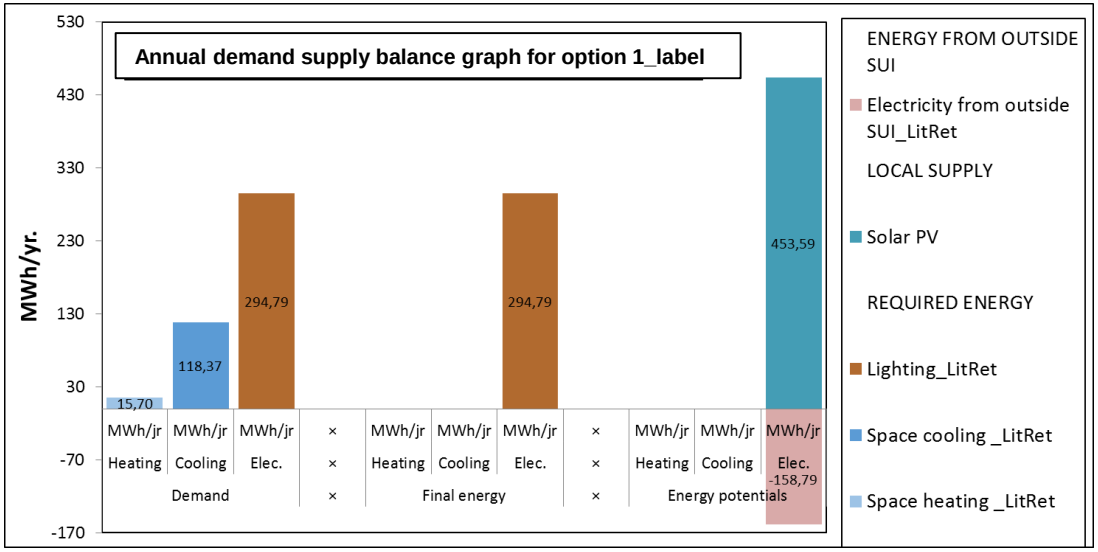
MINI-NETWORK ENERGY CONCEPTS \ RENOVATION SCENARIOS		a	b	c	d
		Status quo (StQ)	Light renovation (label)	Deep renovation (nZEB)	SUI renovation (SUIRet)
1	PV system covering only electricity	1_StQ	**1_label**	1_nZEB	
2	Off-grid PV system covering only electricity	2_StQ		2_nZEB	
3	PV/PVT+HP+Electrically driven vapor compression cooling system			3_nZEB	3_SUIRet
4	PV/PVT+HP+Solar absorption air conditioning system		4_label	4_nZEB	4_SUIRet

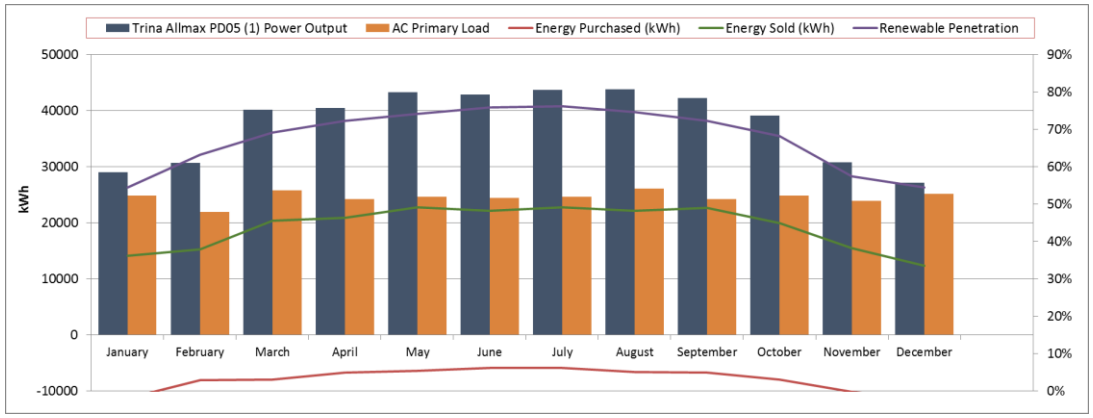
Light renovation applied to all the buildings in the SUI + RES (PV)
Average reduction in energy consumption : 25%

Light renovation: Roof and wall insulation (6-8cm), replace single with double glazing, upgrade air-conditioning systems

5. Case Study - Scenarios

Mini network concepts





On a yearly and a monthly basis the system is 100% self-sufficient (excl. cooling and heating)

On an hourly base it is around 68% self-sufficient

6. Results

Energy profile and CO2 emissions

Scenarios applied:

- **Smart ZEB scenario for the public building (40% Reduction)**
- **Light renovation for the remaining buildings (25%)**

SUI Energy Profile_ Limassol final energy (kWh/m2)
Building
70
Area
165

Total energy consumption 701,0 MWh/yr

+

The mini network production of 453,6 MWh/yr

Final CO2 emissions 195 tons of CO2/yr

Energy Efficiency Refurbishments + RES (mini network)

=Almost 65% reduction in energy consumption

= Almost 70% reduction in emissions

7. Conclusions

1. High energy savings in heating and especially in cooling in buildings can be achieved and hence considerable CO2 emissions reduction with energy efficient Refurbishment (Cool paint, shading film etc., without the addition of insulation).

2. The national legislation should take into consideration and incorporate measures alternative to insulation for enhancing the energy performance of buildings.

3. A mini network, PV system covering electricity in the Urban isle is 100% self-sufficient

4. It is possible to create a positive energy Urban Isle through a combination of deep and light energy refurbishments and with the utilisation of solar energy, thus contributing to the development of Sustainable cities

Thank you!

http://smarturbanisle.eu/
http://www.cyi.ac.cy/index.php/sui-overview.html

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