Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology

Study of a Zero Energy Settlement in Cyprus Original and Contingency plans

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Original Plans for a Cyprus Case Study Settlement

- LOCATION

Located in the western part of Cyprus, near the town of Peyia (Paphos). (34°89'N and 32°38'E).

- CLIMATE description

Intense mediterranean climate, mild winter and hot summers.

Tmax 36°C., Tmin10°C.,

246 HDD, 1038 CDD

Country map indicating location

Original Settlement Description

- TOPOGRAPHY

It is a rural area on a hillside location.

- SETTLEMENT SIZE

The settlement size would be 255,000 sqm. It would be divided in 3 areas: a rehabilitation center, a research center and a residential area.

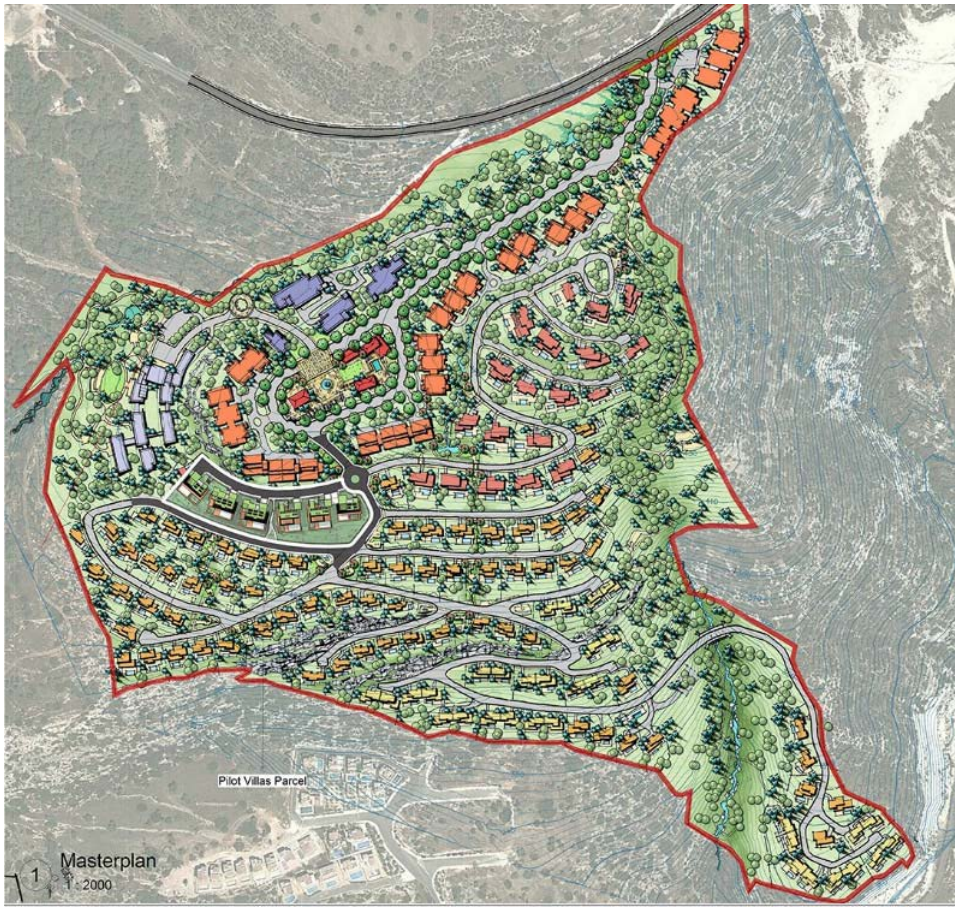
- TYPE & NUMBER OF HOUSES

Total n° of buildings: 1 rehabilitation center, 1 research center, 123 individual houses, and 9-apartment buildings. 2 Zero-Plus houses which would be individual residential luxury villas, Type 1b (building surface about 270 m²) and Type IIa (building surface about 160 m²).

- CONCEPT/OBJECTIVES

The 2 villas would be built within the above settlement with the scope to apply their design in the entire settlement, in order to improve the energy efficiency of the whole project.

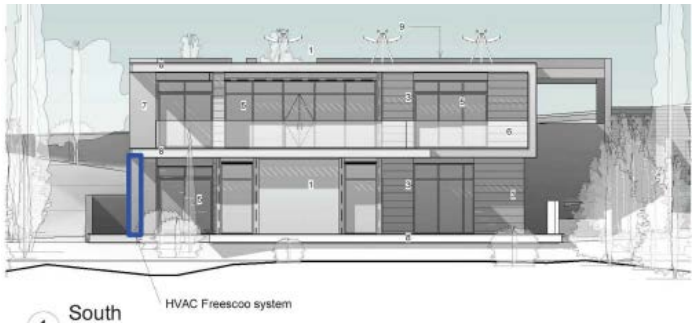
SETTLEMENT MASTERPLAN

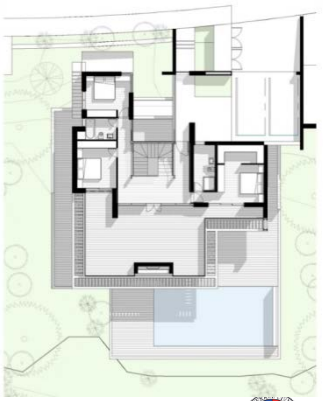


ARCHITECTURAL DESCRIPTION

Villa 1b

	Villa 1b
Total floor area (m2)	268.7
Conditioned net floor area (m2)	241.47
Orientation	North - South
n. of stories	2
no. of bedrooms	4
U value walls U value roof U value floor	0.386 0.352 0.644
Fenestration type U value of windows G-value	Common LowE double glazing 2.40 0.56
Shading	Overhanging slab extension / External shading in bedrooms

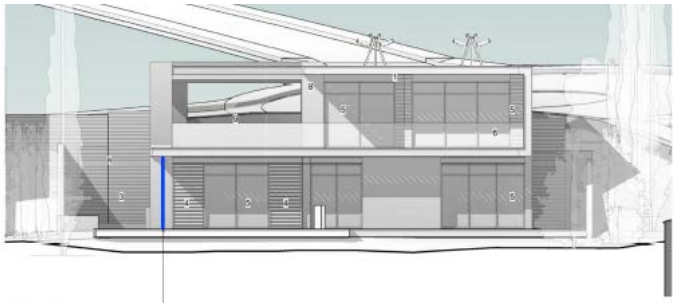


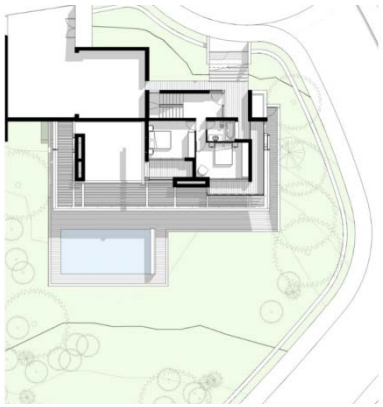


ARCHITECTURAL DESCRIPTION

Villa IIa

	Villa IIa
Total floor area (m2)	174.1
Conditioned net floor area (m2)	163.56
Orientation	North - South
n. of stories	2
no. of bedrooms	3
U value walls U value roof U value floor	0.386 0.352 0.644
Fenestration type U value of windows G-value	Common LowE double glazing 2.40 0.56
Shading	Overhanging slab extension / External shading in bedrooms





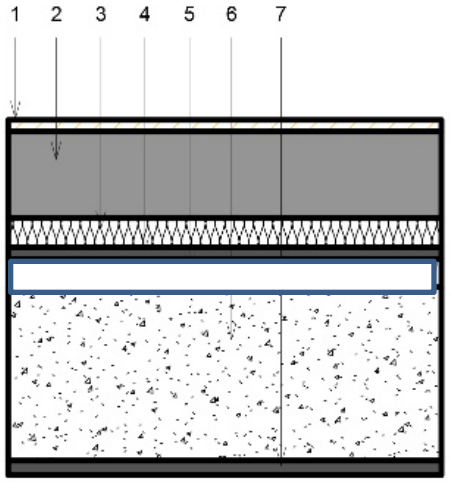
ENERGY CONSERVATION SYSTEMS – BUILDING SCALE

- System name

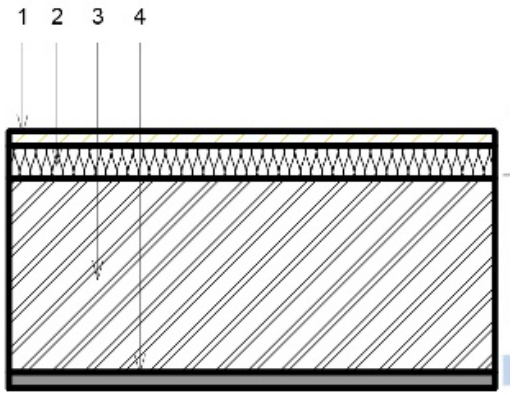
Fibran technology extruded polystyrene with designation code: XPS(Extruded Polystyrene) EN 13164 – CS(10\Y)300-DS(70,90)-TR400-WL(T)1,5.

- System integration details

40mm of Fibran Technology were used on the external walls and 80mm on the roofs (427m2 on walls and 527.5m2 on roofs)



Flat Roofs

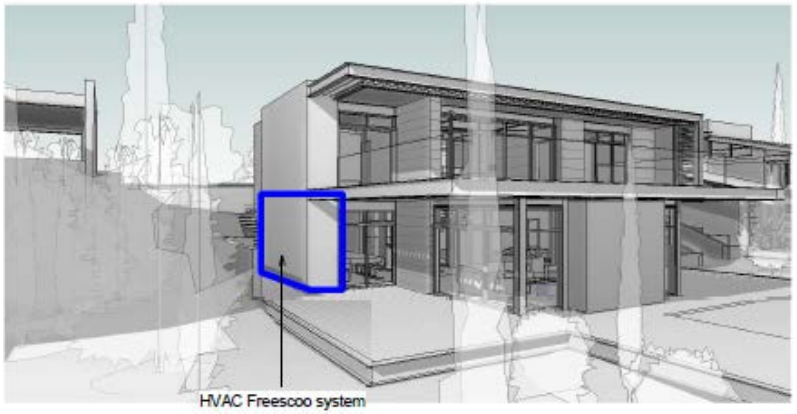


Walls Brick

ENERGY CONSERVATION SYSTEMS – BUILDING SCALE

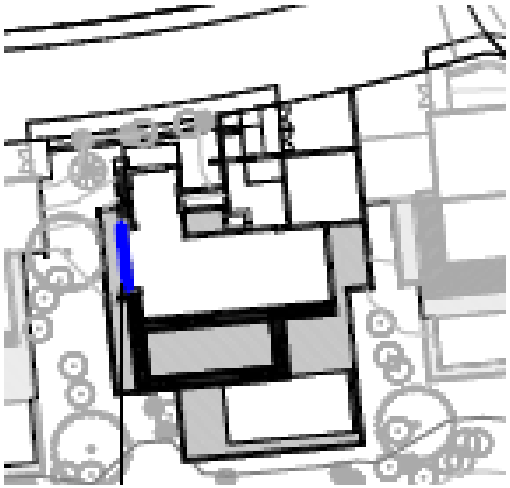
- System name

HVAC Freescoo: this is a technology for a) Ventilation, b) Humidification and c) Cooling. It also affects the heating in combination with the FAE system, and the use of the hot water.


HVAC Freescoo system

- System integration details

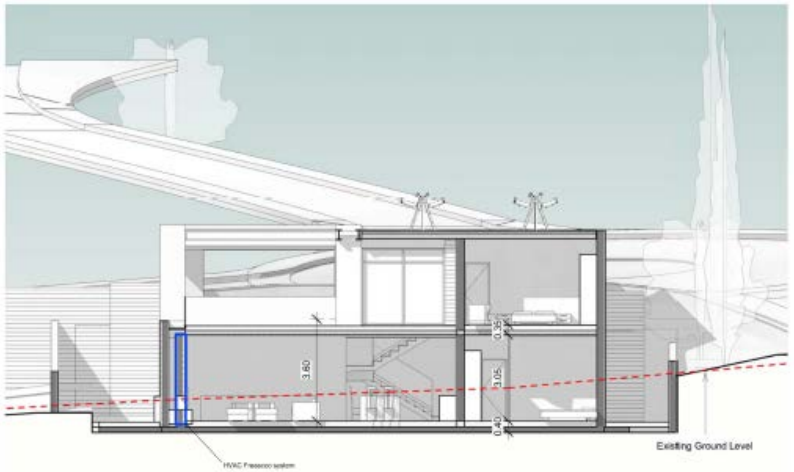
1 Freescoo unit woud be included on the ground floor of each villa. The spaces chosen were the largest and the ones used more frequently.



ENERGY PRODUCTION SYSTEMS – SETTLEMENT SCALE

Module Type	**FAE HCPV**
Number of mirrors x mudule	20
Net Mirror Area [mq]	0.2025
Total Mirror Area [mq]	4.05
Optical Efficiency	0.9
Width X length of Module	1.35 X 6.40
Thermal Efficiency	39%
Electrical Efficiency	28%

System Integration details	
Number of modules	5 (3+2)
Total collector area [m2]	20.25
Electrical Power at peak [kW]	5
Thermal Power at peak [kW]	10
Energy production [kW/m2/year]	52.8 / 51.96



PERFORMANCE AGAINST ZERO PLUS TARGETS

- Table showing performance of case study against the three project targets (regulated energy ≤ 20kWh/m2 , energy production ≥50kWh/m2, cost reduction ≥ 16%)

Target	Performance Villa 1b	Performance Villa IIa	
16% initial cost reduction compared with the reference case	24.39%	24.39%	**> 16%**
Net regulated energy consumption of less than 20 kWh/m2 per year	13.02	11.12	**< 20kWh/m2/year**
Energy production by RES of at least 50 kWh/m2 per year	52.8	51.96	**> 50kWh/m2/year**

3 TARGETS OF ZERO PLUS PROJECT

HOWEVER …..

Due to significant overdue during the planning permission process.

The Cyprus case study has a risk of exceeding the project schedule, which will have a negative implication on the overall performance of the monitoring tasks.

SETTLEMENT MASTERPLAN

Contingency Plans for a Cyprus Case Study Settlement

- LOCATION

Located in the Cyprus Institute (CyI) campus in Aglantzia, Nicosia

(35.14 N and 33.38 E)

It is situated in a low-density area and borders with the Athalassa National Forest Park.

- CLIMATE description

Intense mediterranean climate, mild winter and hot summers.

Tmax up to 46.7°C., Tmin.average10°C.

Country map indicating location

Figure 21. Location of the Cyprus case study

Cyl Case Study Description

Theoretical prefabricated container system structure for residential use.

Multiple “copies” of this demohouse may be installed in the future.

Figure 2: Proposed ZERO-PLUS demohouse

CyI Case Study Description

Creation of this settlement.

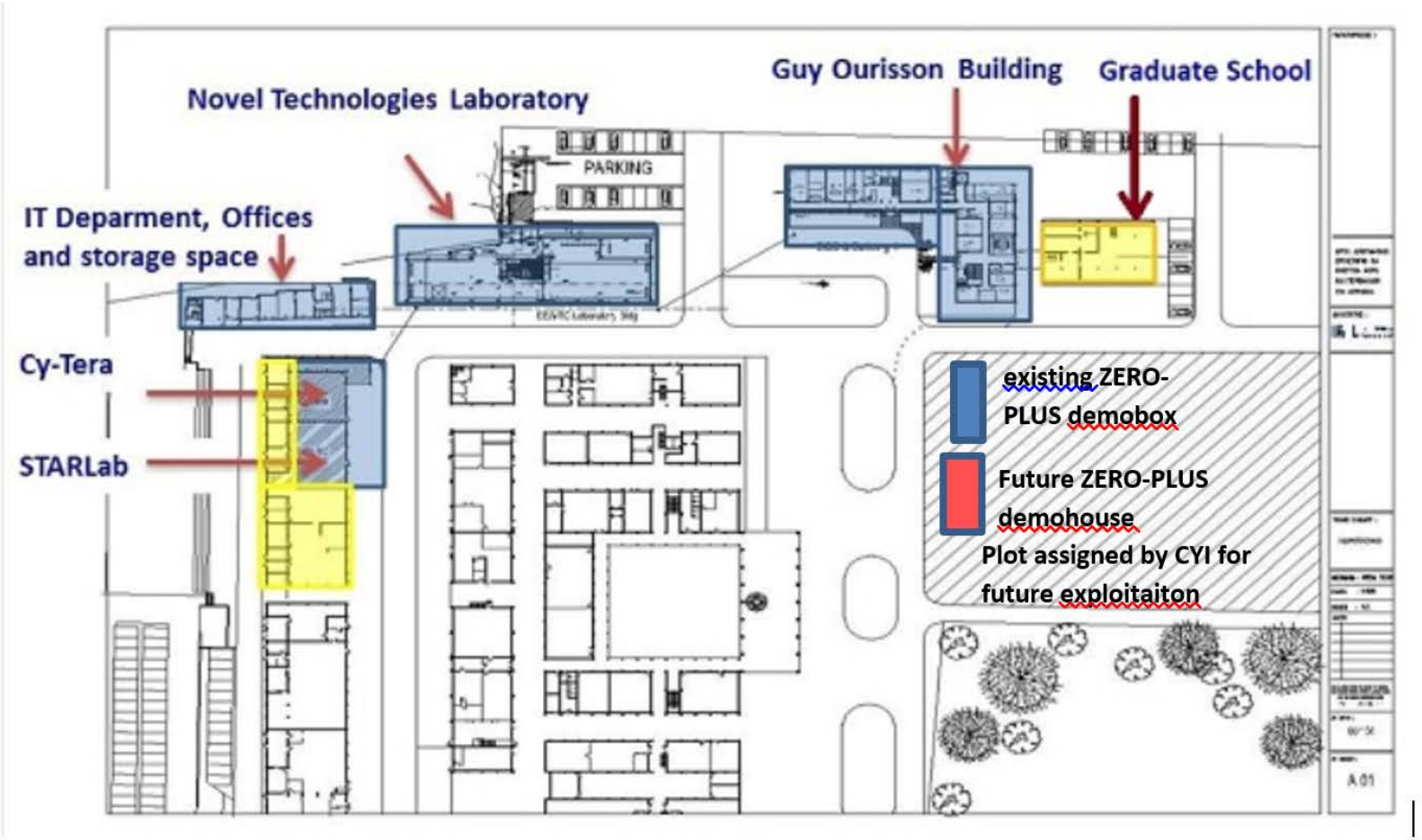
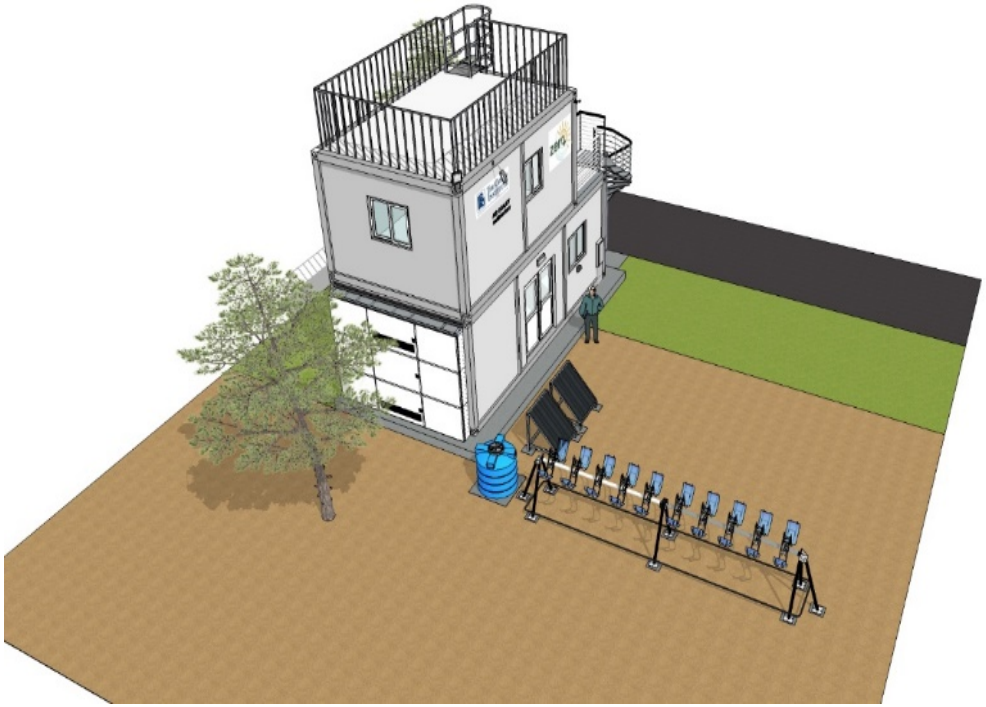


Figure 1: CyI premises

Cyl Case Study Description

Some of the technologies will be installed and monitored on another preexisting prefabricated container system structure.

The approach will be based on a modular system.



Construction Site

Selected ZERO-PLUS technologies

Technology	Energy production	Energy management	Energy conservation per year
FAE HCPV (by ARCA) Setlement level	1 unit		
Freescoo HVAC (by SolarInvent - ARCA) Building level			1 unit
FIBRAN ETICS XPS / walls (by FIBRAN) Building level			40mm

Performance KPI's

ZERO-PLUS objectives	Achieved Performance	
	As-designed[1]	As-built[2]
16% cost reduction compared with the reference case	*17%*	17%
Net regulated energy consumption of **≤ 20 kWh/m2/y**	14.8	TBC
Energy production by RES of **≥ 50 kWh/m2/y**	55.4	TBC

Methodology for verification of the performance and optimization of the design

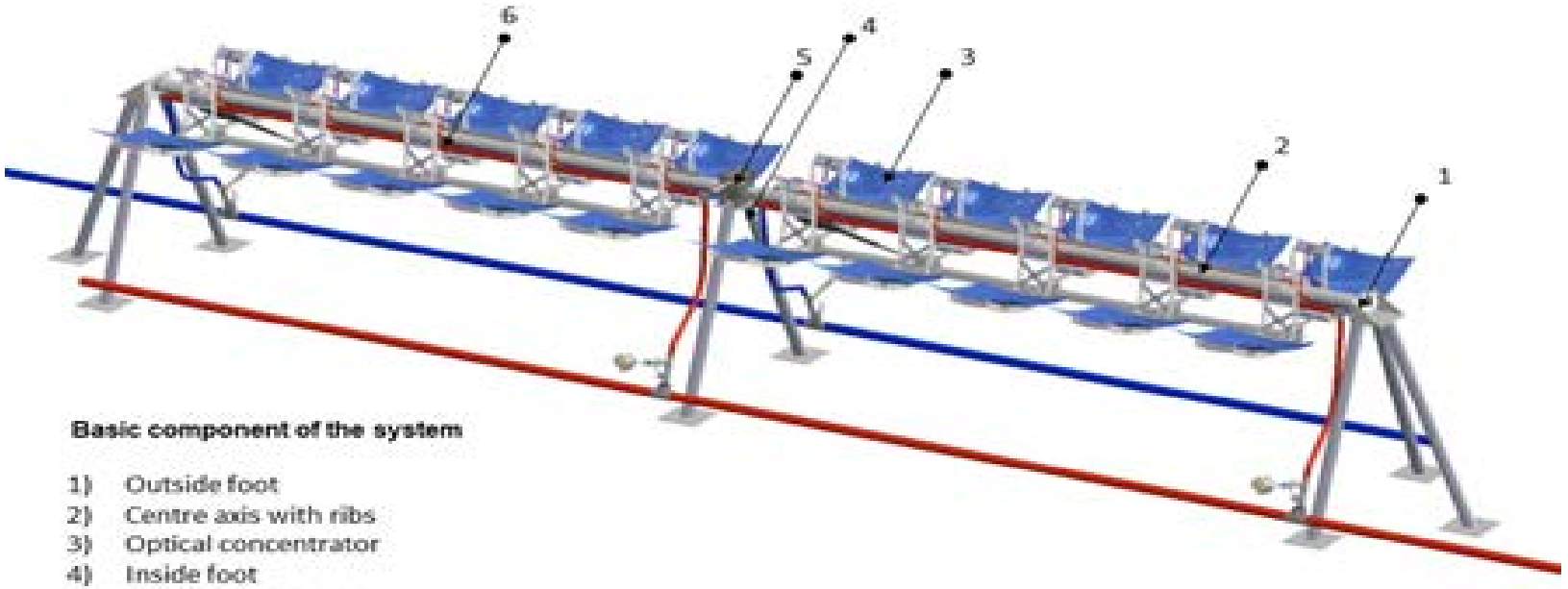
The existing demobox (air quality station) with the technologies mentioned above will be **monitored** on site in order to examine the energy production and consumption both of the Zero Plus technologies, as well as of the demobox itself.

Dual purpose:

- CyI will collect and examine the actual data from the monitoring of the existing demobox (air quality station).
- Having the actual data, CyI will calibrate and fine tune the proposed simulated energy demohouse, in order to have its final performance based on the monitored data in respects to its energy consumption and energy production.

ON SITE INSTALLATION - FAE UNITS

There was a delay in the delivery of FAE HCPV due to a mistake during the transportation to the site of final assembling and testing.
However, everyhing is now fixed and the installation is expected to happen within the next few weeks.



Basic component of the system

1) Outside foot
2) Centre axis with ribs
3) Optical concentrator
4) Inside foot
5) The worm reduction gears (Tramec XC 63 complete with double extension tabs)
6) Optical port

ON SITE INSTALLATION OF FREESCOO AND FIBRAN

THANK YOU!