Interreg Mediterranean

EUROPEAN UNION

MED Greenhouses

Project co-financed by the European Regional Development Fund

2nd International Conference
ADAPTtoCLIMATE

Sustainable agricultural production with the exploitation of innovative geothermal hydroponic Greenhouses

(MED Greenhouses)

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Project Coordinator

UNIVERSITY OF THESSALY

MED Greenhouses

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Objectives 1/2

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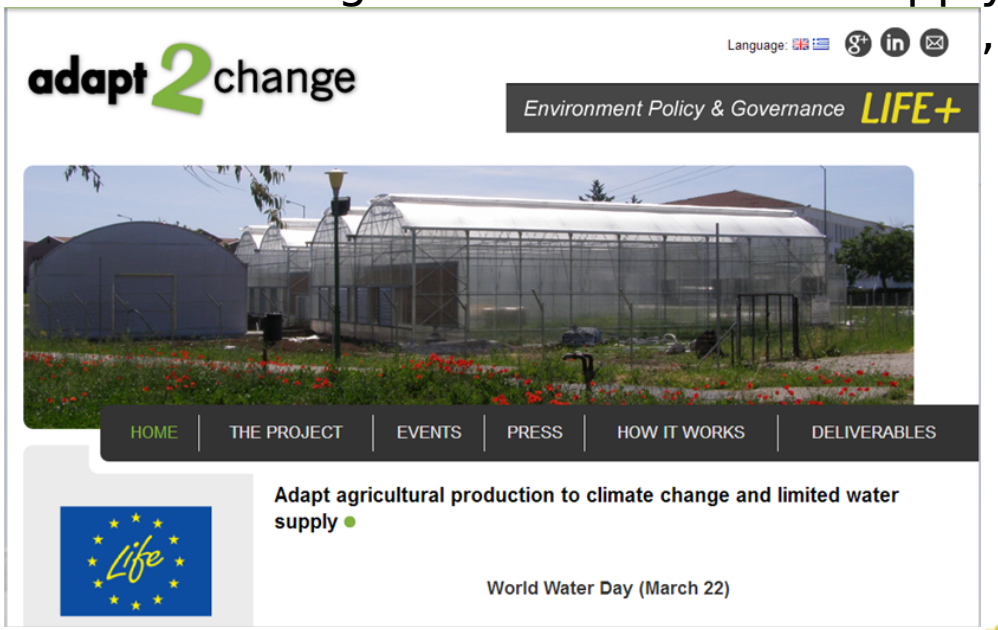
The project will mainly capitalize results of LIFE+ "Adapt2change" project by promoting, disseminating & transferring innovative Greenhouses in the MED area, minimizing water & energy demand.

Project full title: ”Adapt agricultural production to climate change and limited water supply”

Grant 

, Finance (50%):

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Objectives 2/2

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The Innovative Technology of MED Greenhouses aims to address issues related to energy & water efficiency & sustainable agricultural production, contributing to Green Growth & Circular Economy.

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Incentives 1/2

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- *Contribute to Climate Change Adaptation, coping with:*
  - ***Water scarcity***
  - ***Water pollution***



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Incentives 2/2

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- *Addressing issues of agricultural production:*
  - ***Water availability***
  - ***Increased cost for energy***
  - ***Increased cost of raw materials***
  - ***Increased market competition***
  - ***Increased demand for product quality***
  - ***Loss of agricultural land for other activities***

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Introduction of MED Greenhouses

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Production: **600** tn of tomato/ha/year

Conventional Production: 150-250 tn/ha/year

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Introduction of MED Greenhouses

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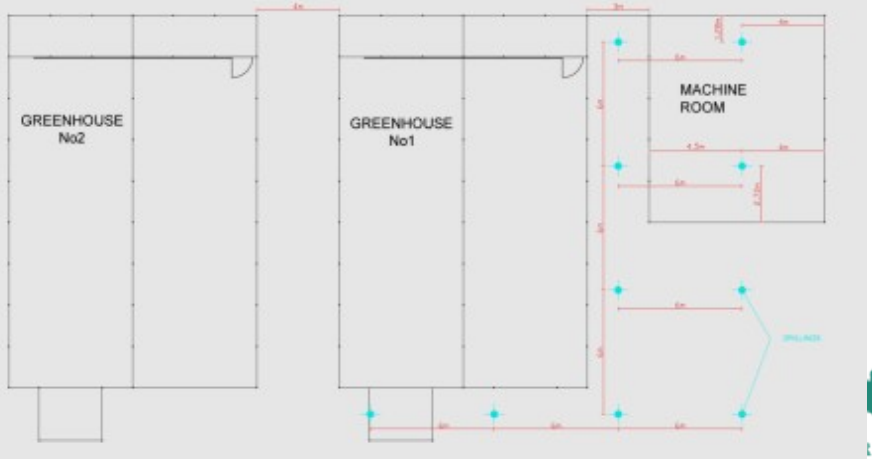

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Introduction of MED Greenhouses

Subsystems:

- Natural cooling & ventilation system
- Dynamic cooling & ventilation system
- Heating system
  - Geothermal heat pumps
  - Oil boiler
- Curtain / thermal insulation curtain system
- CO_2 Enrichment System
- Air Drying System
- Hydroponics system
  - Closed System
  - Open system
- Central System Control System

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Natural cooling & ventilation system (Top wi

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Dynamic cooling & ventilation system (Blinds, Fans, Sides)

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Geothermal Energy Subsystem

- The greenhouses' energy needs for cooling, heating and conversion of water vapour are being covered by a vertical closed loop geothermal system which is built next to the greenhouses, exploiting the available shallow geothermal energy field.
- This system offers significant advantages over other forms of energy as it is a renewable energy source which does not burden the environment with additional pollutants, reducing carbon emissions footprint.
- MED Greenhouses are based on Geothermal Heat Pumps Systems that exploit shallow geothermal energy (exploitation of stored energy of low depth rock and surface / ground water with temperatures <25^{o}C)

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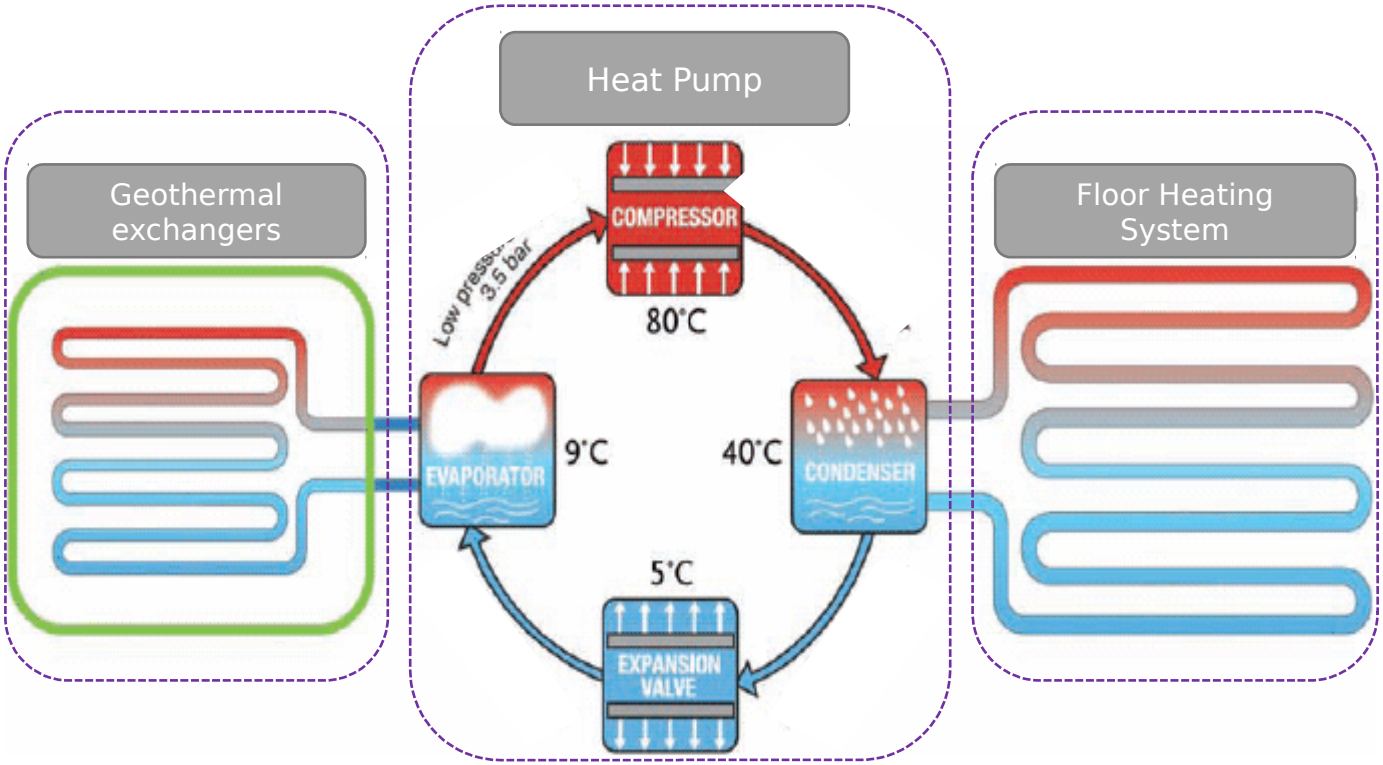
The system consists of the following 3 parts:



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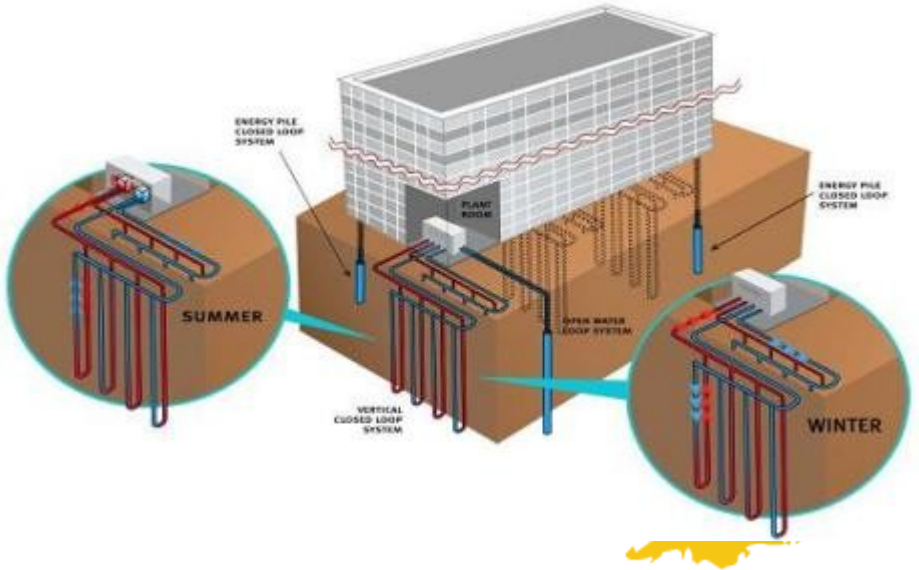

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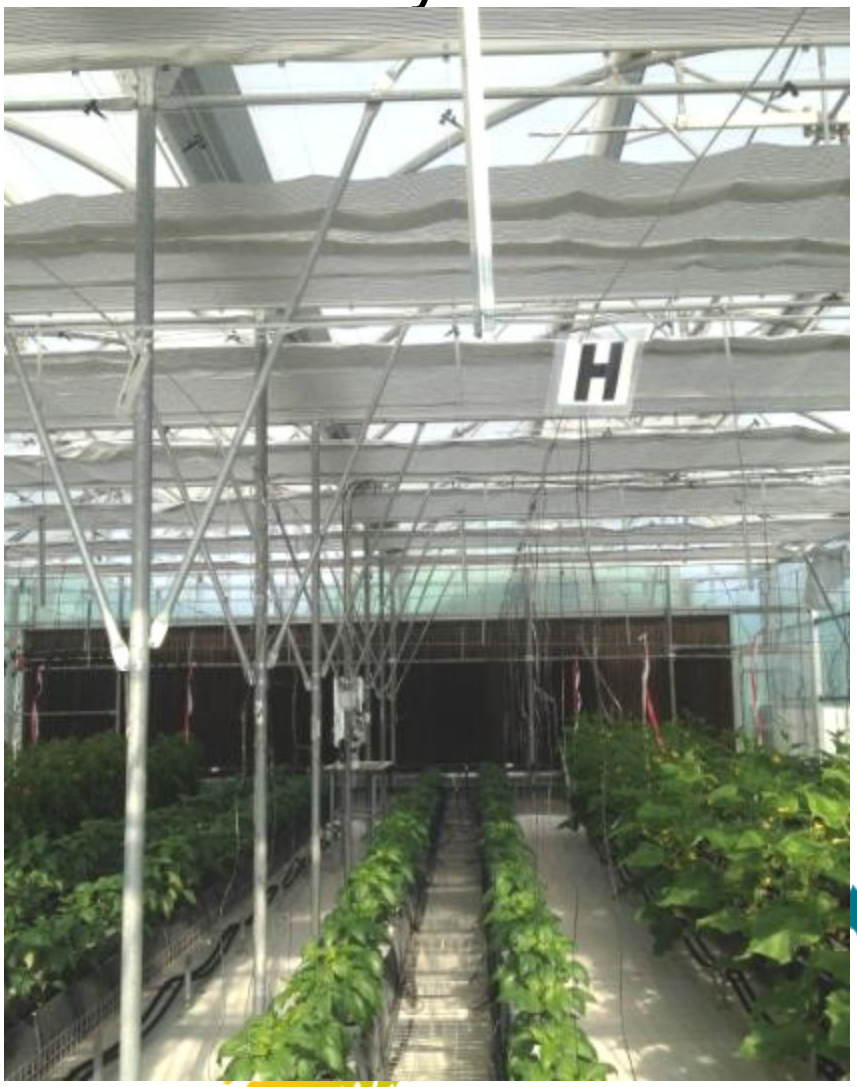
Curtain / thermal insulation curtain system



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CO_2 Enrichment System

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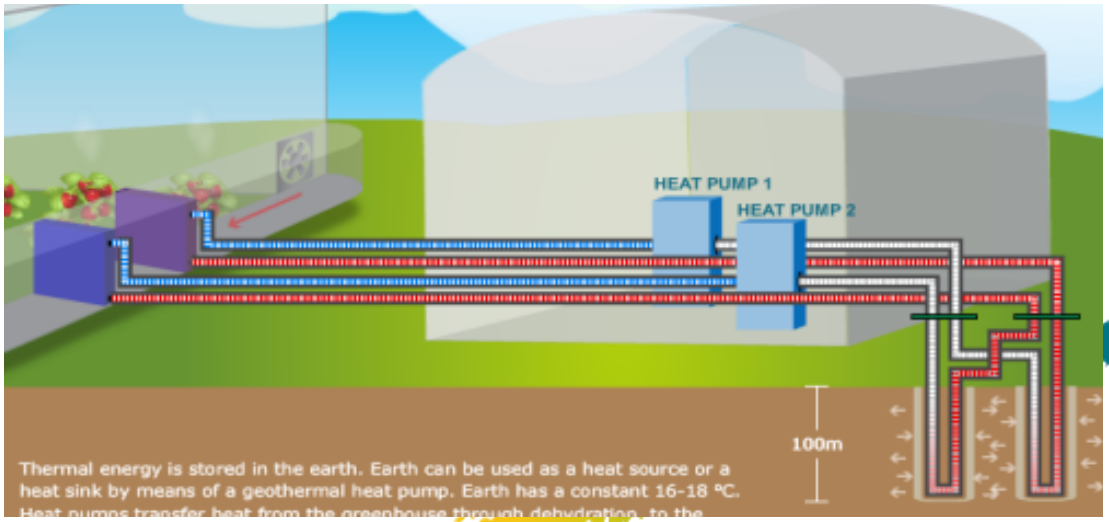
- Air Drying

- Concentration of water in the greenhouse by means of a cold heat exchanger
- Air with high relative humidity passes through a cold heat exchanger
- Coolant heat exchanger temperature lower than dew point
- The humidity of the air is converted into water



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- Hydroponics system
  - Closed System
  - Open system

- Head of hydroponic system with containers of thick nutrient solutions & clean / drainage water
- Preparation of nutrient solution with EC and PH control
- Circular watering
- Growing on rockwool substrate

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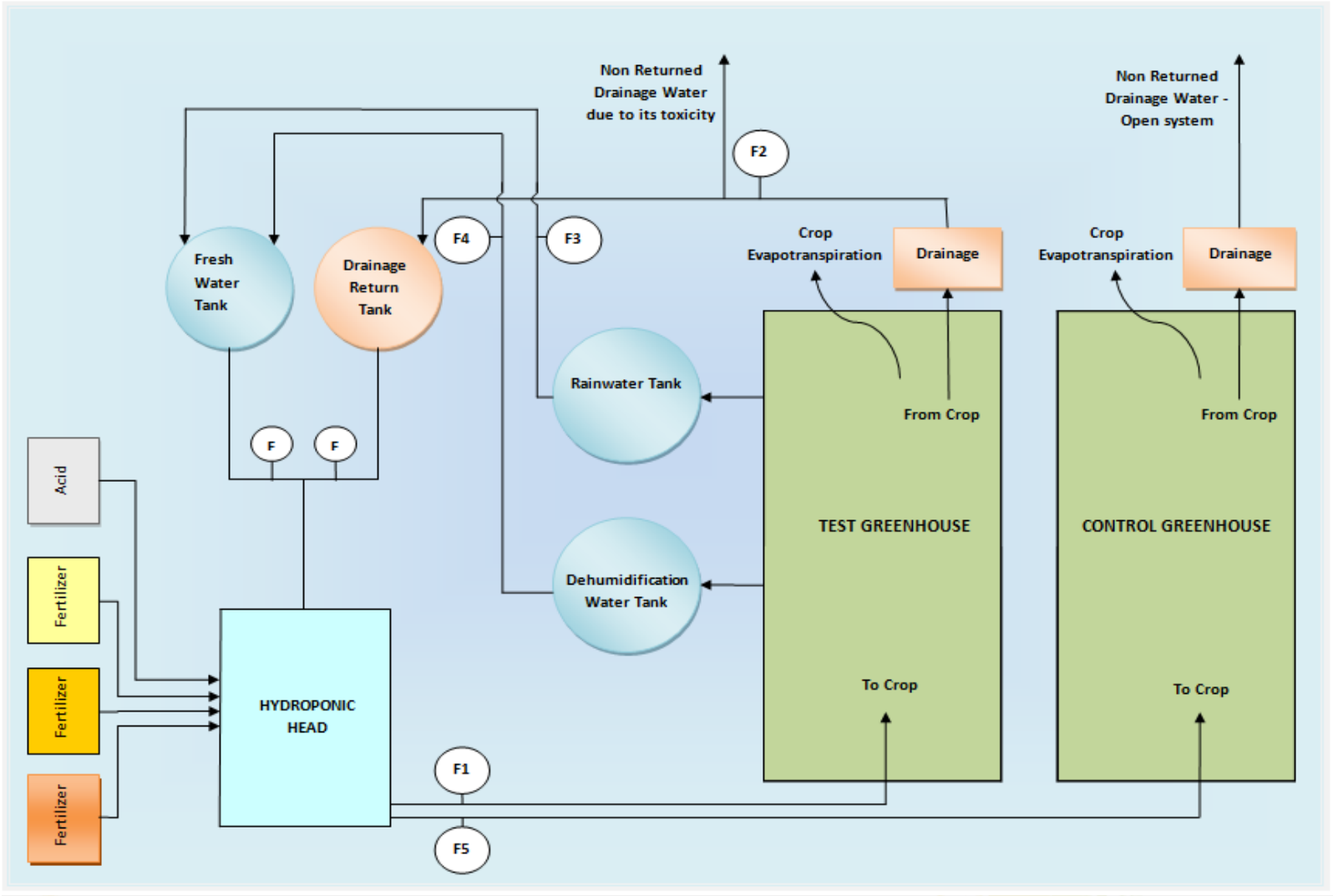
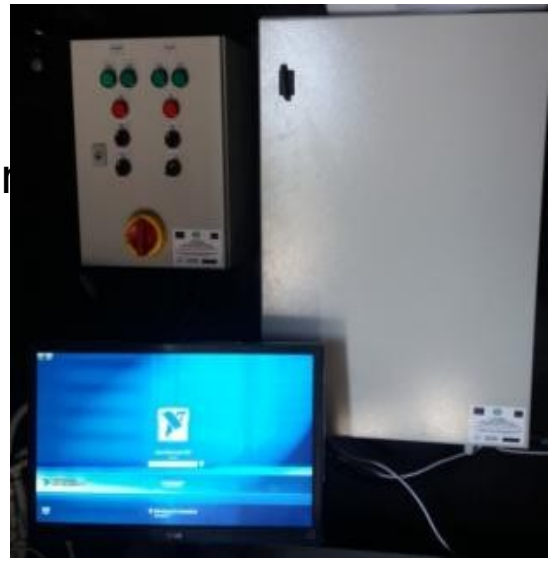
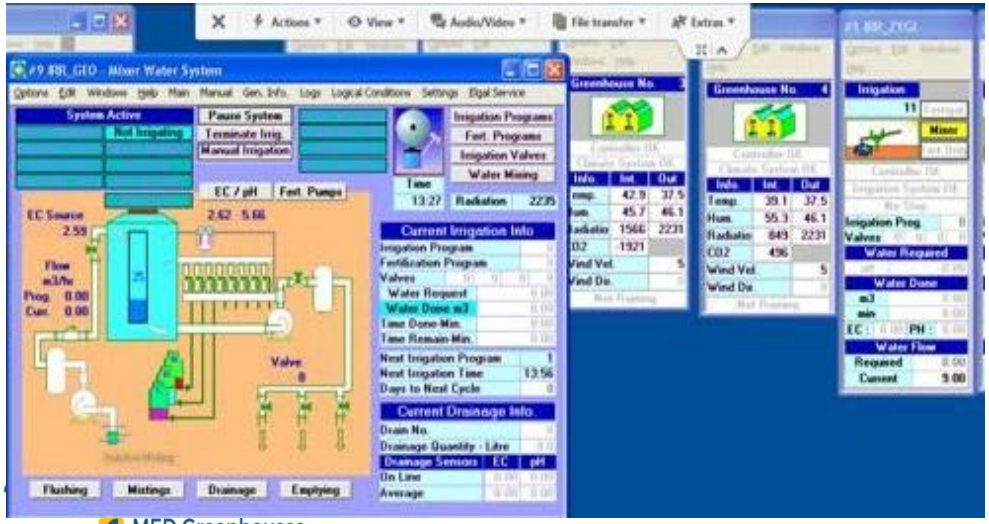


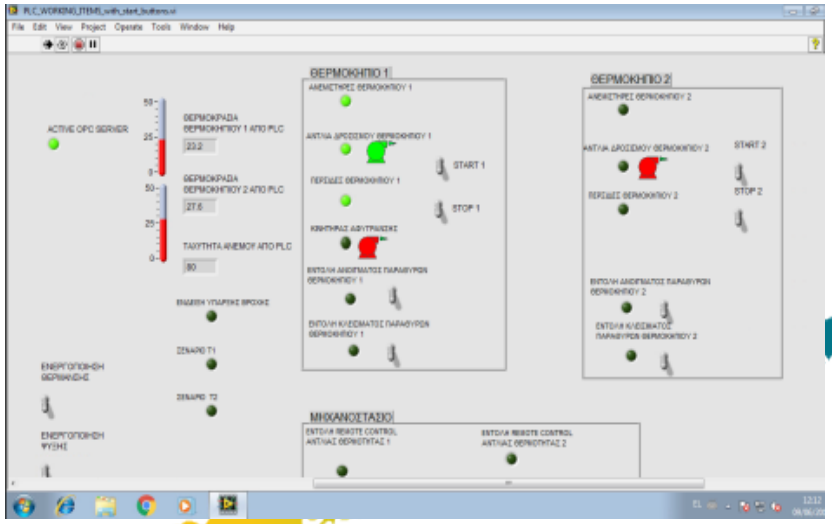
Introduction of MED Greenhouses

Central System Control System

- Easy Greenhouse managemer
- Remote control / setup







Advantages compared to Conventional GH

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Energy Performance

✓ The mean Energy reduction (Kwhe) can by up to **67%**.

Water Efficiency

✓Working as a closed hydroponic system the MED Greenhouses can reduce water consumption by up to **45%**

✓This reduction can reach **70%**, compared to open filed cultivation practices.

✓Considering the additional water retention systems installed inside the MED Greenhouses (i.e. rain-water re-circulation systems), the water re-use can reach, in some cases, **100%**

✓The cooling system of the MED Greenhouses (capacity of 150 W m-2) has the potential to increase the water use efficiency by up to **75%**.

Environmental Benefits

✓The mean CO_2 emissions reduction can be ranged between **46-52%**.

✓The use of fertilizers can be reduced by approximately **30%** compared to an open hydroponic system; this reduction can reach and surpass **60%** compared to open cultivation practices.

Indicative Construction Cost

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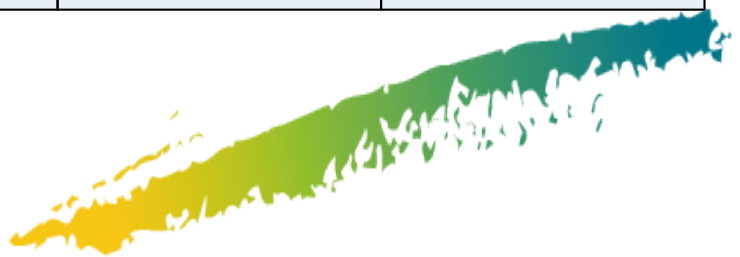
Item	Price per m2 (€/m2)	Cost (€)
Structure	16,30	16.300
Reinforcements Tomato crop	0,50	500
Top Plastic Cover	1,18	1.180
Sides Polycarbonate	2,33	2.330
Insect Proof Net	0,19	190
Inside Thermal screen	2,5	2.500
Outside Thermal screen	6	6.000
Irrigations System	1,88	1.880
Drainage Collection	0,43	430
Climate Control	0.49	490
Cooling System	5	5.000
Assimilation Lights	12,42	12.420
Air Circulation Fans	0.4	400
Electrical Installation	1,42	1.420
Gas Condenser	1,8	1.800
Boilers & Burners	25	25.000
Expansion Installation		
Central Dosing CO2		
Heat Storage tank		
Central Dosing CO2		
Transport Lines, Pipe Rail and accessories		
Part Flow Filter		
Fan Coil	1,72	1.720
CO2 Dosing System	0.4	400
Electricity Generators	1,32	1.320
Clean Water Tank	0,09	90
Ground Cover	0,97	970
Rockwool Substrate	2,03	2.030
Ground Gutters	1,34	1.340
Total price	**85.71**	**85.710**

Item	Price per m² (€/m²)	Cost (€)
Greenhouse unit, Control system, heating, ventilation and cooling systems, Supporting-Auxiliary building	207.17	89.500
Hydroponic system	108.8	47.000
Thermal screen andCO2 dosing system	53.24	23.000
Geothermal drillings and heat pumps	186.8	80.700
Total cost	**556**	**240.200**



Disadvantages of MED Greenhouses

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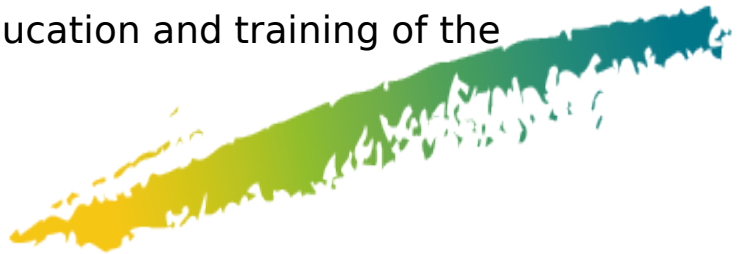
- The up-front **high capital cost** in order to establish the MED Greenhouse. Although such investment seems profitable, the need for drilling and installing this innovative technology increase the cost of the construction/investment. **Overall, it is worth-wile to invest in large scale geothermal greenhouses, payback.**
- A drawback of applying geothermal energy in greenhouse operation is, additionally, the **extended land required for drilling and exploitation**. Generally, the geothermal unit delivers the maximum capacity, as less is the distance between the greenhouse and installed point of the drilling wells. That makes geothermal systems hard to be applied in already established greenhouses, unless a vertical ground source heat pump is used.
- **MED Greenhouses require experts and well trained operators to establish and monitor the whole system**, while proper education and training of the users is also required for its operation.



Transferability factors

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- There is no significant geographical limit
- In vertical loops, ground is not the limit but the investment and functional cost demanded to drill to this depth and the accessibility in innovative technologies needed for producing geothermal heat
- Drilling aspects:
  - Geology
  - Hydrology
  - Land availability
- Access by the responsible ministry authority of the area
- An access to the spatial distribution data, therefore, of the area in which geothermal technology intended to be transferred will aid the experts to clarify the feasibility of the system in the specific area

MED Greenhouses – Photo Gallery

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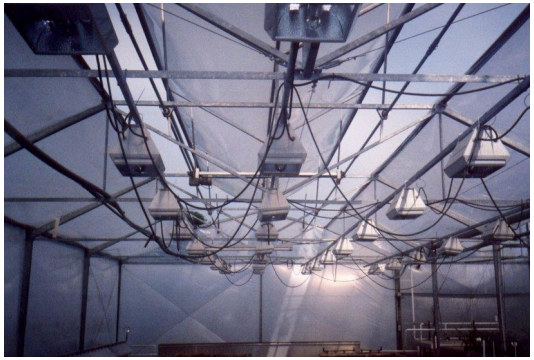


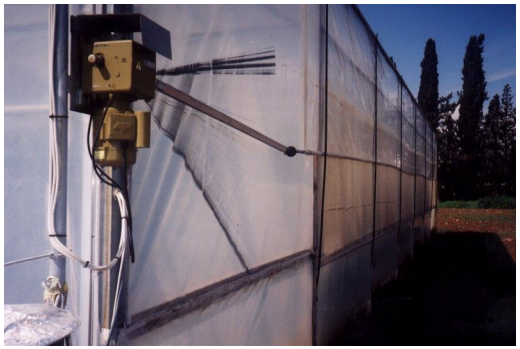






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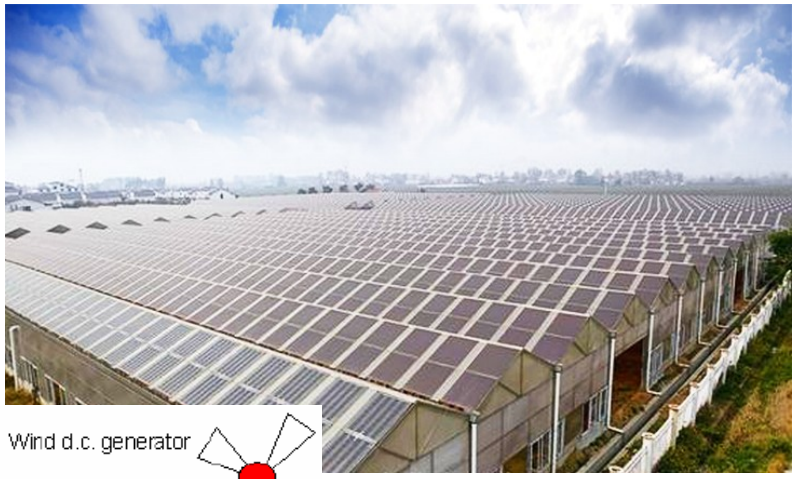
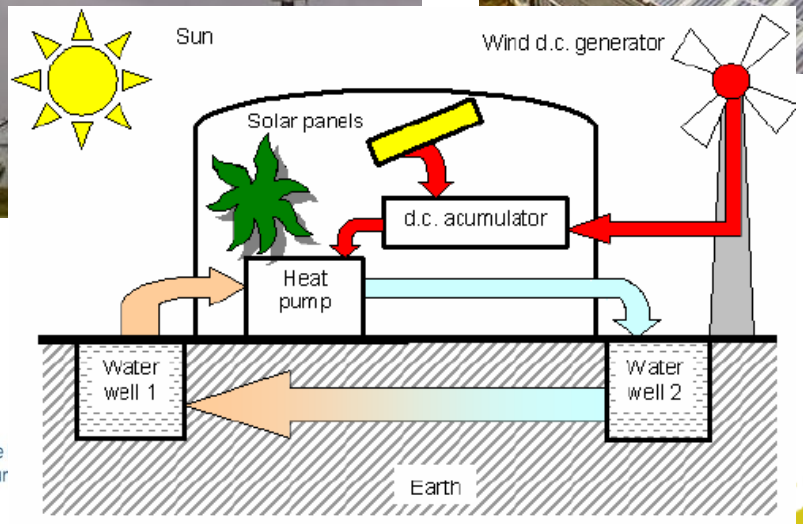
Our future planning for “Energy Autonomous Greenhouses”





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Thank you for your attention!

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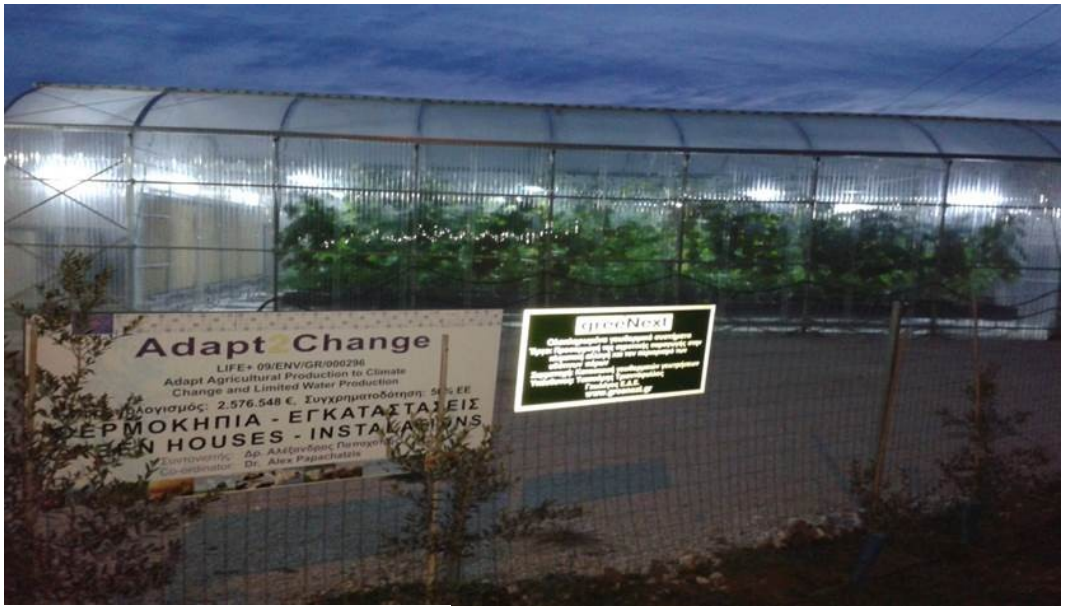

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