



Fostering the use of low temperature geothermal sources through the development of operational exploitation guidelines and green energy solutions of enterprising

energeiaproject.eu

Agro-industrial residuals for enhanced food production in geothermal greenhouses

V. Diamantis, A. Aivasidis, A. Eftaxias, C. Achillas, K. Mimides, F. Pliakas



Fostering the use of low temperature geothermal sources through the development of operational exploitation guidelines and green energy solutions of enterprising

Project overall objectives

- ✓ Promotion of technological exploitability of geothermal fields and the comparative economic advantages of the use of geothermal energy.
- ✓ Contribution to establishing Strategic Planning for the Region to implement programs for sustainable energy use for various applications

energeiaproject.eu

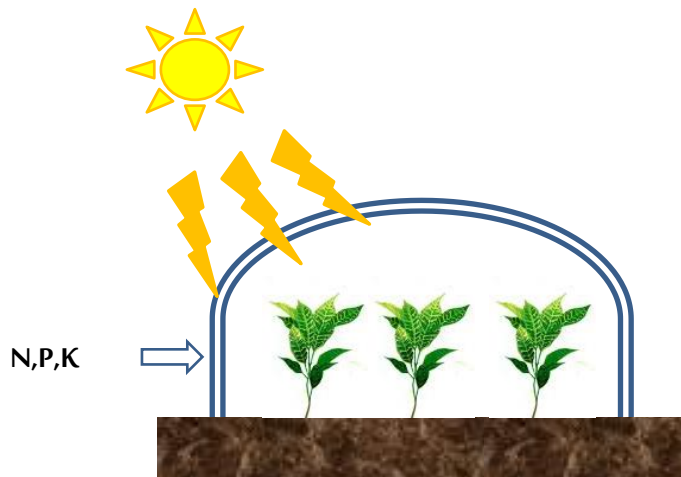
Summary

- Introduction
 - Geothermal greenhouse technology
 - CO₂ enrichment in greenhouses
- Proposed technology
 - How and why using biogas from biomass digestion
- Prototype design and construction

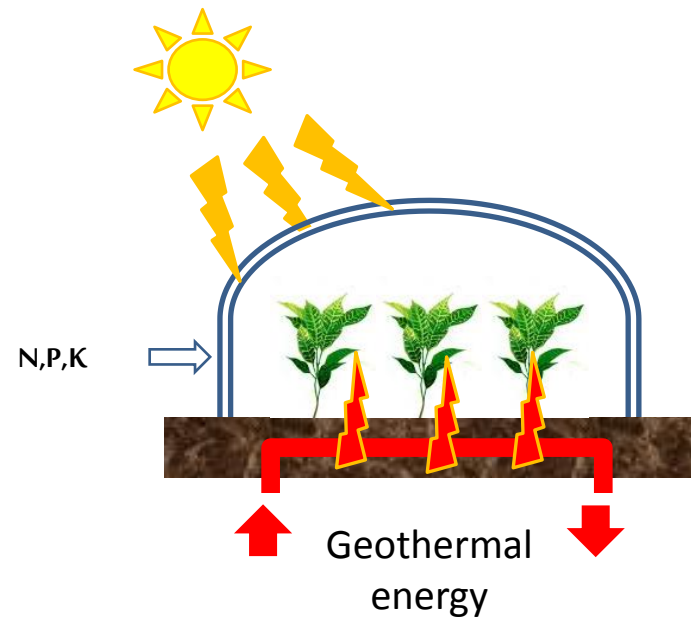


Greenhouse technology

- Traditional and geothermal greenhouse



Greenhouse heating
by solar energy

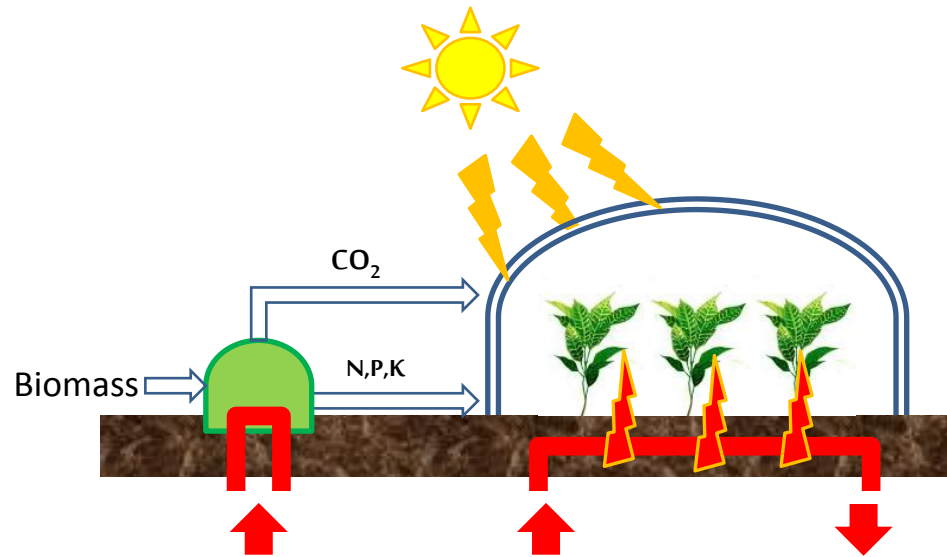


Greenhouse heating by solar
and geothermal energy



Greenhouse technology

- Advanced geothermal greenhouse (bio-greenhouse)

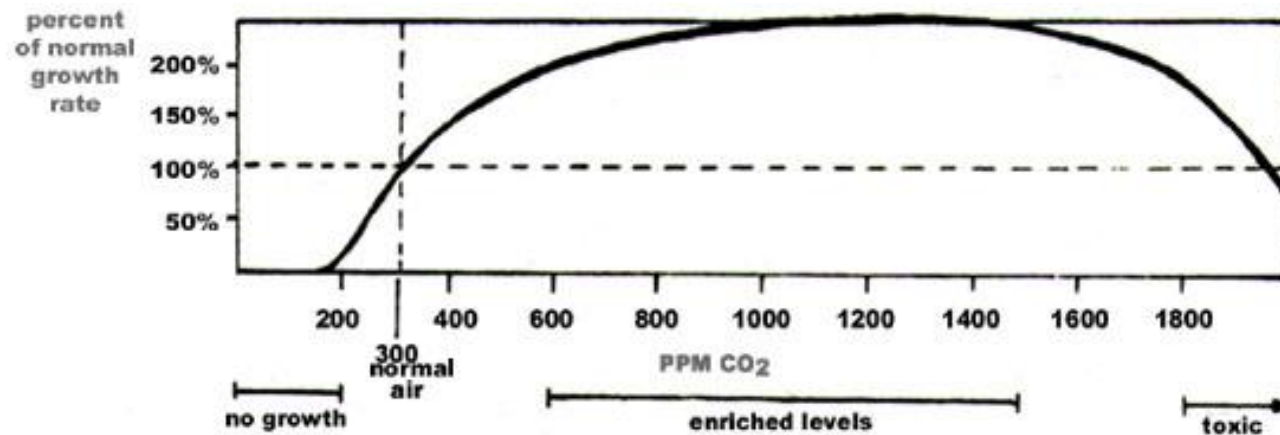


1. Greenhouse heating by solar and geothermal energy
2. CO₂ enrichment from biomass digestion gases
3. Fertilizer supplementation from biomass mineralization



CO₂ enrichment in greenhouses

- Positive CO₂ response in vegetation growth
 - N.T. de Saussure (1804) *Recherchez chimique sur la vegetation*
- Optimum CO₂ level: 700-1000 ppm
- CO₂ enrichment is required during the day time
- CO₂ enrichment compensates production losses from limited sunlight (winter period)



Programme co-funded by the
EUROPEAN UNION



European Territorial Cooperation Programme
Greece-Bulgaria 2007-2013
INVESTING IN OUR FUTURE
Co-funded by the European Union (ERDF)
and National Funds of Greece and Bulgaria

How CO₂ enrichment in greenhouses?

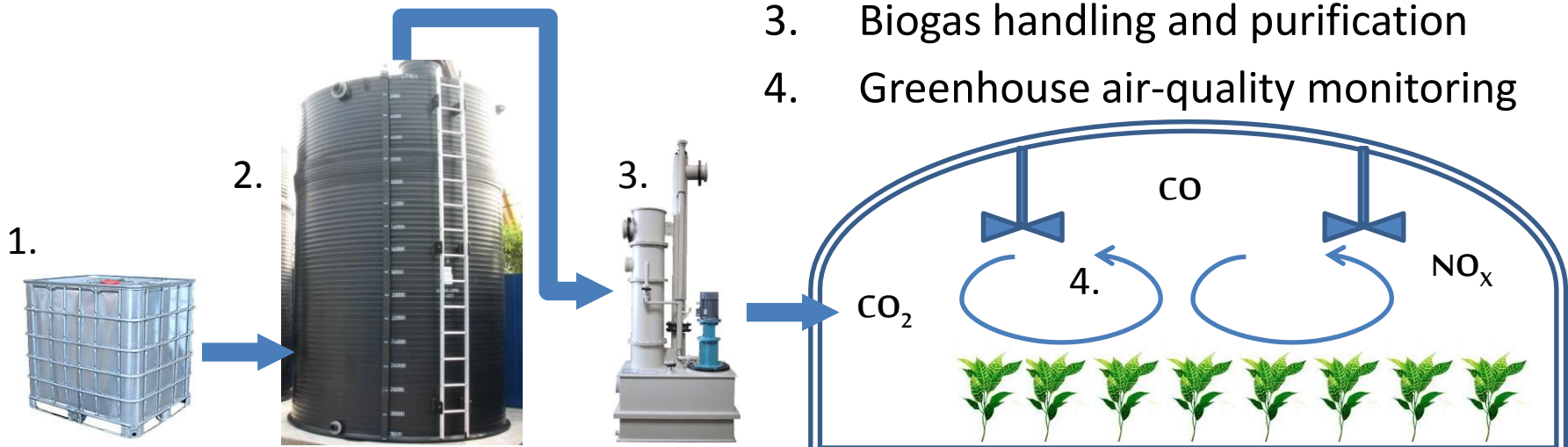
- Burning kerozine and/or propane since 50's
- More than 85% of greenhouses in Scandinavian and North European countries since 70's
- Nowadays burning natural gas or using bottled CO₂



Proposed technology

- CO₂ production from renewable biomass sources

1. Biomass storage tanks
2. Biogas reactor
3. Biogas handling and purification
4. Greenhouse air-quality monitoring



Progress of the prototype

- **Waste water storage tanks**

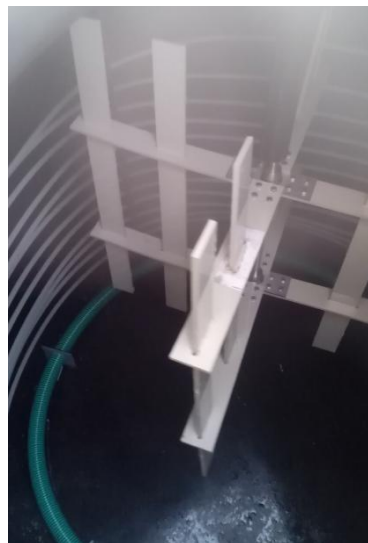
- Plastic containers
- Portable mixer
- Feeding pump
- Tubings, vanes, etc



Progress of the prototype

- **Biogas reactor**

- 8 m³ PE
- Heat exchanger
- Paddle mixer
- Biogas production 5-20 m³/d



Progress of the prototype

- **Biogas handling and purification**
- Wet scrubber AISI304
- Gas engine 5 kW
- Gas meter



Progress of the prototype

- **Greenhouse air-quality monitoring**

- Compact-portable station
- Electrochemical sensors
- CO₂
- CO
- SO_x
- NO_x



<http://mecoeng.gr>

The following steps

- Digester heating using geothermal energy sources
- Continuous operation using agro-industrial residues
 - Olive mill wastewater
 - Wine lees
 - Cheese whey
 - Livestock wastes

