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## Thermochemical Fluids in Greenhouse Farming



**TheGreeFa** aims to **reduce the overall energy consumption in the greenhouses** and **maximise** at the same time **the quote of renewable energy** used for **cooling, heating and humidity control** and to **water recovery** in hot and dry climate zones.

**Two different concepts for greenhouse systems** will be developed and demonstrated in Continental and Mediterranean climate.



The EU Framework Programme for Research and Innovation

# Why TheGreeFa

Today, greenhouse horticulture is related to the **highest productivity of all common methods in agriculture**. The **energy consumption**, especially for heating purposes in Central Europe **are still high**, while in Southern Europe, **growing water shortages** will force to **use seawater desalination**, which may also cause a **quantum leap in energy demand**.



**Increase of  
energy efficiency**



**Large use of  
renewable  
energy**



**Cost savings**

TheGreeFa proposes for greenhouse farming three **innovative solutions** driven by renewable energies, that **recover the latent heat** and **water from air humidity**.

- Solution 1: Humidity control, heating and cooling in one system through a single process.
- Solution 2: Drying processes for herbs and foods at low temperature to preserve their quality and aroma.
- Solution 3: Water recovery by evapo-condensation strategies, including sorptive drying and evaporative cooling with saline water.

# Ways to achieve TheGreeFa's goals

## Reduction of energy consumption

- ❖ **Reduction** of the amount of the **energy** required for the temperature control through the **recovery of the latent heat** of the humid air.
- ❖ **Reduction of the heat losses by humidity control through absorption** instead by ventilation and air exchange with the outside.
- ❖ **Water recovery** from air humidity, **without water purification and pumping.**

## Large use of renewable energy

- ❖ **Low temperature heat is enough** as the driving energy, e.g. solar heat or residual heat.
- ❖ Integration of **free-loss thermal storages**, effective **usage of renewable energy** with seasonal shifting.

## Cost effectiveness


- ❖ Use of **mainly plastic component**, no thermal isolation is required.
- ❖ The only rotating machines are standard pumps and air fans **limiting required maintenance.**
- ❖ Thermochemical fluid (TCF) has an energy density up to 10 times higher than water, **reducing the volume required for storages.**

# Project's structure

The work in TheGreeFa has been broken down into **five work packages** to achieve the overall project goals within the foreseen time frame.


 WP1

In **WP1**, the **concept is before tested and optimised in prototype** before the installation in demonstrators will be explored.

In **WP2**, the **concept is modelled in a software environment** in order to  **WP2** analyse different operation and control modes as well as for the integration of different renewable energy sources.

 WP3

In **WP3**, **case studies are carried out**. They are **providing data for the modelling** of TheGreeFa concept as whole systems (WP2) as well as they **produce data for the potential assessment** (WP3) of TheGreeFa.

**WP4** disseminates the result of  **WP4** TheGreeFa, **gaining stakeholders** and **preparing the future exploitation** on the market.

 WP5

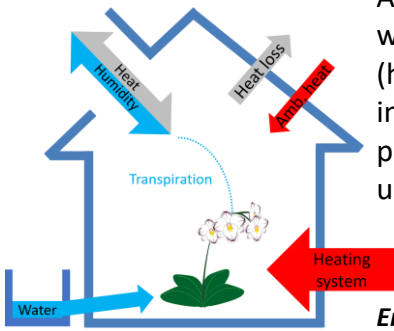
**WP5** builds the **framework and management** infrastructure to achieve goals in the envisage time frame. It monitors all activities, resources and risks to ensure smooth implementation.

# TheGreeFa principles

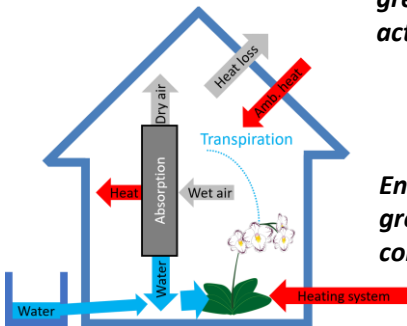
The **reduction of the energy** required for heating is reached in TheGreeFa **recirculating the air** inside the greenhouse **avoiding the exchange with the external air**. At the same time, the **latent heat** of the humid air is **reconverted in sensible heat** used for heating purpose.

In TheGreeFa greenhouse, it is **not necessary to regulate the humidity opening the windows**. The thermochemical fluid (TCF) removes the excess of humidity produced by the transpiration of the plants, so the **thermal energy losses can strongly be reduced**.

At the same time, the water vapour of the air (humidity) condenses in the absorption process releasing useful heat.



*Energy and mass flow in a greenhouse without an active humidity control*



*Energy and mass flow in a greenhouse with TCF air conditioning*



# Contact

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## PARTNERS

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