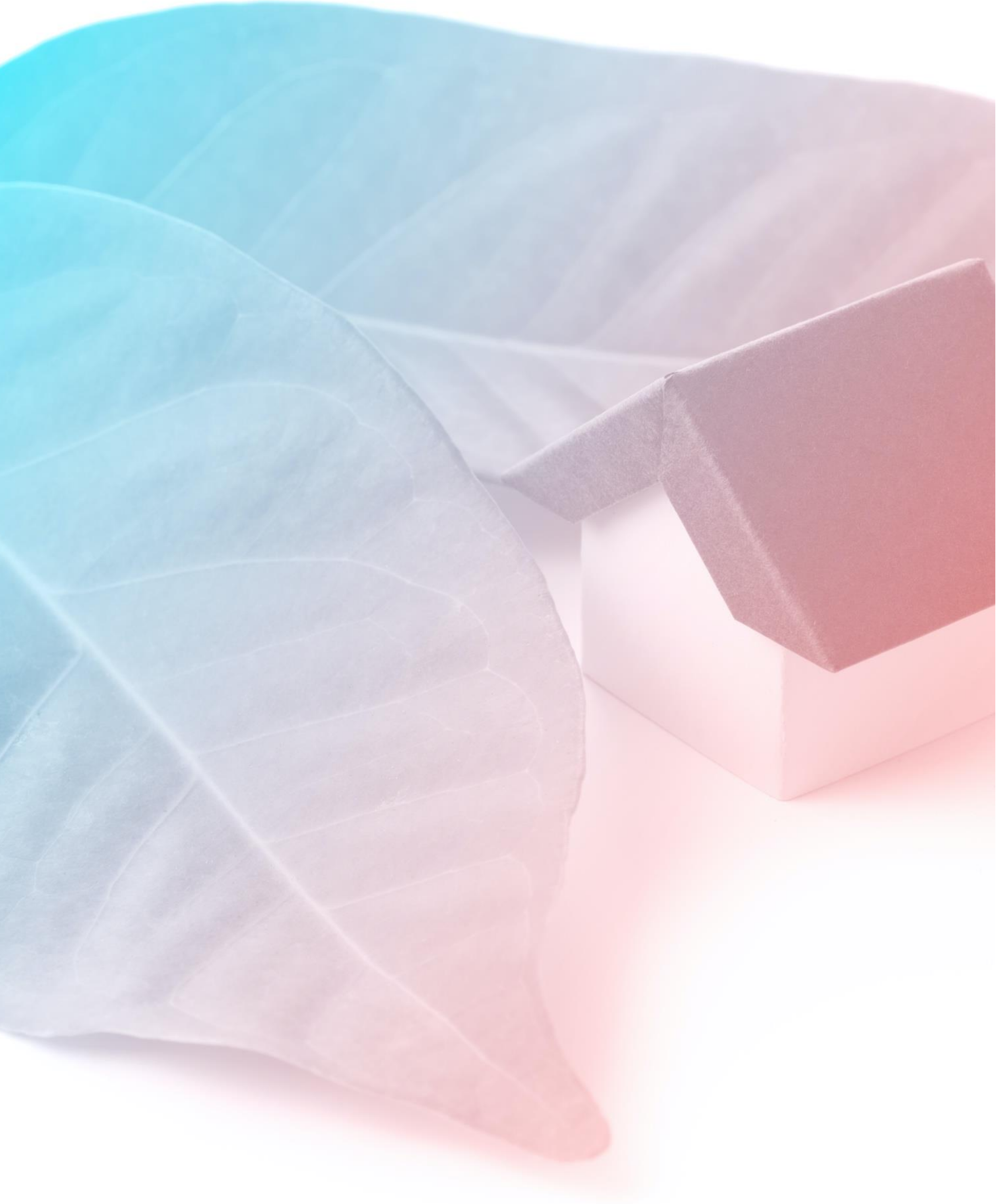
# MiniStor
# Project

A brief Introduction

Presented by: Carlos Ochoa (IERC)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869821



# The MiniStor Project

## Main points

- Awarded as part of Horizon 2020 call LC-EEB-05-2019-20
  Started November 2019
- Will develop a compact residential thermal storage system based on thermochemical materials (CaCl2/NH3)
- International consortium of partners from several EU countries, Switzerland and UK

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# MiniStor Partners

The consortium is led by the International Energy Research Centre - IERC (Cork, Ireland) and has the participation of industry, research institutes, academia, certification bodies, non-profit as well as local government

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# MiniStor Project Main Aims

What we are working to reach:

1. **10.6x storage capacity of water**
   Using PVT to power the process
2. **0.72m3 storage material**
   Flexibility with parallel use of TCM and PCM
3. **Payback period 6.7 years**
   Estimated net energy reduction of 44%
4. **Combine thermal & electric storage**
   Using a Home Energy Management System

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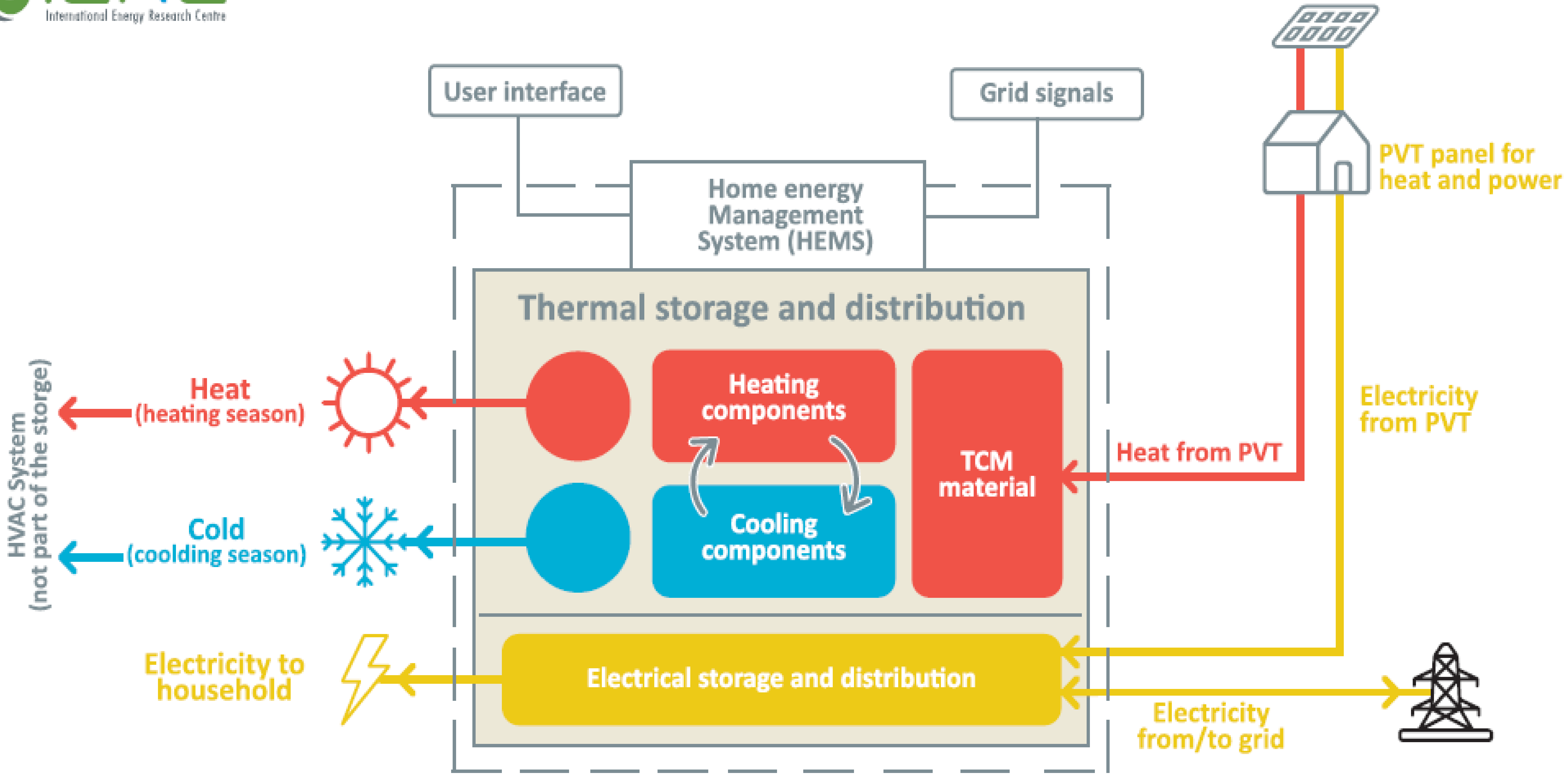
# MiniStor integrated storage system concept

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# System Overview

- ✓ **MiniStor** is a **compact, integrated system** capable of providing sustainable **heating, cooling and electricity storage**, while utilizing solar-based **renewable energy sources**.

- ✓ It combines two different storage technologies:
  - **Thermochemical materials (TCM),** storing heat in the form of chemical energy. They are contained in a sealed vessel (TCM reactor) and used for daily and multi-day energy storage.
  - **Phase Change Materials (PCM),** storing energy in the form of latent heat. They are used for supplementary heating and cooling storage.

- ✓ This configuration results in an overall system **energy storage density of over 180 kWh/m$^3$,** i.e. more than 10 times the energy storage density of water.

- ✓ The necessary **heat input** to the system is provided by a combination of **innovative PVTs** and solar thermal collectors.
- ✓ The PVTs produce also **electricity** that is stored in an electrical battery system (**BESS**)

Prepared by: Athanasios Nesiadis, Nikolaos Nikolopoulos

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# MiniStor Description

## Main components

### TCM reactor (typical capacity 30kWh)

- Ammoniated $CaCl_2$ salts are selected as the reactor sorbents. A two-step reversible reaction is utilized for thermochemical storage.

$$CaCl_2 \cdot 8NH_3 + Heat \leftrightarrow CaCl_2 \cdot 4NH_3 + 4NH_3$$

$$CaCl_2 \cdot 4NH_3 + Heat \leftrightarrow CaCl_2 \cdot 2NH_3 + 2NH_3$$

### Ammonia cycle

- Includes all mechanical devices of a typical refrigeration cycle, i.e. compressor, condenser etc.

### Heat Pump

- To upgrade heat released by the ammonia condensation

### PCM vessels

- Vessels for heating and cooling storage are considered

### Solar field & BESS

- Provides the necessary heat input and electricity

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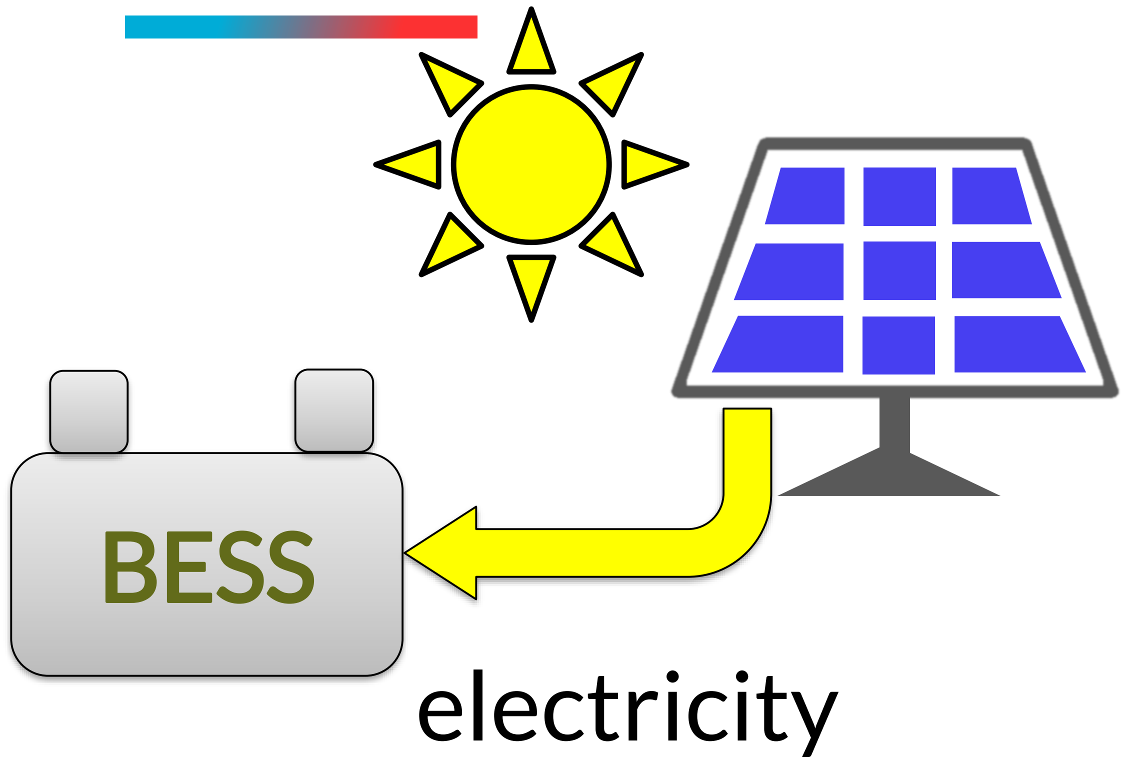
# Basic operating principle

## Charging Phase (winter & shoulder season days)




Solar heat

TCM reactor

Gaseous NH3

1. *The solar heat provides the necessary energy to the TCM reactor for the endothermic reaction. Excess electricity is stored.*

NH3 tank

Liquid NH3

NH3 condenser

Condensation heat

Heat Pump

PCM vessel

2. *The produced gaseous ammonia is condensed and stored in a tank*

3. *The condensation heat is upgraded by a heat pump and covers directly the building heating needs or is stored in the hot-PCM vessel for later use*

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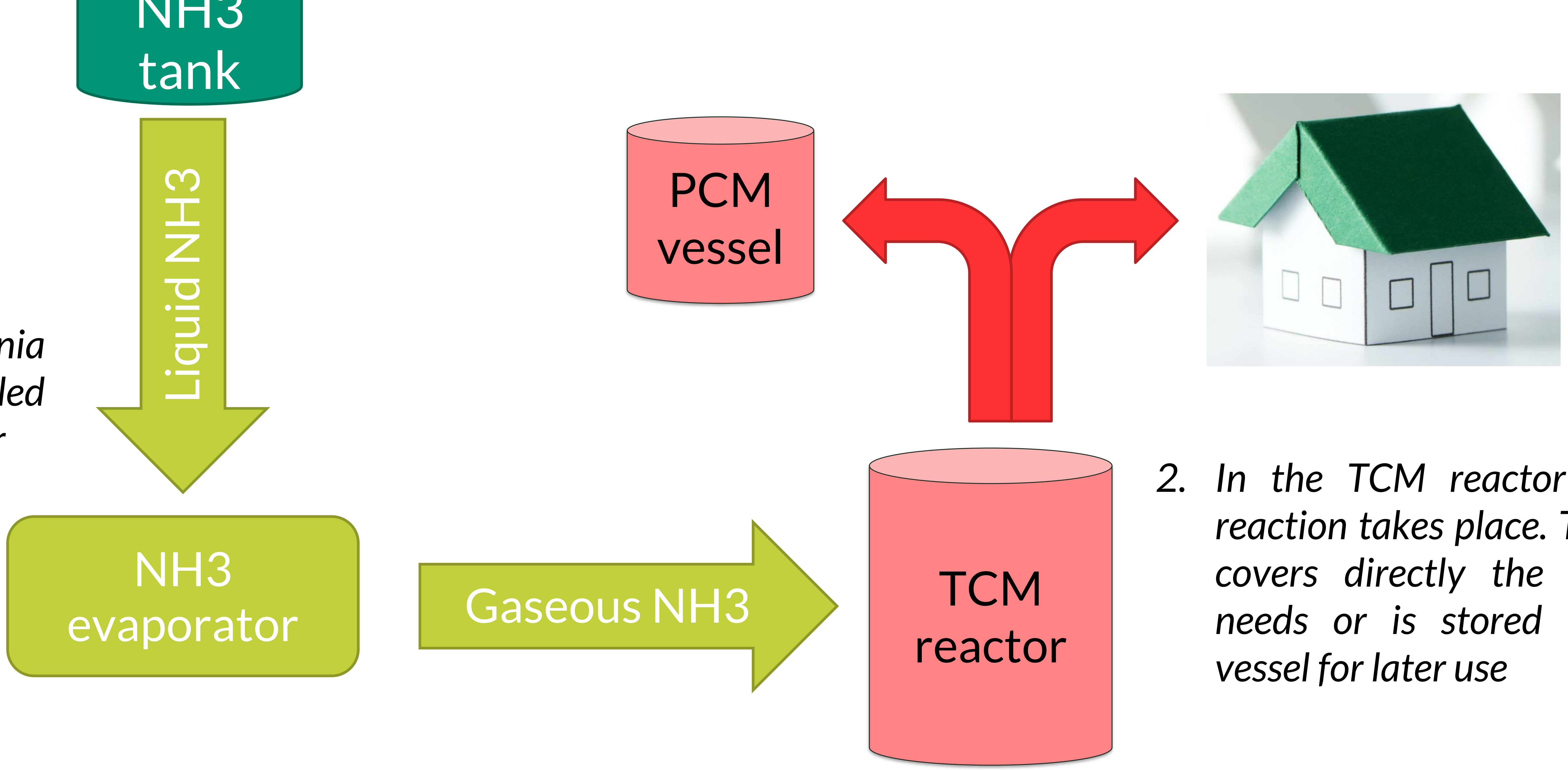
# Discharging Phase (winter nights)

***Considering the energy released during both the charging and discharging phases, an overall system COP for heating equal to 1.8 can be achieved.***




1. *The liquid ammonia is evaporated and led to the TCM reactor*
2. *In the TCM reactor the exothermic reaction takes place. The released heat covers directly the building heating needs or is stored in the hot-PCM vessel for later use*

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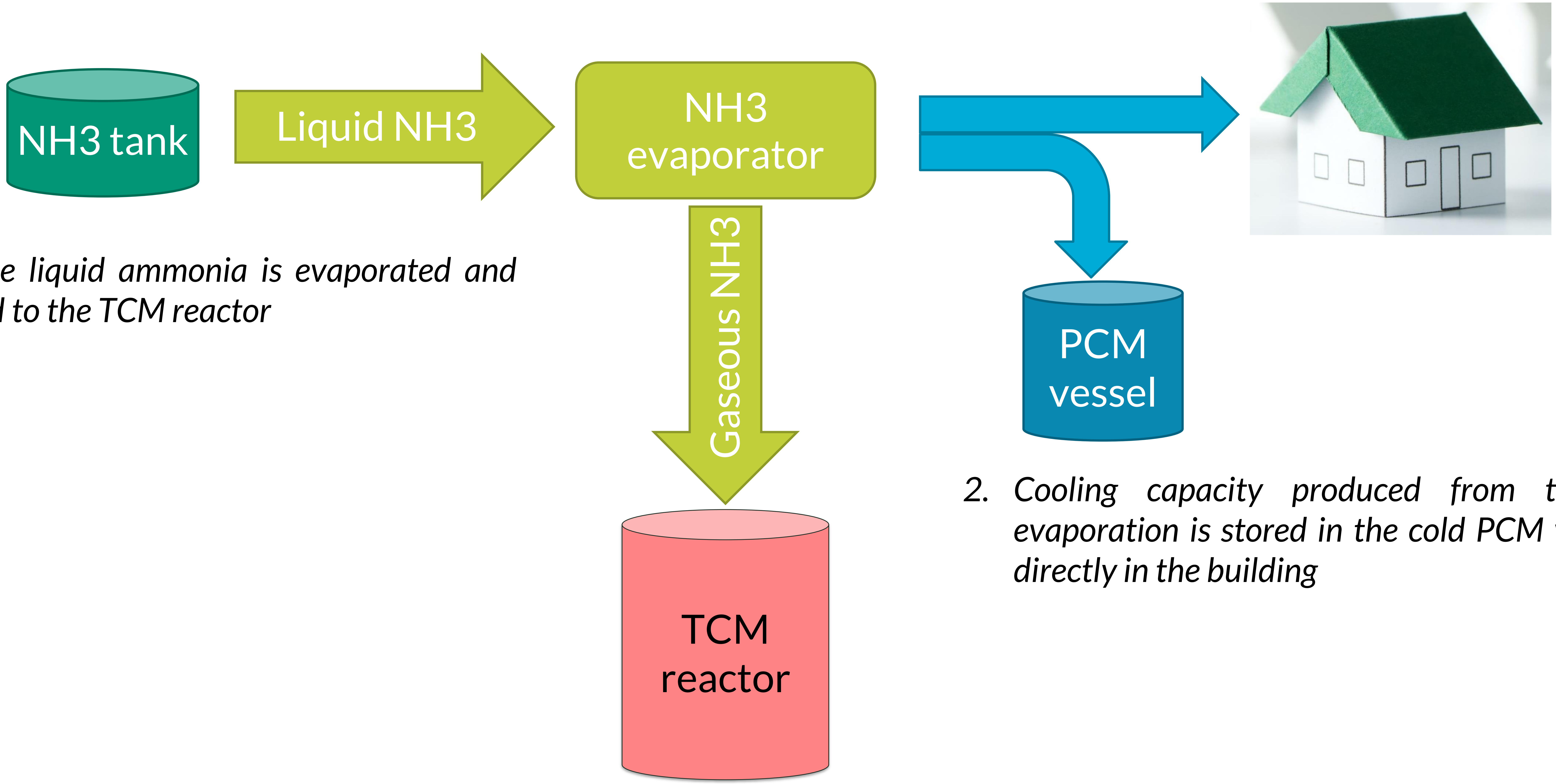
# Basic operating principle

## Discharging Phase (warm summer nights)




1. *The liquid ammonia is evaporated and led to the TCM reactor*

2. *Cooling capacity produced from the ammonia evaporation is stored in the cold PCM vessel or used directly in the building*

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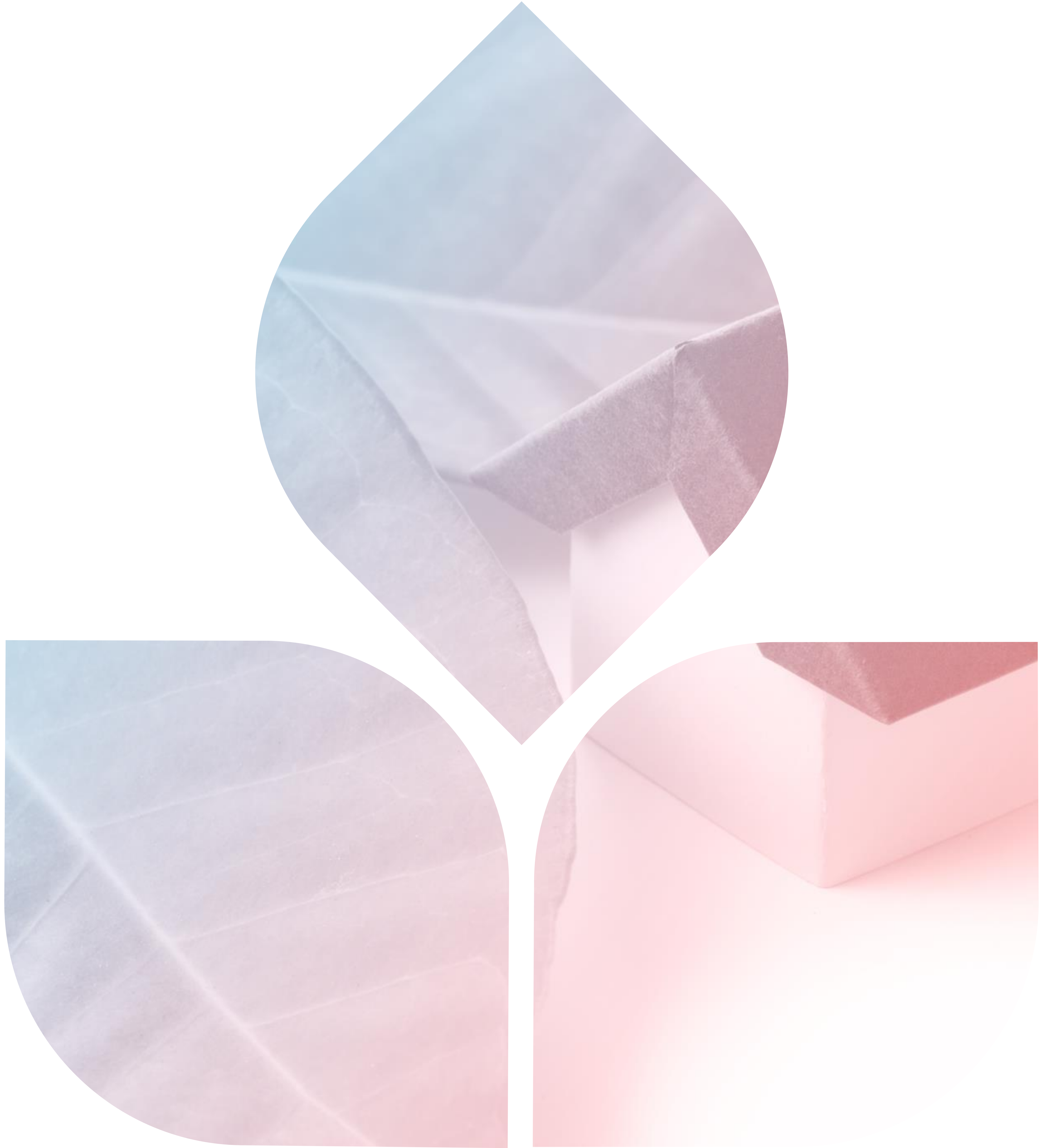

# MiniStor Demo Sites

MiniStor will be demonstrated in a variety of demonstration sites located in:

- Greece (2 sites)
- Hungary (1 site)
- Ireland (1 site)
- Spain (1 site – in process of making official its participation)

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# Demonstration sites in Europe


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# Implementing thermal storage in residential settings in Europe

Why we don't have high energy thermal storage in our houses?

- Technology
- Price
- Regulation
- Consumer acceptance

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# Implementing thermal storage in residential settings in Europe

Why we don't have high energy thermal storage in our houses?

## Technology
Exploit potential of material properties with safe and reliable implementation

## Price
Must compete with well-established technologies

## Regulation
Regulations need to take into account new technological developments

## Consumer acceptance
Confidence by the consumer, otherwise will never be accepted

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# Thanks for your attention!

Follow us: **www.ministor.eu**

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