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EUA-EPUE input paper on Energy Systems

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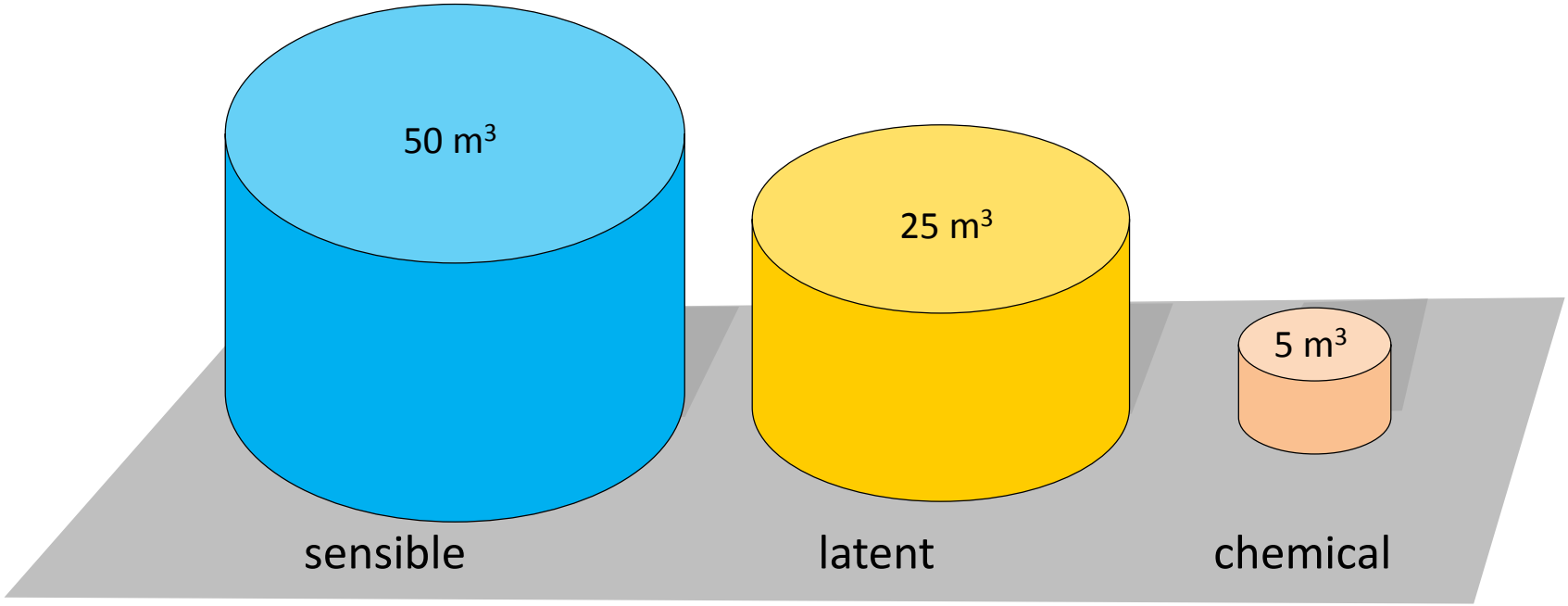
TU/e Technische Universiteit Eindhoven University of Technology

Where innovation starts

Introduction

- [C1] Asset lifetime
- [C2] Other energy forms
  - Heat
  - Power2X, X=Prosumer most importantly!
- [C3] X-borders balancing & backup
- [C4] Lower TRL levels needed (1-3)

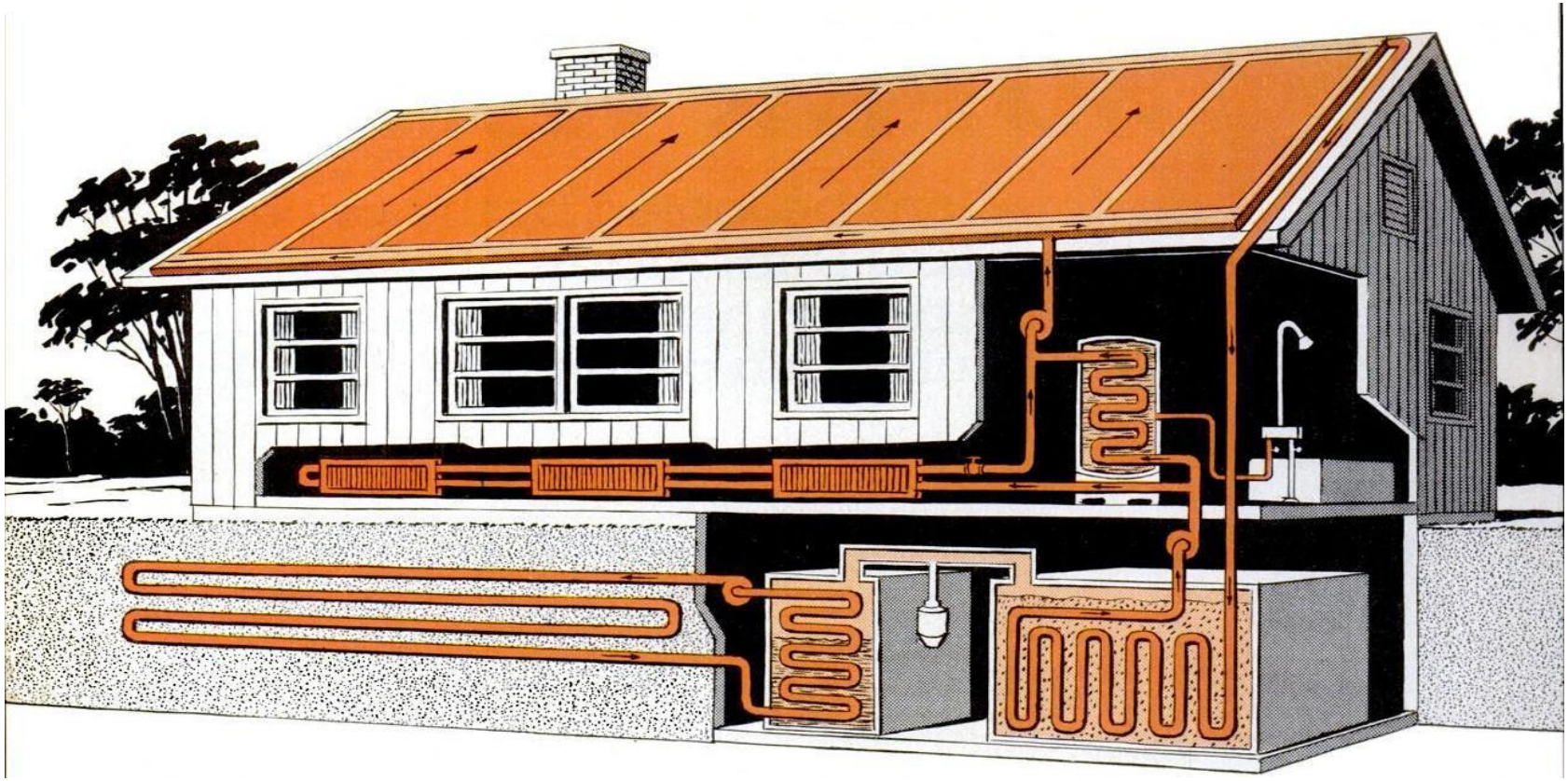
Heat storage



Water	PCMs	TCMs
0.2 GJ/m^3	0.4 GJ/m^3	2 GJ/m^3

Source: Abedin & Rosen, 2011

Closed-loop residential heat storage system



Brunberg, 1980: evacuated Na_2S system

Overarching goals

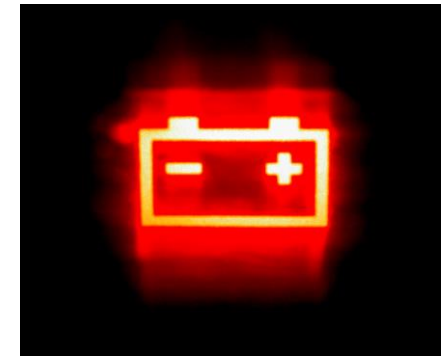
- [C4] System integration – conversion needed
- [C5] Flexibility, storage, metering
- [C6] Interlinking should be 2-way traffic system

Strategic targets

- [C7] Lower TRL levels
- [C8] Customer participation (example: smart metering does not save energy…….
- [C9] Observable and controlable
- [C10] Social aspects, storage needed: storage is the new gamechanger

Energy density comparison

0.07 kWh/kg
(35 kWh/m^3)



0.33 kWh/kg
(550 kWh/m^3)

0.13 kWh/kg

12.4 kWh/kg

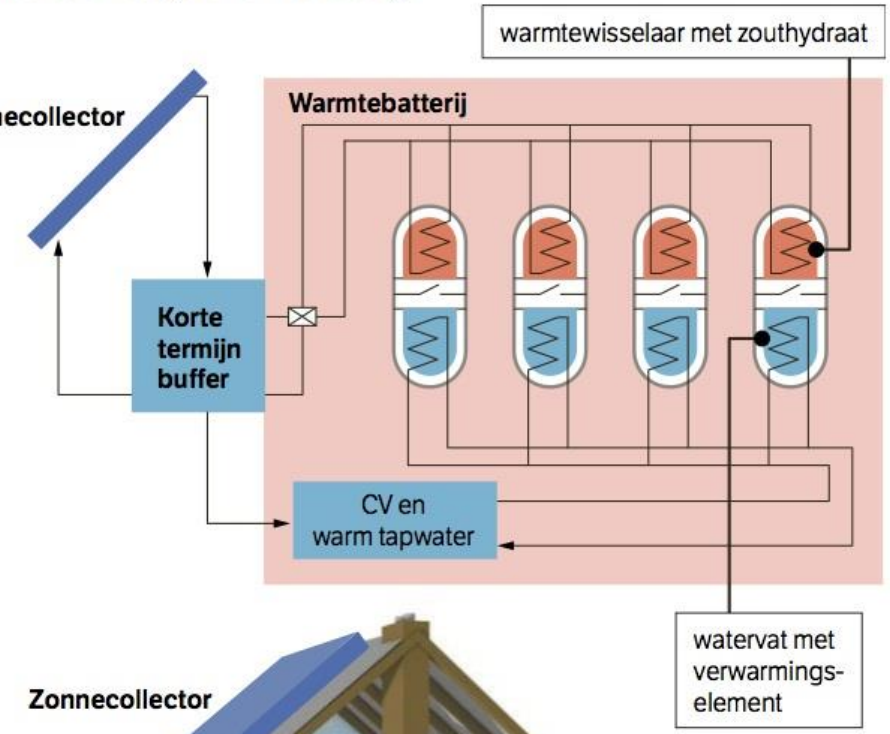
Strategic targets

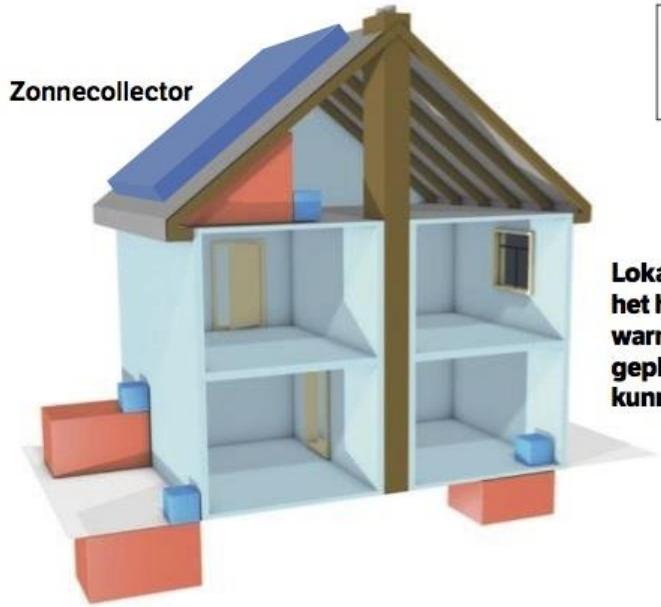
- [C7] Lower TRL levels
- [C8] Customer participation (example: smart metering does not save energy…….
- [C9] Observability & controlability
- [C10] Social aspects, storage needed: storage is the new gamechanger
- [C11] more independent research needed
  - Centralized – decentralized
  - Economic implications
  - LVDC

Potential additional & improved indicators

- [C12] Seasonal basis needed
- [C13] Incentives & data availability

Schematische weergave warmtebatterij





Lokaties in of rond het huis waar de warmtebatterij geplaatst zou kunnen worden

NRC 051116 / RB / Bron: TNO, Universieteit Utrecht

Conclusions and next steps

- EUA-EPEU can play important role (not economically biased)
- Power2Prosumer, risk of monumental collapse of societal trust (Piketty, Stiglitz)
- More money at lower TRL
  - Accept failure
  - Avoid brain drain
  - Avoid manufacturing drain (reshoring)
- Standarize, localize, individualize
- There is more out there than electricity

Options for energy storage

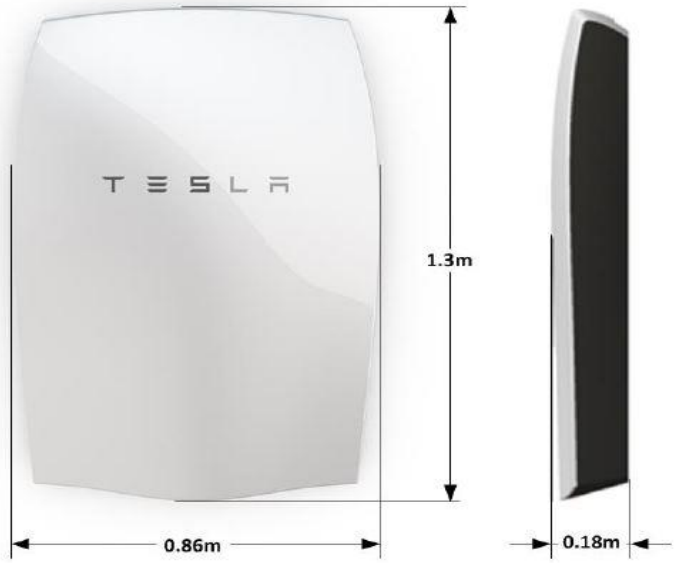
12 V x 70 Ah = 0.84 kWh

Ordinary car battery (70 €):

More than 1 kWh storage capacity

Less than 1 kWh storage capacity

Tesla power wall



Eneco: 7000 €, 100 kg

More than 10 kWh storage capacity

Less than 10 kWh storage capacity

7 kWh storage capacity: 10 times more capacity for 100 times higher price
Density 0.07 kWh/kg

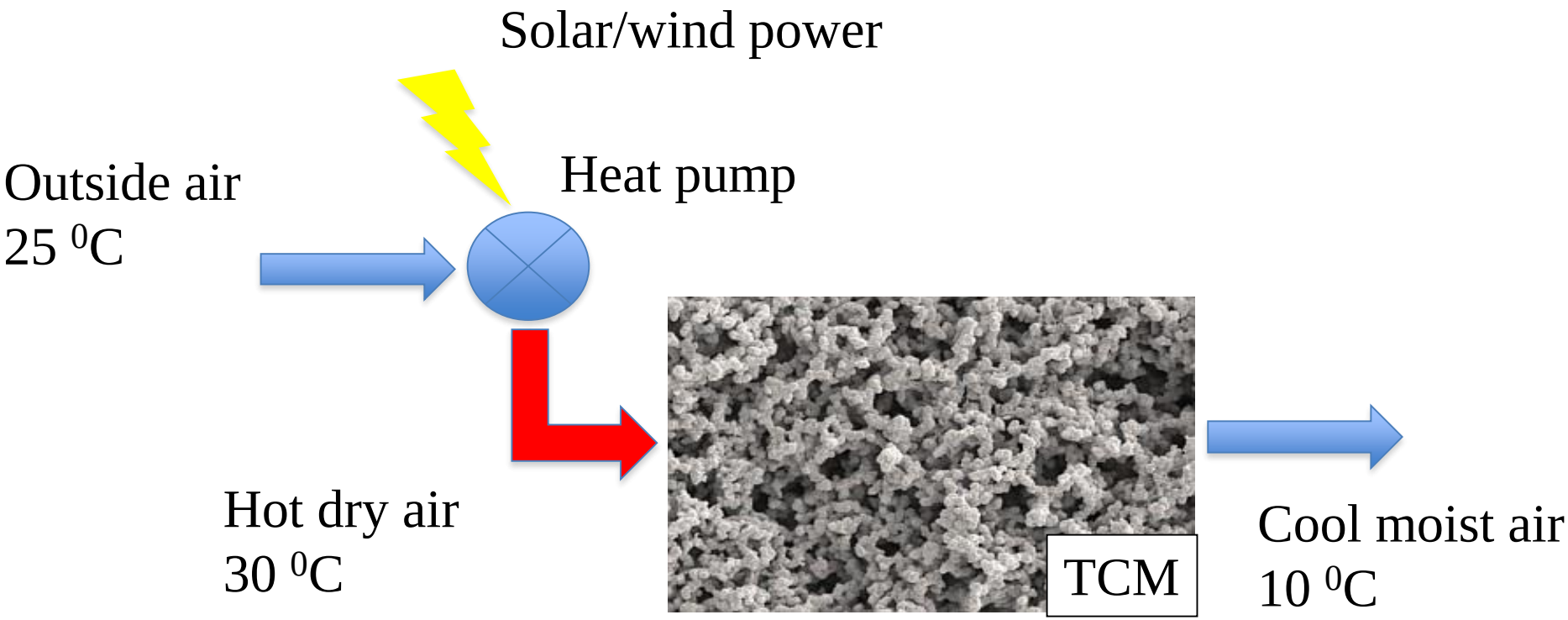
How much is 7 khW?

1 panel (1.65 x 1 m) of 275 Wp x 0.85
("rule of thumb") =
234 kWh/year = 0.64 kWh/day averaged.

Tesla power wall can provide one day
electricity for an averaged household

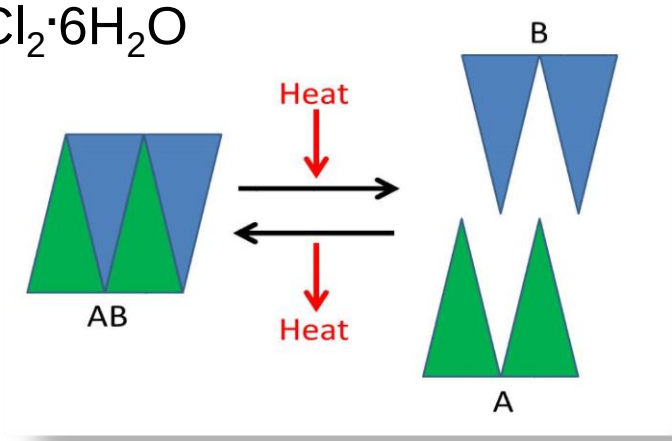
And 4 times more is also needed for heat……..

TCM heat battery (open system)



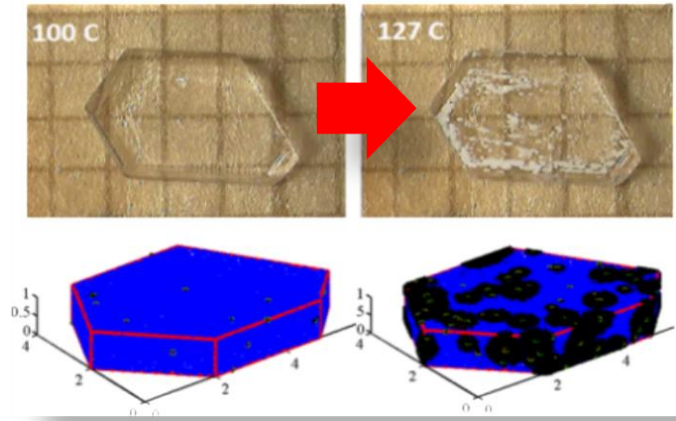
Thermochemical Materials (TCMs)

$CaCl_2 \cdot 6H_2O$



Exothermal chemical reaction between components H_2O en $CaCl_2$

Salt hydrates



Source:
C. Ferchaud (TU/e)

Why salt hydrates?

- High energy density
- Appropriate window (*p, T*)
- Inexpensive materials