

Key Compact Storage tanks

Technology Comparison and Outlook

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The goal is clear!

A 100 % renewable energy supply in the near future



The challenge is **not** the energy production

- ➔ The challenge is the **energy storage**
 - Electrical energy storage
 - Thermal energy storage

Thermal energy storage is a key technology for solar thermal systems

Thermal Energy Storage

Future requirements on thermal energy storage

- large storage capacity
- modular design
- high storage density
- low heat losses
- applicable for short term -
and long term heat storage



Image: Coasline Windows & Conservatories

State of the Art

Solar Thermal heating

Water based storage systems



Image: Sonnenhaus-Institut

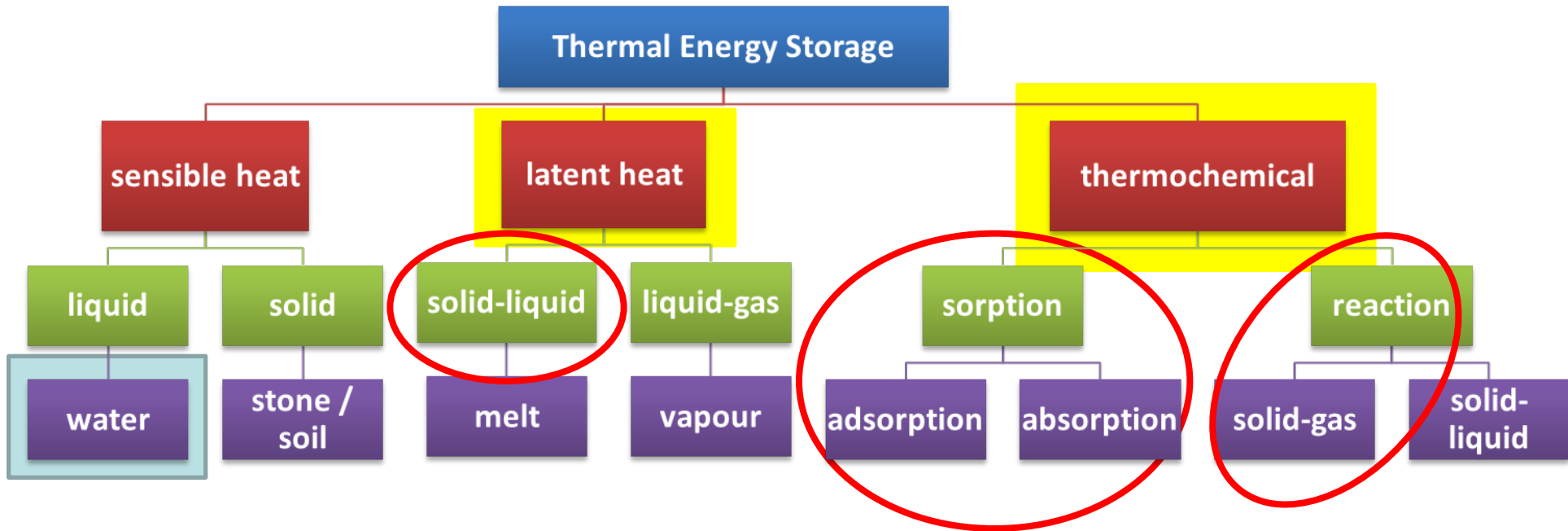
Future prospects:

Compact and highly efficient storage based on new storage technologies



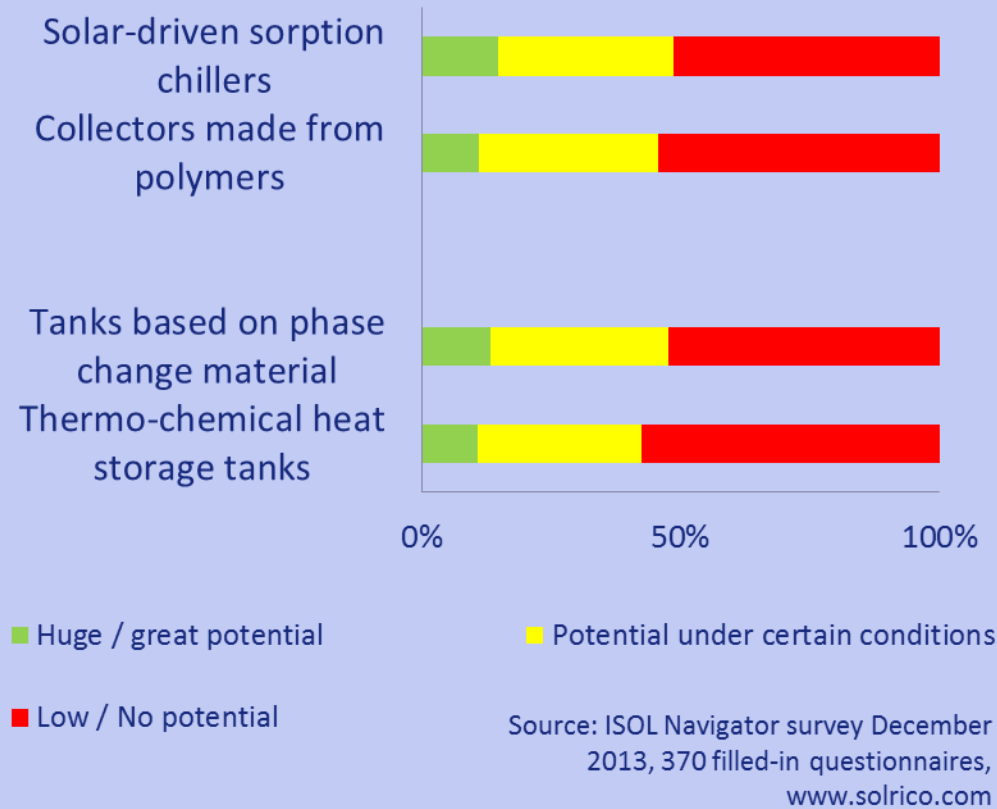
Image: Sonnenhaus-Institut, modified by ITW

Thermal Energy Storage Mechanism



Solrico Technology and Market Survey

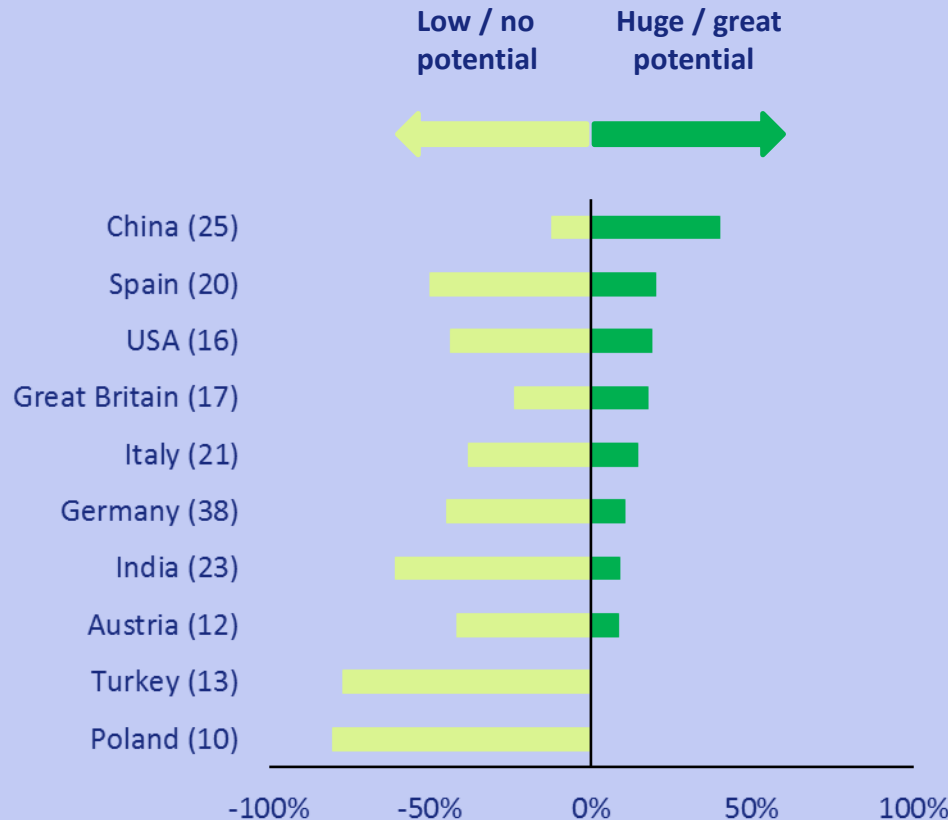
Market potential of different solar thermal technologies



- ▶ Question: “How would you estimate the market potential of the following technologies in your national / key solar market?”.
- ▶ Around 370 solar thermal system suppliers answered this question in the ISOL Navigator Survey December 2013.
- ▶ General: up to 50% of ST manufactures are aware that new technologies show a relevant market potential

Solrico Technology and Market Potential Survey

Market potential of tanks based on phase change material / latent heat storage

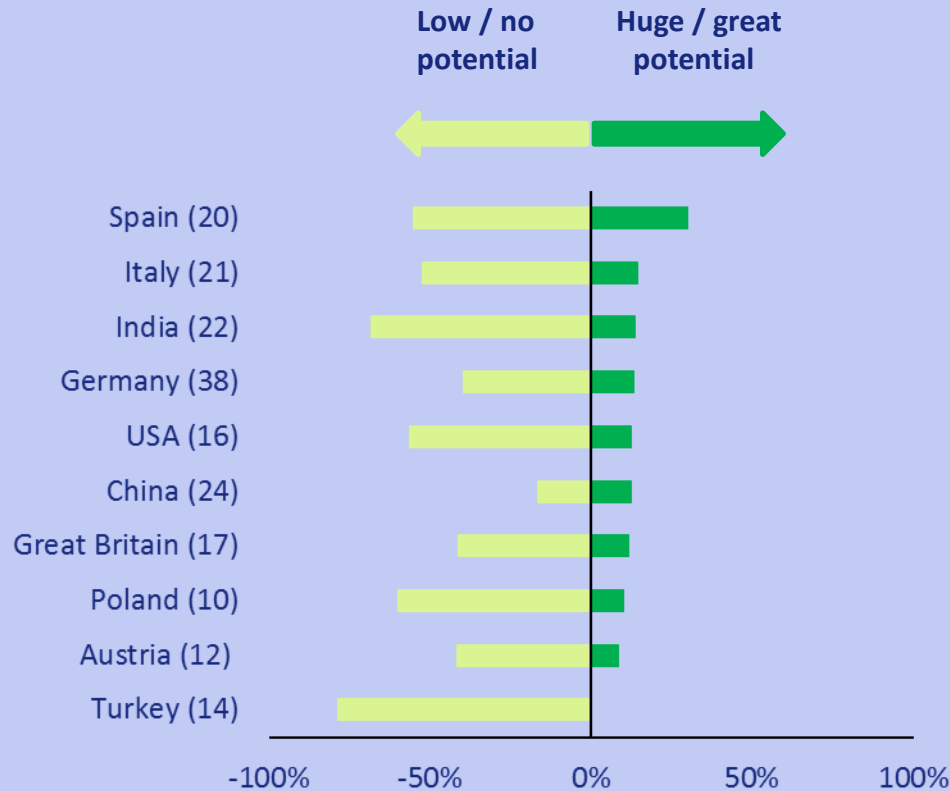


Source: ISOL Navigator survey December 2013, 370 filled-in questionnaires, www.solrico.com

- ▶ Chinas manufacturer see real opportunity for latent heat storage.
- ▶ Spain, USA and Great Britain give the technology a chance
- ▶ most of German manufactures are still hesitant

Solrico Technology and Market Potential Survey

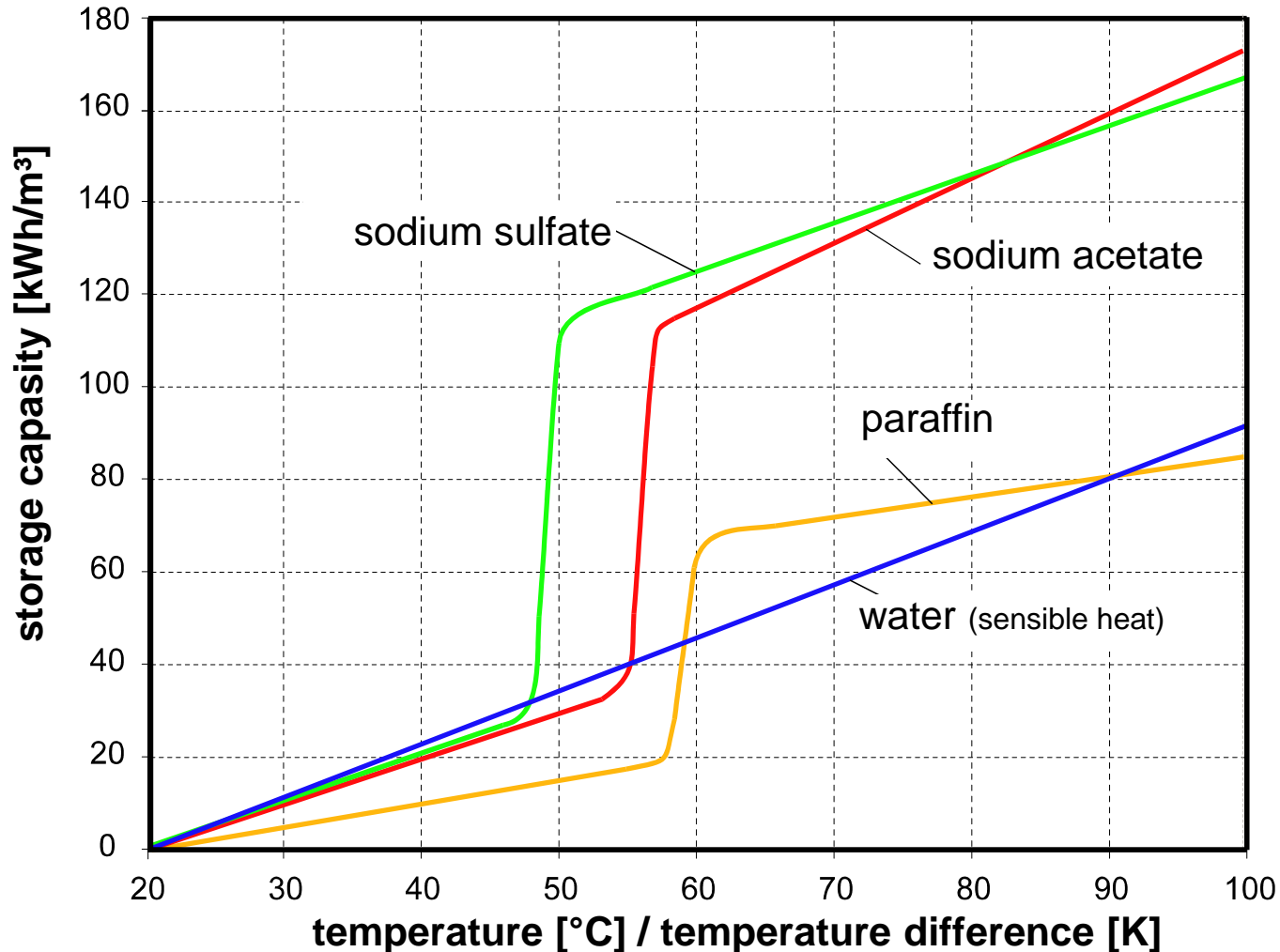
Market potential of thermo-chemical heat storage tanks



Source: ISOL Navigator survey December 2013, 370 filled-in questionnaires, www.solrico.com

- ▶ thermo-chemical heat storage is a very new (maybe unknown) technology
- ▶ however in every country already some manufacturers attest huge potential
- ▶ every third manufacturer in Spain believes in thermo-chemical
- ▶ further development and demonstration is necessary to increase confidence in the technology

Mechanism of latent heat storage



Latent Heat Storage

Company

Icebear Energy (formal Power Tank)
Institute for energy efficiency
Switzerland
www.latentspeicher.com

Storage material

paraffin
melting point: 40 / 50 / 60°C

application

short and mid term
solar thermal heating,
Combined Heat and Power (CHP)

more than 15,000 cells sold



Source: Icebear Energy

Latent Heat Storage

Company

H.M. Heizkörper GmbH & Co. KG
Germany
www.muhr.net

storage material

sodium acetate
Melting point: 58°C
storage capacity per cell: 50 kWh

tank material

stainless steel
cylindrical

application

solar thermal heating,
Combined Heat and Power (CHP)
short and mid term



Source: H.M. Heizkörper GmbH & Co. KG

Latent Heat Storage

Company

SUNEX S.A.

Poland

www.sunx.pl

storage material

sodium acetat

melting point: 55°C

Storage capacity per cell: 8 kWh

tank material

galvanised steel (2mm)

rectangular shape

application

solar thermal heating

short term



Source: SUNEX S.A.

Phase Change Material - Water



Latent Heat Storage

Company

Consolar Solare Energiesysteme GmbH,
 Germany
www.consolar.de

storage material

water
 melting point: 0°C
 storage volume: 0.5 m³

tank material

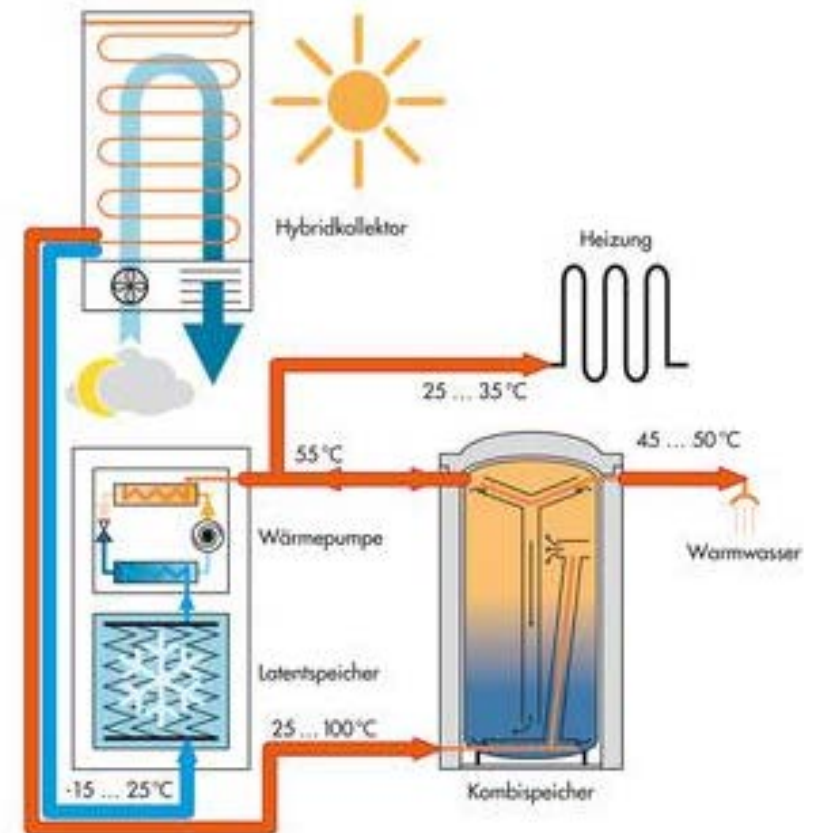
polymere
 rectangular shape

application

heat pump
 short term storage



Hocheffiziente
 Solaranlagen



Source: Consolar GmbH

Latent Heat Storage

Company

isocal HeizKühlsysteme GmbH
Germany
www.isocal.de

storage material

water
melting point: 0°C
storage volume: 10 – 18 m³

tank material

earth buried concrete
no insulation

application

heat pump
long term storage (weeks)

isocal
nachhaltig mehr



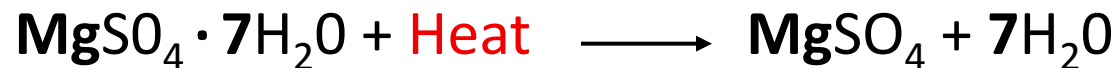
Source: isocal / ITW

Mechanism of thermo-chemical heat storage

How a chemical reaction can be used for energy storage

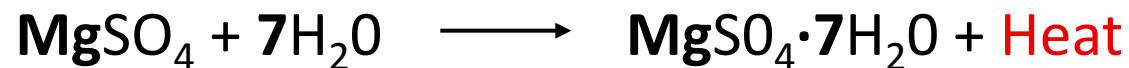
- solid/gas-reactions very suitable for thermo-chemical storage
- For example salt hydrates (Magnesium sulfate)

1. charging (dehydration): heat supply to split hydrates



2. storing: separation of reaction components

3. discharging (hydration): gain heat of reaction



Advantage of thermo-chemical heat storage

- high storage density

	storage density	factor
water*	60 kWh/m ³	1
latent	50 -120 kWh/m ³	1 – 2
adsorption	120 - 180 kWh/m ³	2 – 3
reaction	200 - 600 kWh/m ³	4 – 10

* bei $\Delta T = 50 \text{ K}$

Advantage of thermo-chemical heat storage

- high storage density
- loss free heat storage
- separation of power and capacity
 ➔ scalability

➔ crucial factors for long-term energy storage
and high temperature storage

➤ **disadvantage:** high regeneration temperature (120 – 180°C)

Comparison of Technologies

	hot water	latent heat	thermo-chemical
storage density	○	+	++
heat losses	○	+	++
modularity	○	+	+
scalibility	○	+	++
short term	++	++	○
long term	○	+	++
market readiness	++	○	-
future potential	○	+	++

Conclusion and Outlook

- ➔ Hot Water Stores are state of the art

What about new storage technologies?

Most of solar manufactures seem to be conservative for new technologies

However awareness of PCM and TCM technologies increases

- ➔ PCM storage
 - some products on the market
 - paraffin and sodium acetate storage for space heating
 - ice storage in combination with heat pumps

Conclusion and Outlook

- ➔ Thermo-chemical energy storage
 - many national and international research activities
 - new storage materials and innovative system design are under development and tested in laboratory or pilot scale
- ➔ new knowledge and important experiences gained
- ➔ technical feasibility has been proofed in many projects

In addition to sensible heat, the technology of latent heat and thermo chemical energy storage are a very promising solution for the future of solar heating and cooling, CHP,

Thank you for your attention

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