

ENERGY. FUTURE. ZAE.

The Industrial Waste Heat Utilisation Project

Dual-Media High Temperature Thermal Storage for Industrial Waste Heat Recovery

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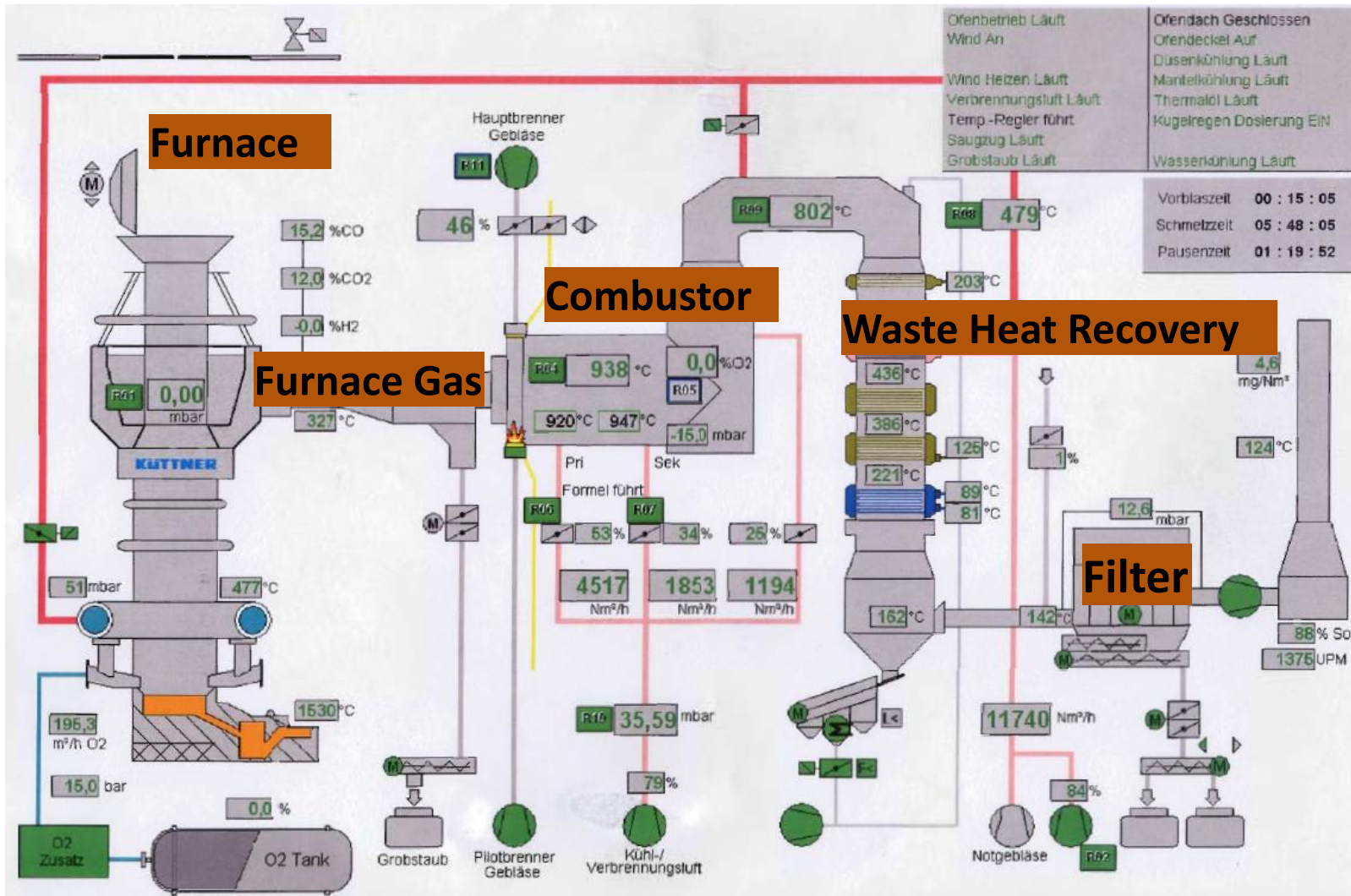
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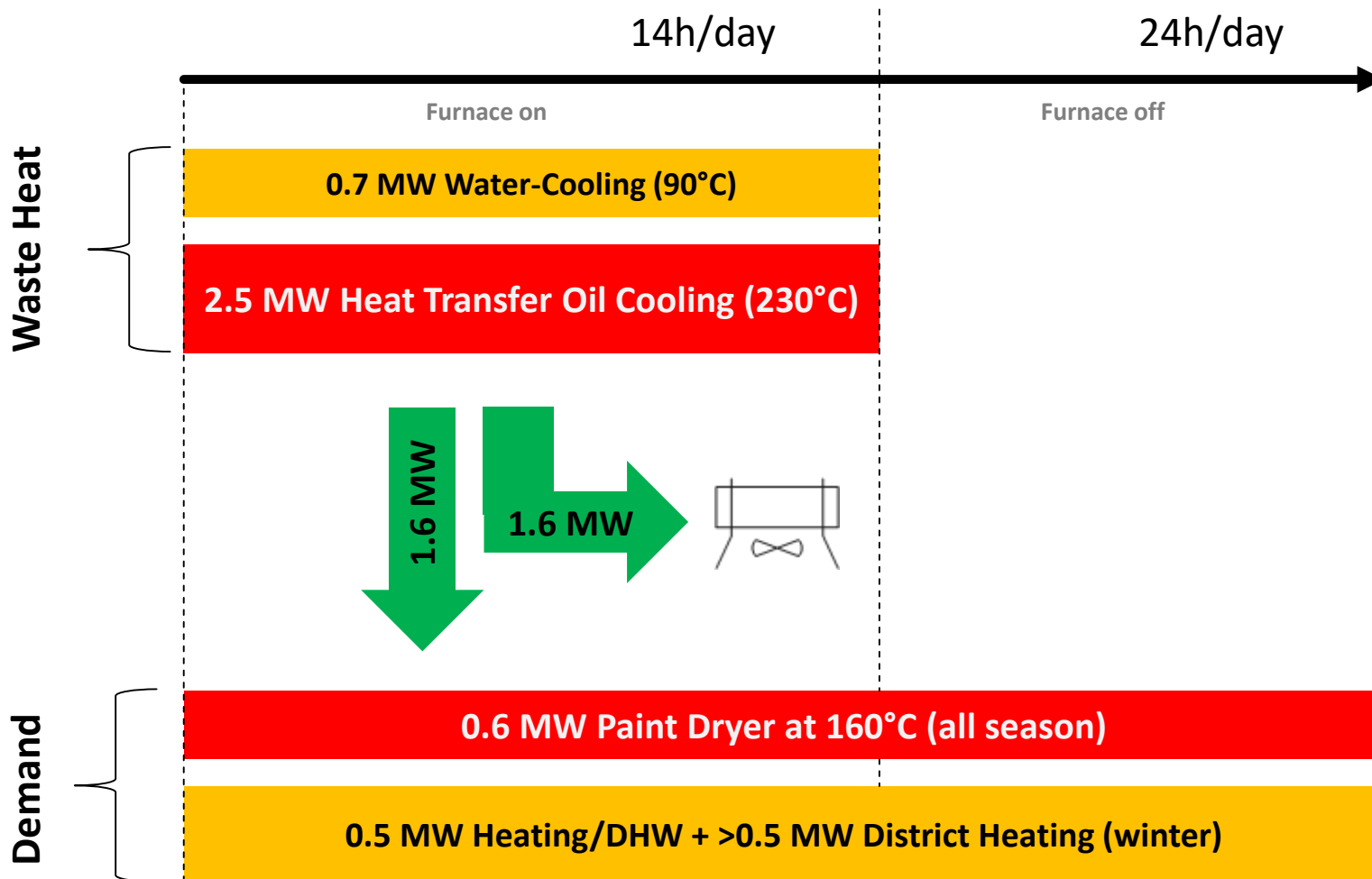


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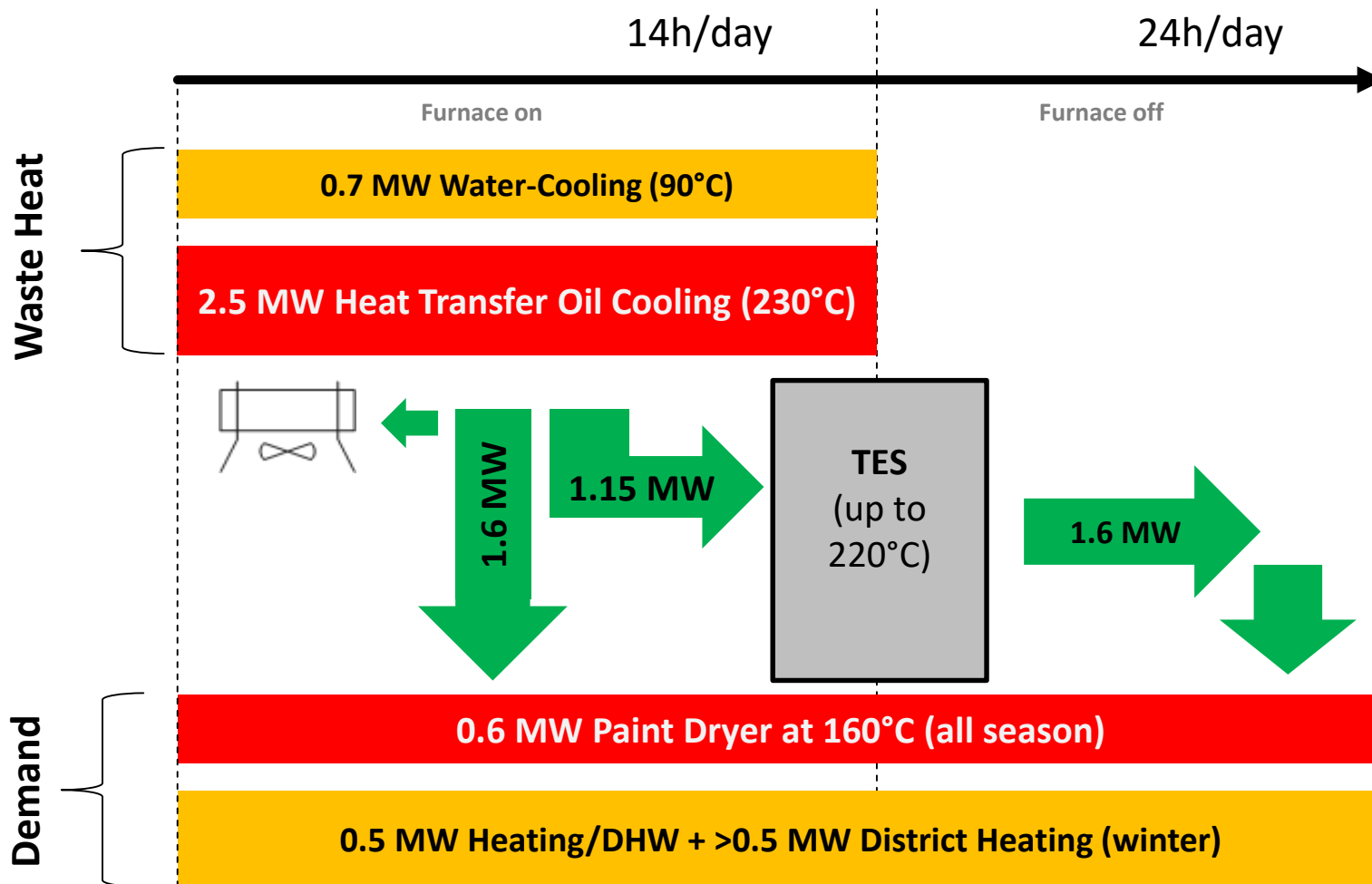
Waste heat situation



Waste heat recovery today



Tomorrow: Waste heat recovery through thermal energy storage



Sensible thermal energy storage up to 220°C

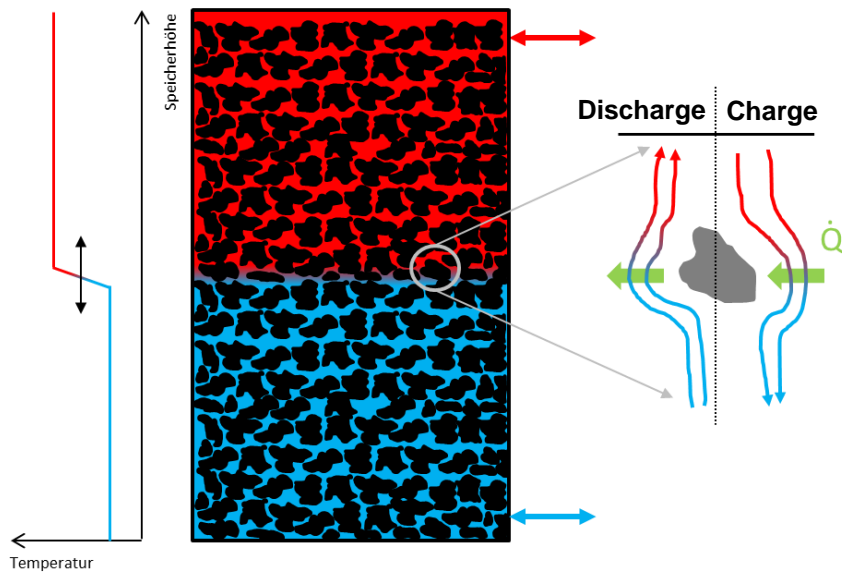
Dual-Media thermal storage



Concept:

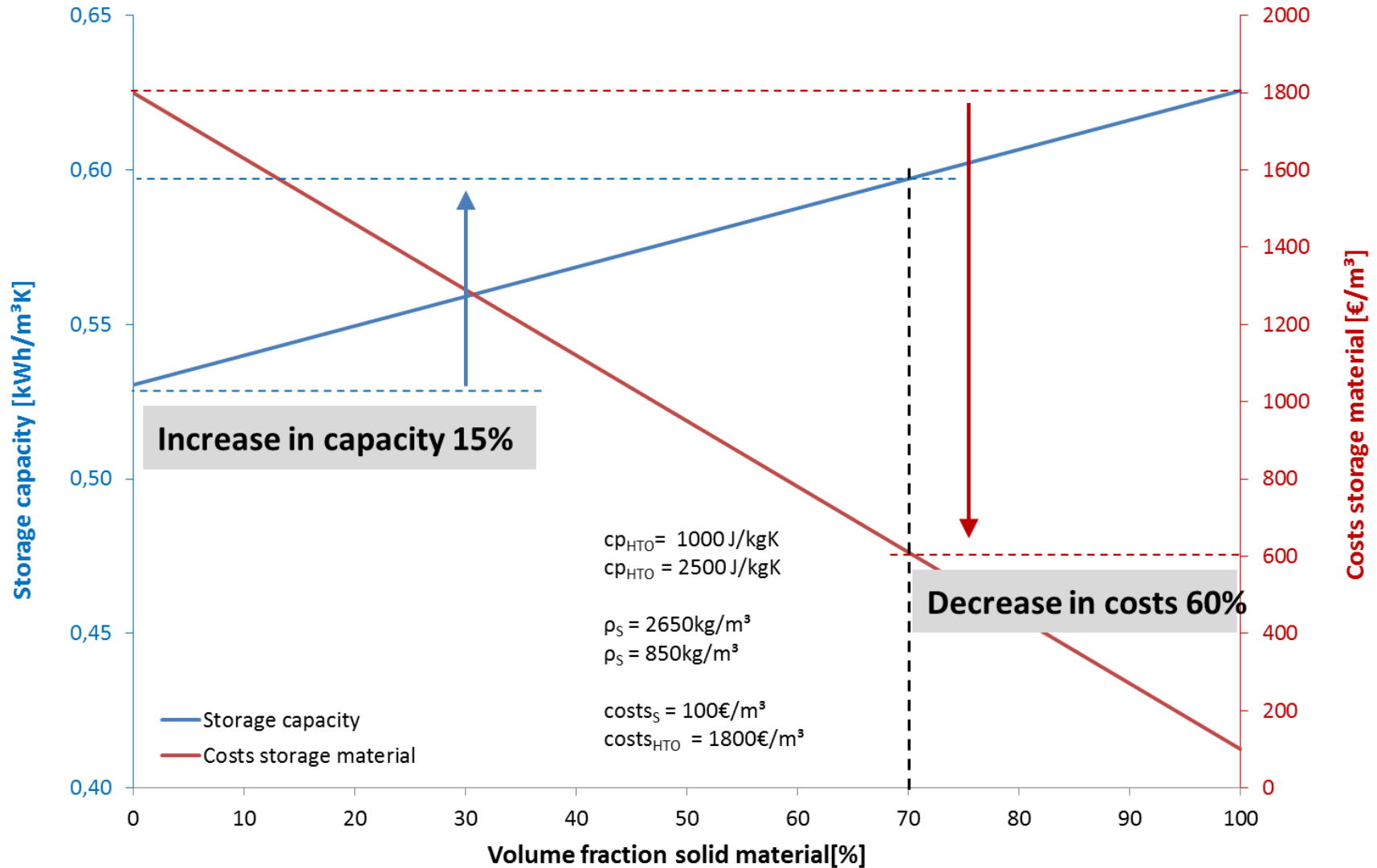
Solid material replaces oil as storage media.

Oil mainly used as heat transfer medium (direct contact).



- Replacing oil by cheap **solid material** (e.g. rock) **reduces costs**
- **Direct thermal contact** between solid material and heat transfer oil enables good **heat transfer**
- **Storage capacity** can be **increased** by using suitable solid material

Sensible thermal energy storage up to 220°C



Sensible thermal energy storage up to 220°C

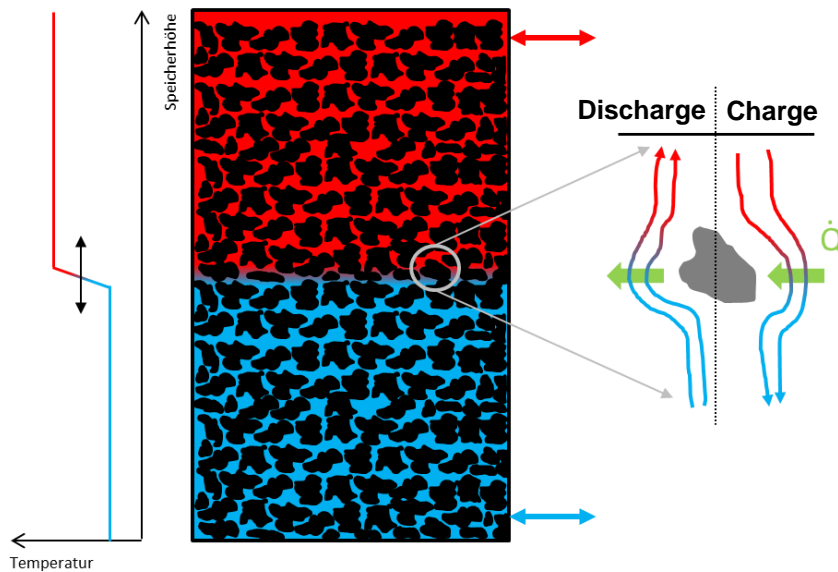
Dual-Media thermal storage



Concept:

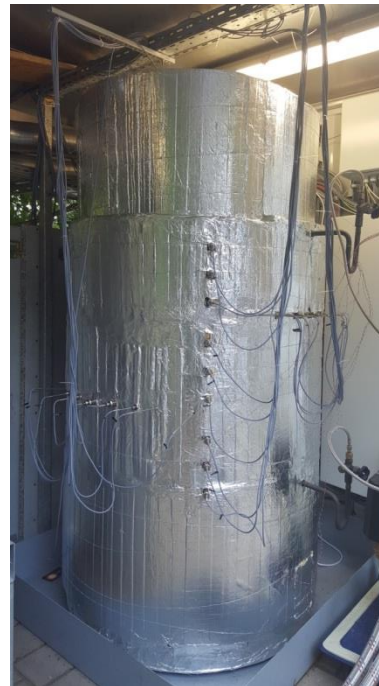
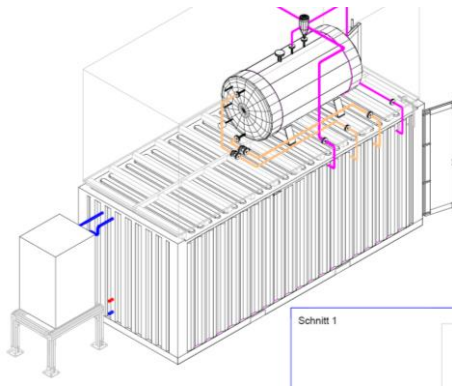
Solid material replaces oil as storage media.

Oil mainly used as heat transfer medium (direct contact).



- Chemical resistance of rocks/oil?
- Impact of thermal stress?
- Discharge of rocks?
- Pressure drop?
- Thermal power?
- Thermal capacity?
- Efficiency?

Storage Test Site at ZAE Bayern



R&D on dual media thermal energy storage

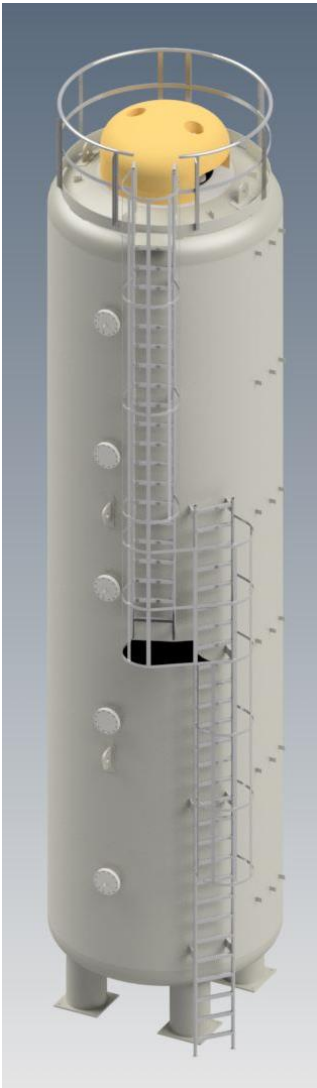
- Tests under real conditions with a test storage
- Determination capacity, thermal output and efficiency
- Determination pressure drop, discharge of material
- Long term tests for determination of chemical and thermo mechanical behaviour

Storage Test Site at ZAE Bayern

- Thermo mechanical stability of storage material after 6750 cycles ✓
- Chemical stability of storage material/oil after 8000h ✓
- Pressure drop very low ($< 10 \text{ mbar/m}_{\text{height}}$) ✓
- No discharge of solid storage material was observed ✓
- Energy efficiency $> 90\%$ ✓

Pilot storage installation

Planned pilot storage installation at Gießerei Heunisch , Bad Windsheim



Modul parameter:

- Height: ~12 m
- Diameter: 2,9 m
- Volume: 50 m³
- Target bulk density: >60 %
- Weight storage material: ~ 75 t

- Modul transportable
- Filling with storage material on site

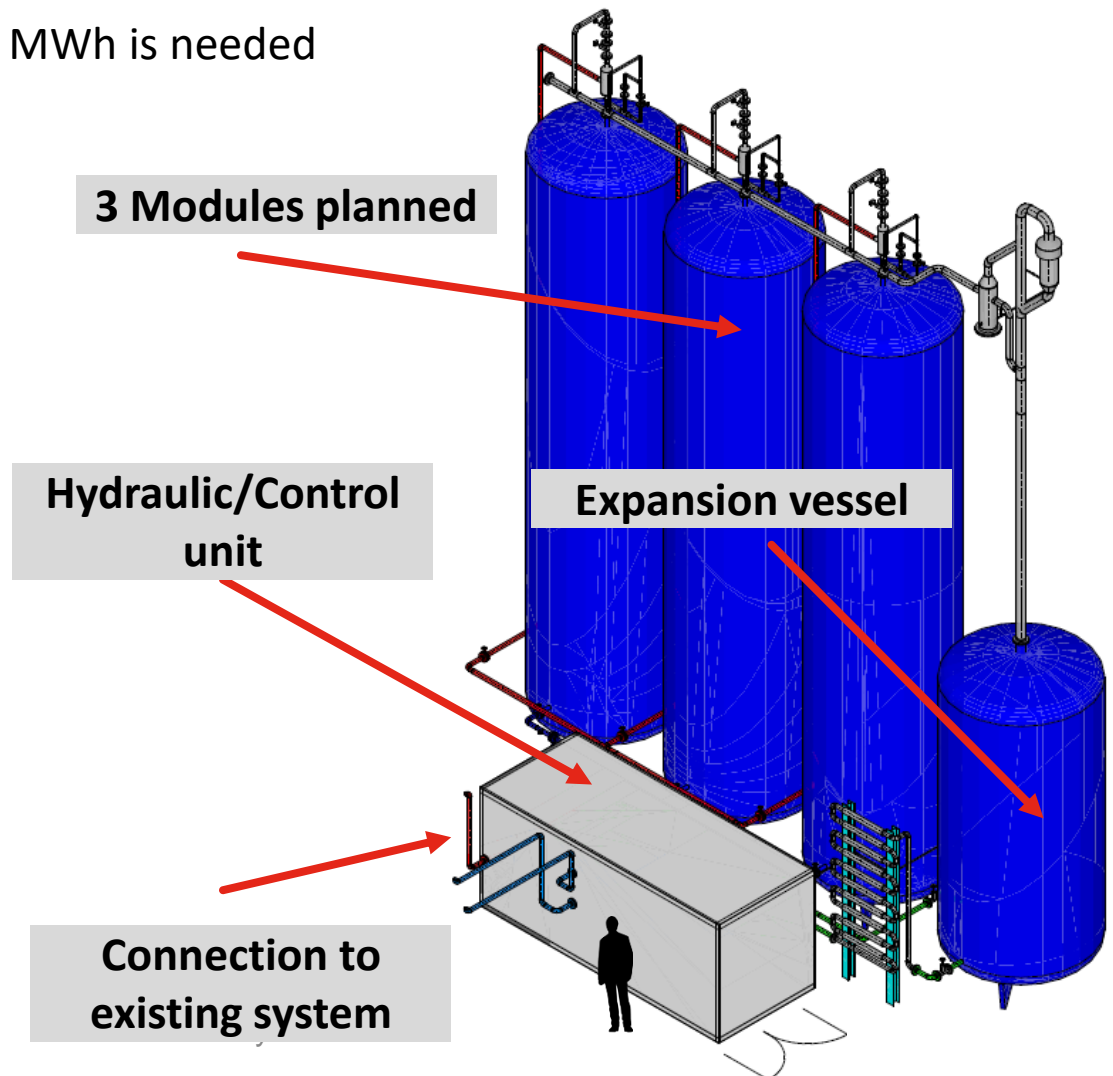
- Double walled container:
 - For safety reason
 - Used as insulation (vakuum super insulation)

- Theoretical storage capacity: ~3.6 MWh (100°C <-> 215°C)

Pilot storage installation

Planned pilot storage installation at the foundry consists of several modules

- Max storage capacity of ~12 MWh is needed
- Installation of modules takes place step by step
- Construction of the first modul is scheduled to start this year



The project overarching objectives, The consortium

Developing thermal energy storage unit for operating up to 220°C and demonstration under real conditions in a foundry

- Proof of concept
- Determination of real storage system costs
- Operational experience
- Performance evaluation and optimization
- Evaluation impact on energy efficiency of the foundry and reduction of CO2 mitigation
- Evaluation of the economy

Supported by:



on the basis of a decision
by the German Bundestag

System and component
development

Implementation and operation
of the demonstration plant

Design and planning of the
demonstration plant



Bavarian Center of Applied Energy
Research



Foundry Heunisch Guss

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Industrial plant manufacturer

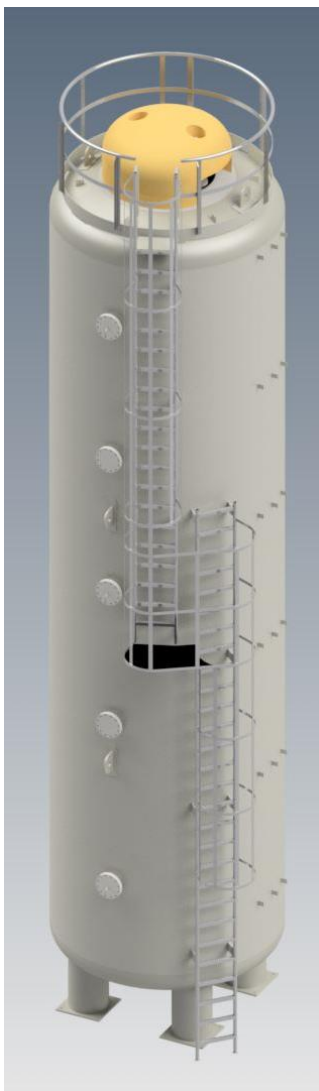
Main lessons learned and barriers

- **Partners only for technology demonstration are hard to find**
 - High risk (technical/economic)
 - Economic demonstration under real conditions often difficult
 - No benefit from marketing the technology
- **Industry expectations regarding payback times**
 - 3 years is often unrealistic
- **The effort required for system integration of storage technology must always be taken into account**
 - Costs are often considerable
 - Expenditure in advance difficult to estimate

Needs for future R&I activities

- **Long term evaluation during the entire operating period**
 - Investigation of ageing phenomena (chemical and mechanical stability)
- **Analysis of cost saving potentials regarding**
 - Construction
 - Operation
 - Maintenance
 - Planning and commissioning
 - Integration
- **Analysis of performance potentials regarding**
 - Efficiency
 - Power

Prospects and needs



Prospects are positive if

- Energy price is relevant
- Daily in use
- Temperature range ~ 100 K
- Reduction of CO₂ emissions are relevant
- Longer payback period acceptable due to long service life

What the storage needs

- Partners for further demonstrations activities in different industrial application in order to build trust
- Increasing knowledge about technology from customers, manufacturers, planners, plant engineers...
- For the use in the EU:
 - Interregional cooperation to meet individual regulatory requirements
 - Interregional partners for realisation

Thank you for your attention!

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