Utilising Sand & Brick Batteries for Sustainable Energy Storage

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1. Introduction:

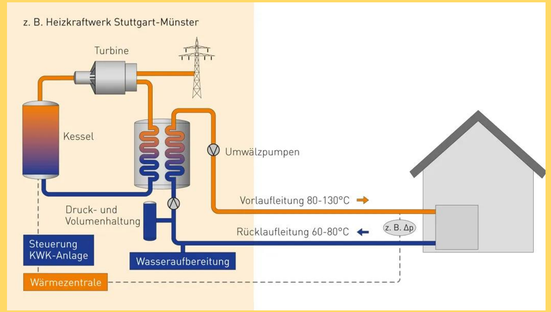
- Need for Storage
- Intermittency of Renewable Energy Sources
- Solar and wind power are intermittent sources of energy, meaning they don't produce electricity consistently throughout the day. Storage allows excess energy generated during sunny or windy periods to be stored and used when these sources are not generating power.

2. Objective:

- Provide a comprehensive overview of the types on thermal energy storage solutions
- Evaluate the materials used in battery systems
- Evaluate the potential for TES systems to reduce greenhouse gas emissions and support renewable energy integration.
- Explore how TES can be integrated with renewable energy systems (e.g., solar thermal, wind) to enhance energy storage and supply reliability.
- Identify the key technical challenges facing TES technologies,
- Highlight gaps in current knowledge and propose areas for further research to advance the field.

5.2 Opportunity:

- Germany is to ban all new oil and gas heating systems from 1 January 2024, by Green Party
- Use it as heat by warming up water in a separate, closed-loop system, like a district heating system or geothermal heat pump.
- Bi Products or a mix of both can be used as a medium.
- Since sand can hold a high amount of energy it can also be used to store heat for industrial purposes like steam reforming



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3. Methodology:

Sand Battery:

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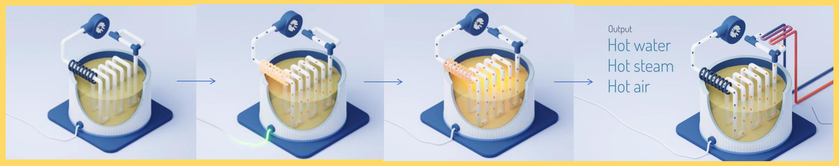
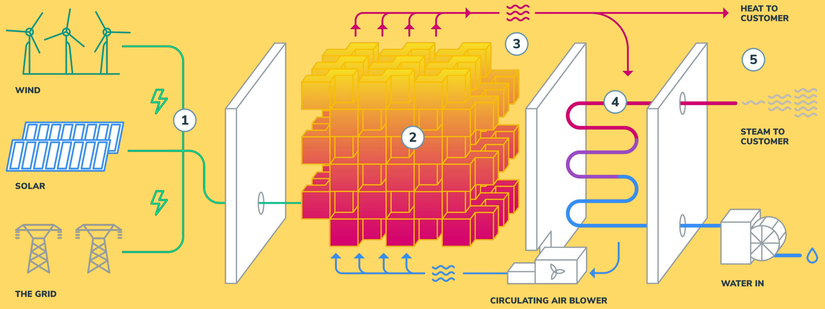
Sand is heated with electricity from the grid over local production	It is charged when clean and cheap electricity is available	The energy is transferred to the sand battery using a closed circuit heat transfer system	The heat is discharged from the system using a heat exchanger.



Rondo Energy: The Rondo Heat Battery:

1:	2:	3.	4.	5.
Low-cost, intermittent electricity turns into heat.	IThermal radiation warms bricks at temperatures up to 1,500°C, storing heat.	Heat is delivered whenever it's needed, on-demand, start-stop or continuously.	Heat is delivered as superheated air or as superheated steam.	Air and/or steam is delivered to any industrial process 24/7



4. Comparison:

Battery Type		Lithium-Ion Battery	Sand Battery	Rondo Bricks:
CO2 Emissions		Total for 1 year: 52,680 metric tons CO2	Total for 1 year: 300 metric tons CO2	Total for 1 year 220 metric tons CO2
Efficiency	Thermal	Not typically used	80 – 90%	90%
	Electricity	85% - 95%	60%	90%
Investment, Area & Capacity		€159.09 per kWh	€75 per KWh	€ 124 per KWh
Life Span		10 to 15 years	30+ years	30+ years

Key figures for the battery storage project in Hamm and Neurath

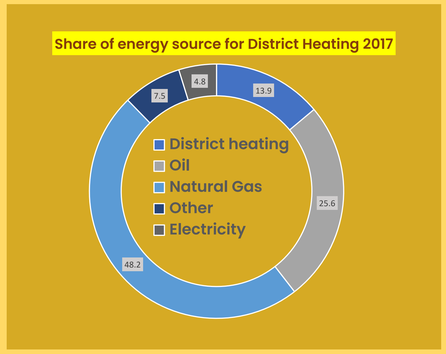
690 battery blocks	**21,000 m²** surface area	**220 MW** maximum output
140 million euros total investment	**2023** construction start	**2024** planned commissioning

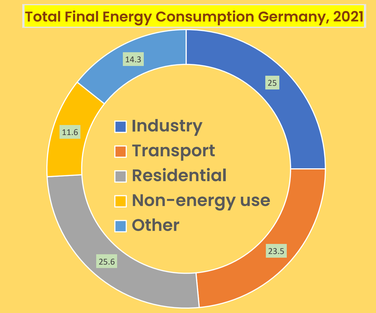
5. Discussion:

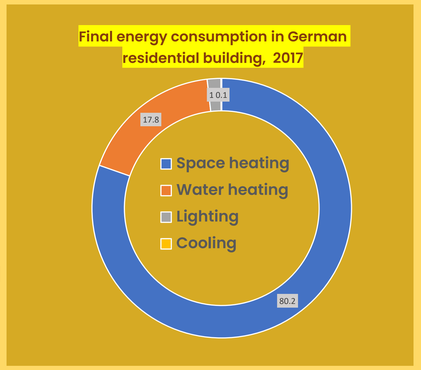
5.1 Challenges:

- Turning heat into electricity drops efficiency 30% to 50%.
- Thermal conductivity of sand is not very good.

6. Tabulated & Graphical Data:







7. Conclusion:

- Thermal batteries support advancement in sustainable storage capability.
- As we're finding ways in finding a good mix of renewable energy generation. It is also important to find a more sustainable energy storage system.
- As research and development continues, we can expect more sustainable thermal batteries, considering their environmental impact and efficiency.

8. Reference

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