Final report

1. Project details

Project title	Mobilt termisk batteri til udnyttelse af overskudsvarme
File no.	64021-1030
Name of the funding scheme	EUDP
Project managing company / institution	Copenhagen Atomics A/S
CVR number (central business register)	36719230
Project partners	Norfors, Arkil, WSP
Submission date	30 December 2024

2. Summary

Describe the objectives of the project, the obtained results and how they will be utilized in the future, both in English and in Danish. The summary will be published on www.eudp.dk and www.energiforskning.dk.

Project summary:

The purpose of the project

The goal of this project was to demonstrate a novel mobile molten salt thermal storage system, a mobile "thermal battery", which can: a) store surplus thermal energy, and b) to deliver this thermal energy to customers in need of thermal energy. The result was that the surplus thermal energy directly replaces fossil fuel.

The concept was anticipated to be demonstrated by using surplus thermal energy from waste burning for thermal soil decontamination. The project represents an important contribution to the green transition as this thermal battery activates and monetizes surplus thermal energy which would otherwise be wasted. The project significantly strengthens Danish Green Tech solutions by both providing a novel storage solution (commercialized by Copenhagen Atomics), reducing the waste of surplus thermal energy by converting it into a new revenue stream (Norfors) and enabling a green transition for soil decontamination (Arkil). To put the project in perspective - the annual amount of wasted thermal energy in Denmark, corresponds to 560,000 ton CO2.

The project includes both a technical and economical assessment of the thermal battery, the thermal supply side and the end-user scenario.

Results, conclusions and perspective

A surprisingly simple concept for the mobile thermal battery based on molten salt has been developed and designed. This means that a very cost-effective solution can be manufactured, and that the solution is significantly more robust and easier to handle during charging and discharging. This is especially important in the use situation where specially trained personnel are not required.

The developed concept is also very applicable to large stationary solutions for storing thermal energy, where the concept has several unique advantages compared to existing solutions based on molten salt:

- Increased safety as only a smaller part of the salt is circulated, i.e. waste in connection with leakage is significantly less
- No (or significantly reduced) need for heat tracing so that salt does not solidify in connection with cooling
- 25-50% reduction in component costs and higher uptime (>99% versus ~90%)

Discussions are ongoing with Vestforbrændingen regarding the implementation of a 2000 m3 molten salt storage based on the developed concept. There are also negotiations with Aalborg CSP regarding commercialization of the concept.

Unfortunately, changed circumstances at Norfors have made a meaningful demonstration of the mobile thermal battery impossible, and it has been agreed with EUDP that the project will therefore be terminated. This also means that only approx. 15% of the budget has been used.

Projektresumé:

Målet med dette projekt er at demonstrere et nyt mobilt smeltet salt termisk lagringssystem, et mobilt "termisk batteri", som er i stand til at: a) lagre overskydende termisk energi og b) levere denne termiske energi til kunder med behov for termisk energi. Resultatet er, at den overskydende termiske energi direkte erstatter fossilt brændsel. Konceptet demonstreres ved hjælp af overskydende termisk energi fra affaldsforbrænding til termisk jordrensning.
Projektet repræsenterer et vigtigt bidrag til den grønne omstilling, da dette termiske batteri aktiverer og kapitalisere overskydende termisk energi, som ellers ville være spildt. Projektet styrker danske Green Tech-løsninger markant ved både at levere en ny lagerløsning (kommercialiseret af Copenhagen Atomics), reducere spildet af overskydende termisk energi ved at konvertere det til en ny indtægtsstrøm (Norfors) og muliggøre en grøn omstilling af jordrensnings teknologi (Arkil).
For at sætte projektet i perspektiv - den årlige mængde spildt termisk energi i Danmark svarer til 560.000 ton CO2. Projektet inkluderer både en teknisk og økonomisk vurdering af det termiske batteri, den termiske forsyningsside og slutbruger-scenariet.

Resultater, konklusioner og perspektiv

Der er blevet udviklet og designet et overraskende simpelt koncept til det mobile termiske batteri baseret på smeltet salt. Dette betyder dels at der kan fremstillet en meget kost-effektiv løsning, og dels at løsningen er betydelig mere robust og enklere at håndterer under op- og afladning. Dette er specielt vigtigt i en brugssituation hvor der således ikke kræves specialuddannet personale.

Det udviklede koncept er ydermere meget anvendeligt til store stationære løsninger til lagring af termisk energi, hvor konceptet har en række unikke fordele sammenlignet med eksisterende løsninger baseret på smeltet salt:

- Øget sikkerhed idet kun en mindre del af saltet cirkuleres, dvs. spild ifm. lækage er signifikant mindre
- Intet (eller signifikant reduceret) behov for heat tracing så salt ikke størkner ifm. nedkøling
- 25-50% reduktion i komponentomkostninger og højere oppetid (>99% mod ~90%)

Der pågår diskussion med Vestforbrændingen omkring implementering af et 2000 m3 smeltet saltlager baseret på det udviklede koncept. Der er også forhandling med Aalborg CSP omkring kommercialisering af konceptet.

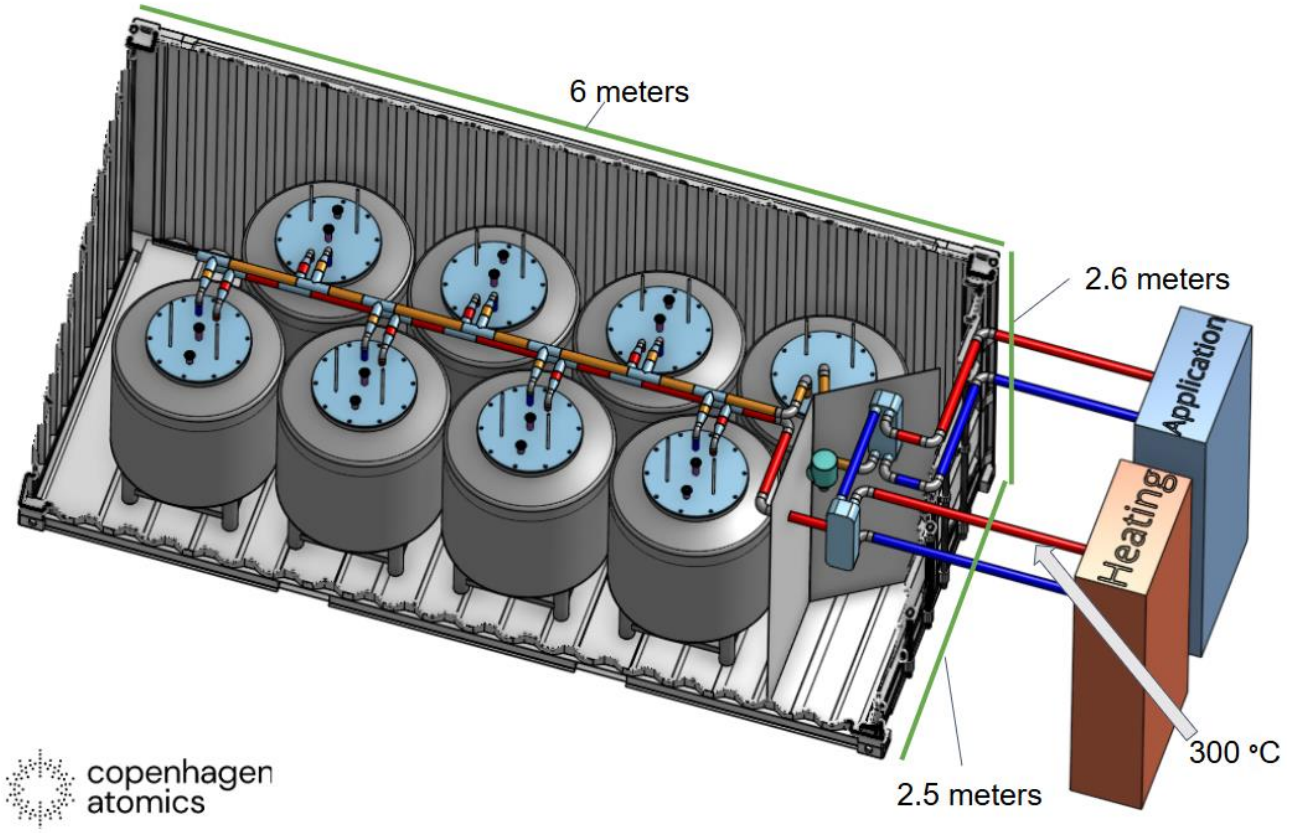
Desværre har ændrede forhold hos Norfors umuliggjort en meningsfuld demonstration af det mobile termiske batteri, og det er aftalt med EUDP at projektet derfor afsluttes. Det betyder også at der kun er brugt ca. 15% af budgettet.

3. Project objectives

The basic idea of this project is to activate and monetize surplus thermal energy by transporting it cost effectively to an application where it replaces fossil fuels. The surplus thermal energy is thus converted from waste to CO2 free energy with a value comparable to oil and gas.

The goal was to demonstrate a mobile molten salt thermal storage system, a mobile “thermal battery”, which is able to: a) store surplus thermal energy (charging), and b) to deliver this thermal energy to “disconnected sites” in need of thermal energy (discharging). The result is that the surplus thermal energy directly replaces fossil fuel.

The concept for the mobile thermal battery was developed, and was anticipated to be build as a containerized solution:



Heat coils and four tanks were purchased before the project was terminated due to change of plans at Norfors. Thus, the concept was never demonstrated in practice.

4. Project implementation

The project evolved as planned (even if a little delayed initially), and calculations related to both storage capacity and cost looked highly promising. Furthermore, the developed solution was quite a bit simpler to operate and interface with both charging and discharging. Thus, the key anticipated technology risks was successfully addressed.

The change of plans at Norfors resulted in a termination of the project before the actual demonstration could be completed.

5. Project results

The overall objective was to develop a novel solution for thermal energy storage in molten salt. This part was completed, and the developed solution has potential both for mobile and stationary thermal energy storage. The flexibility of the solution means that both capacity and charge/discharge rate can be easily tailored to different requirements without altering the basic concept.

The mobile solution was abandoned due to the changes at Norfors. However, in the project results is sought commercialised together with Aalborg CSP. The project result and concept has been pitched at Vestforbrændingen, who have shown serious interest in a 2000 m3 storage solution.

6. Utilisation of project results

CA will continue to seek commercialisation together with Aalborg CSP. However, at a lover activity level until a potential project with Vestforbrændingen have been clarified.

7. Project conclusion and perspective

The project outcome is a highly interesting solution for low-cost thermal energy storage. The lack of demonstration will delay the commercialisation. However, there is an increased interest for such solutions as it can assist in e.g. PtX for thermal processes and district heating (i.e. simply use low cost electricity at night to charge the storage, thus enabling supply for peak demand).

8. Appendices

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