HEAT STORAGE

MNEXT MATERIALS & ENERGY X TRANSITION

Energy transition & Heat storage

The challenge

The peak loads of the sun and wind are not at the same time of the peak loads of humans. The extra energy supplied by the solar panels and wind turbines is delivered back to the grid.

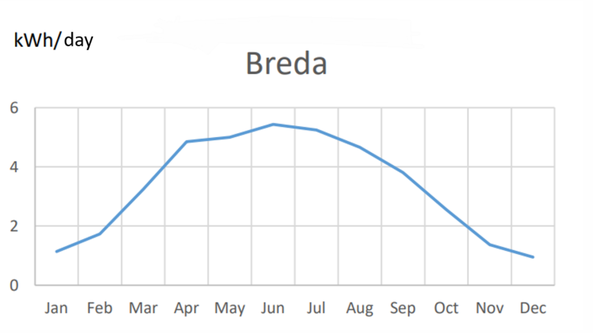

Figure 1: Daily production per year in kWh per day. Source: (de Moor, 2023)

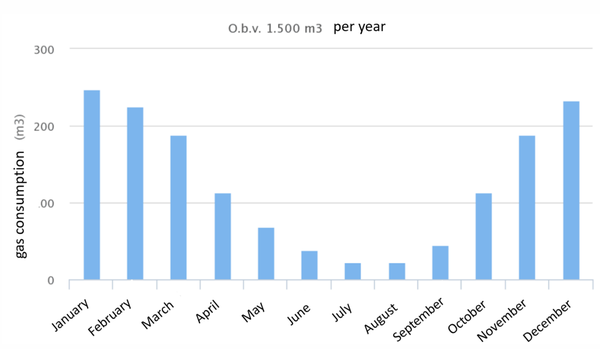

Figure 2: Gas consumption in m^3 based on 1500 m^3 per year. Source: (de Moor, 2023)

The extreme increase of demanded power capacity creates blockages on the power grid. This is also known as **grid congestion**.

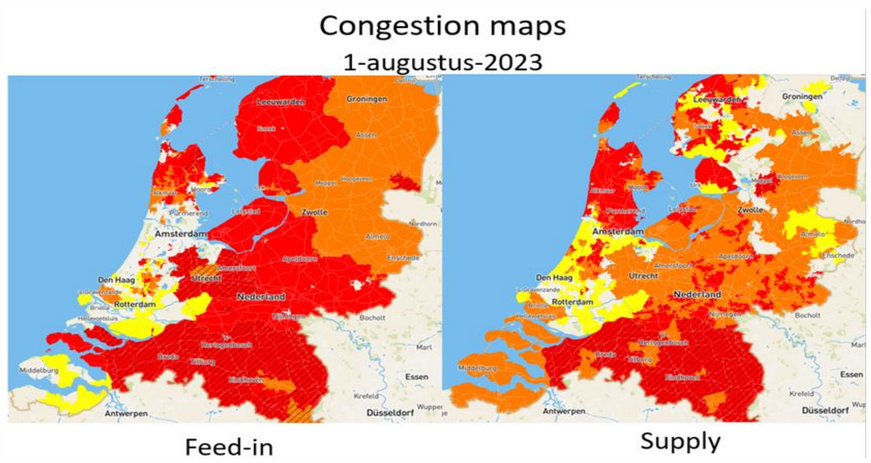

Figure 3: Power offtake is mapped by companies on Aug. 1, 2023. The map clearly shows that many parts of the Netherlands the power grid is overloaded. Feed-in means the power delivered back to the grid from solar panels, wind turbines, water plants or coal-fired power plants. Supply means the power demanded from consumers. Source: (Nederland, 2023)

So the energy overflow must be stored. Energy can be stored in the form of heat.

The goal

The goal of the project is to analyze the pros and cons and calculate how much heat can be stored per cubic meter and per kilogram of different heat storage options.

MNEXT wants to find a solution to allow new and existing neighborhoods to grow sustainably without further burdening the power grid.

Method

1. Different ways of storing heat researched and explained.
2. Find pros and cons of different ways to store heat.
3. Visited and interviewed companies that make heat storage.
4. Calculate how much heat per m^3, per kg and per 1000 m^3 can be stored in a specific heat storage.
5. Write a conclusion about the different heat storage possibilities.

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Results

Table 1: Table 1 shows the amount of kJ and kWh that can be stored per 1000 m^3. It also shows how many houses can be supplied with heat for six months.

Heat storage in:	How many kWh can be stored per m^3?	How many houses can be heated with 1000 m^3 for six months?
Storing hydrogen in: Iron powder	720	1474
Storing hydrogen in: Formic Acid	180	364
Gravel sand of 1200°C	420	86
Hydrogen (700 bar)	385	79
Steel slag 450°C	260	53
Salt storage (potassium carbonate)	230	47
Gravel sand of 600°C	210	43
Phase Change Material Glauber salt decahydrate	110	23
Water 90°C	83	18
Heat cold storage system 15°C	8	2
Hydrogen (1 bar)	3	0,6

Table 1 shows that 1000 m^3 of hydrogen at 700 bar, 1000 m^3 of silica sand at 1200 °C, storing hydrogen in 1000 m^3 iron powder and storing hydrogen in 1000 m^3 formic acid can heat most houses for half a year.

Conclusion

The best storage depends on the environment or location, the amount of heat to be used or stored and the amount of space available.

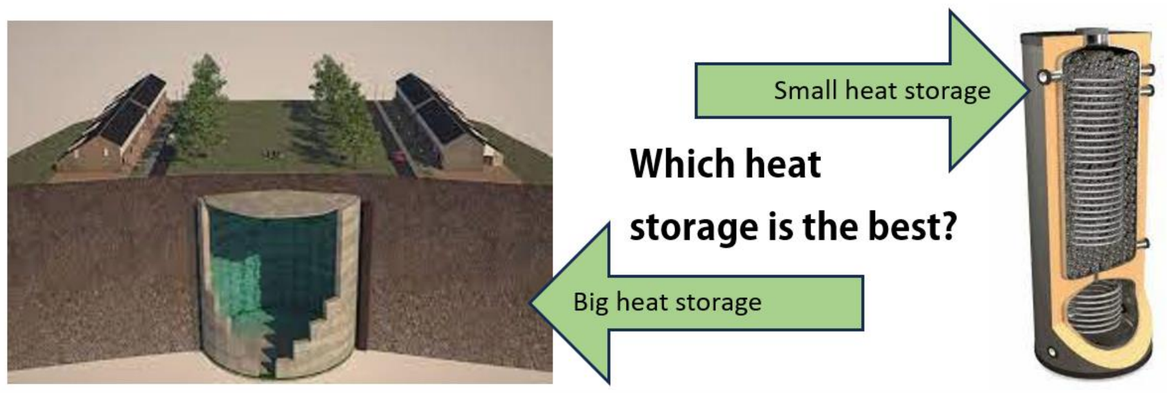

Figure 4: Which heat storage is the best? Big heat storage of small heat storage? Big heat storage is most economical, but it is not always possible te place a big heat storage. Source: (Renova,2022) (Ecovat, 2022)

It can be concluded that storing heat in large volumes is most economical. Unfortunately, it is not always possible to place a large heat storage.

References

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