

#	Vraag/Question	Antwoord/Answer
1	How have the constants/scaling factors for the various options in the economic model been determined on slide 8?	The KPIs have been worked out in a spreadsheet, including assumptions and the calculation methods. We will publish the spreadsheet in the coming weeks.
2	Wat is de reden dat Pit thermal energy storage is minder toegepast en ATES juist heel veel in NL?	Nederland heeft veelal een hoge grondwaterstand, wat ongunstig is voor PTES. Daarnaast is de grondprijs in Nederland hoog, waardoor de kosten voor PTES hoger zijn. Daartegenover zijn er veel gebieden in Nederland waar de ondergrond goed geschikt is voor ATES.
2	What is the reason that Pit Thermal Energy Storage (PTES) is less commonly applied, while Aquifer Thermal Energy Storage (ATES) is widely used in the Netherlands?	In the Netherlands, there is often a high groundwater level, which is unfavorable for Pit Thermal Energy Storage (PTES). Additionally, the land prices in the Netherlands are high, making the costs for PTES higher. On the other hand, there are many areas in the Netherlands where the subsurface is well-suited for Aquifer Thermal Energy Storage (ATES).
3	What are the insights so far regarding optimal choices for TES in the Netherlands and why?	Hi Aly, for more information see this website (in Dutch) https://www.warmingup.info/thema/5/ondergrondse-warmteopslag and this report (also in Dutch) https://ce.nl/publicaties/potential-for-power-to-heat-in-the-netherlands/
4	kunnen de links hier gemeld worden om te kopiëren en nader te bestuderen?	Here are the links: Leaflets, KPI List, LTES systems overview, further documentation on Task 39 website (https://iea-es.org/task-39/), Giga_TES final report (https://gigates.at/index.php/en/publications/reports), Policy Workshop 5 December 2023 (https://lnkd.in/dwRMn3ZB)
4	Can the links be reported here for copying and further study?	Here are the links: Leaflets, KPI List, LTES systems overview, further documentation on Task 39 website (https://iea-es.org/task-39/), Giga_TES final report (https://gigates.at/index.php/en/publications/reports), Policy Workshop 5 December 2023 (https://lnkd.in/dwRMn3ZB)
5	Can you say something on % energie loss for each of the different long term thermal storage options	live beantwoord
6	wat zijn globaal de kosten per huishouden?	Dat is moeilijk in het algemeen te zeggen. De HT-ATES is nu voor glastuinbouw toegepast, en nieuwe ontwerpen zijn gericht op buffering warmte in een district heatig systeem. HT-ATES heeft ook niet de focus om als directe bron te fungeren, maar als een buffer tussen warmte bron en afnemer.
6	What are the approximate costs per household?	It is difficult to provide a general answer to that. HT-ATES is currently applied for greenhouse horticulture, and new designs are aimed at buffering heat in a district heating system. HT-ATES does not focus on serving as a direct source but rather as a buffer complementary to the heat source.

7	tot welke afstand rondom de opslag zijn de verliezen laag?	Dit is erg afhankelijk van het type opslag en de manier waarop het is gerealiseerd. Voor HT-ATES (HTO) wordt er vooraf berekend wat het opslagrendement is, omdat het ook belangrijk is voor de business case.
7	Within what distance around the storage are the losses low?	This greatly depends on the type of storage and how it is implemented. For HT-ATES, the storage efficiency is calculated in advance because it is crucial for the business case.
8	The PTES of Dronninglund as a seasonal storage has a heat loss rate of only 7%. Depend on the system and how it is operating.	Thanks for the information Thomas!
9	Is it possible to send an idee to the "teachers" of a Ptes system which might be very cheap and uses the high ground water levels. I would like to have their thought about it.	Sure! I believe the email address of Wim has been shared. If not, you can send us an e-mail. Also know that there will be a webinar on PTES on 7 december (so in two weeks).
10	In addition to above 7% on seasonal storage. The Dronninglund has ~2,5 cycles per year. End even has a positive >100% efficiency on the P2H source due feeding cool water at the bottom gaining heat from the ground.	Thanks for the addition Toine!
11	Is de onderbouwing beschikbaar waarom opslag warmte goedkoper is dan opslag energie en beter voor het milieu?	Deze onderbouwing is online wel te vinden. Lagere kosten en milieuprestaties zitten hem o.a. in materiaalgebruik
11	Is the justification available for why heat storage is cheaper than electricity storage and better for the environment?	This justification can be found online. Lower costs and environmental performance are attributed, among other factors, to material use.
12	ATES: can you share something about the typical cause of failures for ATES, and what the typical range of lifetime is?	Traditional ATES is designed to run for over 30 years and in the Netherlands, there are systems which reached this life time. Risks are clogging, which can be prevented by good design, good drilling, proper well development and regular maintenance.
13	Dear Herman Sytema, yes please send me your idee. In our R&D project Efficient Pit we are developing the next generation of the PTES. My mail adress is tlabda@solmax.com	Thanks for making the connections Thomas!
14	In the Dutch situation, is there a ceiling temperature for HT storage.	Interesting question. The actual system is design for 90-95°C. However, we are looking into the possibilities for making new systems up to 120°C.
15	Why is aquathermia not being mentioned as a heat source?	IF Technology definitely has experience with this. 'Aquathermie' is not actually a term often used outside of the Netherlands. Thermal energy from water is a term that is used outside the NL, but its popularity is nowhere as high as in the NL :)

16	What's the current situation regarding regulations wrt HT ATES?	There is a provisional assessment framework for HT-ATES ("Voorlopig afwegingskader voor HTO"), which is used by a couple of provinces as guideline for when to provide permits. This will be evaluated based on monitoring results of the HT-ATES in Middenmeer and other research programs.
17	Is HT-ATES completely safe to use for microbial underground life, or are there some dangers?	We are monitoring the microbiology at the HT-ATES in Middenmeer. We look at the type and amount of various species. However, it is not expected that there will be risks. Also good to know that the abstracted water, wil be injected and there is no contact with the environment at surface level. Additional answer: This report from KWR gives some insights: http://api.kwrwater.nl/uploads/2020/05/KWR-2019.117-Prestaties-en-effecten-van-ondergrondse-warmteopslag.-Een-verkenning-voor-het-P2X-project.pdf Above 60 degrees there are certainly some effects
18	Heel NL geschikt voor HT-ATES, of vooral de randstad?	Het is belangrijk dat de opslag tussen twee goede kleilagen in zit, omdat daarmee de warmte goed op zijn plaats wordt gehouden. Liefst zien we ook een aquifer wat wat minder doorlatend is. HT-ATES is vanuit technisch oogpunt dus zeker niet overal in Nederland toe te passen. De huidige HT-ATES is in Middenmeer, dus buiten de randstad. Groningen heeft sinds kort ook een MT-ATES. De lagere MT-ATES temperaturen zijn op meer plekken toe te passen dan HT-ATES.
18	Is all of the Netherlands suitable for HT-ATES, or mainly the Randstad (large metropolitan area)	It is important that the storage is situated between two good clay layers, as this effectively contains the heat. Ideally, we also prefer an aquifer that is less permeable. From a technical perspective, HT-ATES is certainly not applicable everywhere in the Netherlands. The current HT-ATES is in Middenmeer, outside the Randstad. Groningen recently introduced an MT-ATES. The lower temperatures of MT-ATES can be applied in more locations than HT-ATES.
19	Is er bijvoorbeeld een kaartje met groffe inschatting beschikbaar?	Wordt hiermee een kaartje bedoeld met locaties waarop HT-ATES potentie heeft? Van de potentie van WKO (ATES) zijn er wel kaarten, maar omdat hogere temperaturen andere eisen hebben, hoeft het niet te betekenen dat wat voor WKO ongeschikt is ook per se voor HTO ook ongeschikt zou zijn en andersom.
19	Is there, for example, a map with a rough estimate available?	Does this refer to a map with locations where HT-ATES has potential? There are maps for the potential of ATES, but because higher temperatures have different requirements, soils that may be unsuitable for ATES might be suitable for HT-ATES, and vice versa.

20	Do we know the effect on nature when heating underground? For instance on our water supply.	There is experience with some systems in the past and there has been done a lot of research to the effects. At Middenmeer, TKI is supporting a large scale 3 years monitoring program to measure various effects. Together with the existing info and the info from other research programs, we can make a good estimation and learn how safe it is.
21	The costs of 2,5 - 4 M EUR per project is about 5-10x the price of a regular ATES project. What causes this increase in costs?	It is a bigger system, but mainly you have to chose other, more expensive materials, higher drilling costs, and it is the first of its kind, so high design costs.
22	what are the insights sofar in the High temperature ATES cases regarding: reservoir impairment, facilities scaling, sand production and its impact on maintenance needs?	Water treatment in the form of added acidity is necessary to prevent limescale. Other minerals haven't been in amounts that might make them problematic for temperatures up to 90°C. Sand production has been negligible. The filters are changed every season for analysis, but the pressure drop over the filters remains unchanged, as there is very little sand.
23	Wat gebeurt er na die 30 jaar wanneer het WKO-systeem is versleten? wordt er weer een nieuw gat in de grond gemaakt? the same reservoir would be feasible to use still?	As mentioned during the presentation, if the ATES system is well designed, well used and well monitored, there is no reason it couldn't keep working after 30 years. If for some reason the well cannot continue functioning, a second drilling nearby can be made and the reservoir would still be usable.
24	What if the big tank starts leaking into the natural habitat around the tank?	The pit is filled with water, with additives that give it a relatively high pH (9,8). Thus, leakage would lead to a slight pollution of the ground. In order to prevent leakage, the volume is constantly monitored, and new systems for leak detection are being developed and tested.
25	Welke diepte is gangbaar voor HT ATES?	In Nederland worden hiervoor veelal diepere lagen gekozen dan voor WKO. Dit verschilt per gebied, maar zal variëren tussen 200 m en 500 m diepte.
25	What depth is common for HT ATES?	In the Netherlands, deeper layers are often chosen for HT-ATES than for LT-ATES. This varies per region but it is usually between 200 meters and 500 meters deep. Other countries may be different.
26	What's the impact of dissolved minerals in the groundwater as used in HT-ATES? Could those harm the heat exchangers, as they crystallize upon extracting the heat from the HT-ATES?	This report can also be useful here I guess, although it is not specifically about heat exchangers: https://library.wur.nl/WebQuery/hydrotheek/2291271
27	Maximale retourtemperatuur is volgens mij 30 graden. Hoe zit dit met high temperature storage?	Ik vermoed dat dit betrekking heeft op de retourtemperatuur voor geothermie. Voor HT-ATES (of HT-OBES in NL) is er geen harde grens. Het is een afweging van wat het systeem erachter nodig heeft en wat de effecten zijn voor de omgeving. Hoe hoger de temperatuur van de 'lauwe bron', des te groter de mogelijke negatieve effecten zullen zijn.

27	The maximum return temperature is, I believe, 30 degrees. How does this apply to high-temperature storage?	I suspect this pertains to the return temperature for geothermal wells. For HT-ATES, there is no strict limit. It is a consideration of what the system behind it requires and what the effects on the environment are. The higher the temperature of the 'lukewarm' well, the greater the potential negative effects will be.
28	mag je wel hoge temperatuur opslaan in een aquifer? volgens mij is dat wettelijk beperkt tot 25 graden?!	Dat is niet wettelijk beperkt. Dat is wel de temperatuur die de meeste omgevingsdiensten standaard in een vergunning hanteren. Dit is echter geen absolute grens.
28	Are you allowed to store high temperatures in an aquifer? I believe there is a legal limit of 25 degrees Celsius, isn't there?	It is not legally restricted. However, 25 degrees Celsius is the temperature that most environmental agencies typically use as a standard in a permit. Nevertheless, this is not an absolute limit.
29	Is er geen wettelijke beperking t.a.v. hoogte temp.	Nee, die is er niet. De omgevingsdienst kan wel weigeren om een vergunning te verlenen als er geen goede onderbouwing is voor de effecten van het opslaan van de hoge temperaturen. Wij houden daarom altijd goed contact met de omgevingsdienst.
29	Is there no legal limitation regarding the temperature level?	No, there isn't one. The environmental agency in the Netherlands can refuse to grant a permit if there is no proper justification for the effects of storing high temperatures. Therefore, we always maintain good communication with the environmental agency.
30	Who is the owner of the storage in Middenmeer?	The owner is Ennatuurlijk Aardwarmte, which during the design and production was a separate company called ECW.
31	Thank you for very interesting presentation. Why does ATES is not more used in Germany, France, Spain etc.	It is mainly because the technology is not well known outside of the Netherlands. Besides the state of the art HT-ATES, the already mature technology of low temperature ATES could be rolled out on larger scale in Europe relatively easy. We also have contributed to ATES systems in many other countries, like the USA, Canada, Japan, South Korea, Germany, China, and more. However, until recently scaling up hadn't been the intention of the parties involved. That seems to be gradually changing.

32	this is a complex and expensive installation, why not use low tech solutions like the CESAR heat storage in ecodorp Boekel?	<p>The CESAR heat storage certainly has some advantages: Very high temperature, simple in design, (claimed) easy maintenance, applicable wherever there is enough available surface area.</p> <p>The main advantages for ATES, when compared to CESAR are: Small physical footprint, less material use, lower investment costs, easier to apply in existing heating networks, more variety in charging options (not just power to heat), 3 to 6 times larger yields for power to heat (using heat pumps), suitable for (much) larger scale storage, LT-ATES and MT-ATES also suited for efficient direct cooling.</p> <p>Every type of storage has its own niche. The upcoming 3 presentations also have their USPs, so it might be interesting for you to see those as well.</p>
33	can you share the link to sign up for the extra session on the 14th?	https://iea-es.org/events/
34	Is het mogelijk om de presentaties in het Nederlands te krijgen? Technisch Engels is vaak wat lastig te volgen.	<p>Goed nieuws: op do 28 maart 2024 organiseren we een dag of dagdeel om het thema MTO&HTO en wat je daarmee kan in de Nederlandse warmtetransitie verder uit te leggen en inzichtelijk te maken. Deze is in het Nederlands.</p>