

20,000 ATES SYSTEMS IN THE NETHERLANDS IN 2020 - MAJOR STEP TOWARDS A SUSTAINABLE ENERGY SUPPLY

M.S. Godschalk, G. Bakema

IF Technology
Velperweg 37
6824 EA Arnhem, the Netherlands
Tel: +31 26 35 35 555
b.godschalk@iftechnology.nl

ABSTRACT

Aquifer thermal energy storage can significantly contribute to the European Union ambitious triple energy target for 2020. Already 1,000 systems are running in the Netherlands, but to archive 2 % energy savings of the total energy consumption, the amount of systems should increase to 20,000 in 2020.

Stimulating an increase in growth, supply and demand of energy will have to be geared to each other through scaling up. Clever combinations with other durable technologies will have to develop. Legislation on the utilisation of the subsurface and groundwater will have to provide an adequate framework for energy storage. And last but not least, it will require the creation of a favourable investment climate.

All measures will help the Dutch, but can also stimulate the use of ATES in other European countries to make a major step forward on the road towards the triple energy target for 2020.

1. THE 2020 DREAM

Energy supply in the Netherlands will be green and sustainable by 2020. Gas will be finished. Sustainable energy sources, such as residual heat, heat pumps, energy storage, solar energy and ambient heat, can be used in the built-up environment, non-residential buildings and the industry. Use of the subsurface as an energy source and storage medium has now been defined in the overall policy with the purpose of guaranteeing total energy savings in the Netherlands. The use of sustainable energy is not just an option, it is common practice. Most Dutch cities comply with the European CO₂ objectives. Heat pumps and borehole heat exchangers have become generally accepted in homes. Agriculture also widely uses sustainable sources for producing foodstuffs. That includes closed greenhouses, deep geothermal energy and residual heat distribution. All these efforts have improved the climate environment in the Dutch cities. Concrete and asphalt structures have been converted into ecological structures of green areas and water, where people spend their leisure time outdoors and enjoy the extra coolness in the hot summer (Bakema et al. 2007).

2. THE REALITY ON SUSTAINABILITY IN 2009

Reality is still a far cry from the above ideal image, though the first outlines have been drafted. In its policy programme “*Schoon en Zuinig*” (clean and economical) the Dutch government have plotted a course towards increasing the sustainability of our energy consumption. They focus on CO₂ emissions. A 30-% reduction of CO₂ emissions by 2020 compared to 1990 is the target. The following measures have been proposed to achieve that.

First of all, annual energy savings of 2 % are required. In addition, the share of sustainable energy should be increased to 20 % by 2020 and, finally, various additional measures must be taken to reduce the CO₂ emissions. In 2006 only 2.8 % of the energy consumption will be sustainable (CBS, 2007). The question crops up how the government will be able to realise this target and what obstacles will have to be removed? How can the government implement their ambitions? And if energy storage is an option, what will be required to promote this type of sustainable energy supply?

In order to realise this ambitious target, the Dutch government has indicated that they want to aim at cost-effective technologies that are easy to implement. Proven technologies are preferred, because these promote acceptance and implementation. Energy storage is considered a major option and has been highly successful in the Netherlands. While there were still only some 400 projects in 2005 (Snijders, 2005), today already more than 1000 systems are operational and these are joined by 200 new ones every year.

3. THE SUCCESS OF ENERGY STORAGE

The considerable success of energy storage in the Netherlands can first of all be ascribed to the fact that most of the subsurface is highly suitable for energy storage, also on a large scale. Usable aquifers can be found almost everywhere in the Netherlands. In the Amsterdam region it is even possible to extract and infiltrate over 250 m³/h (2000 kW) with only one well. In the densely urbanised Netherlands it is almost impossible to realise sustainable options such as wind energy and biomass. Energy storage on the other hand, is invisible, noiseless and odourless.

Energy storage in the Netherlands is a proven technology with a high growth potential; this has resulted in a highly competitive supply market. Consequently, out of all types of sustainable energy, the energy storage technology has the most favourable economic characteristics. Its payback time is only a few years compared to conventional fuels. Sustainable energy storage is the system of choice in the Netherlands for government buildings and for public buildings, including schools, because here too the government's aim is to set an example for society and to create a green and sustainable image towards the citizens.

4. GROWTH

The present 12-% growth of the number of energy storage systems will be easy to maintain over the years to come. That would mean that the number of systems will have grown to about 3000 in 2020 (see figure 1). However, the potential is many times higher. If in 2020 a figure of 25 % of the buildings (some 7 million households and 350,000 non-residential buildings) in other words 1.8 million buildings will be equipped with energy storage, this will cause a drop in energy consumption in the Netherlands by 2 %, which means a 5-Mt reduction of CO₂. There are possibilities to increase this percentage for the period after 2020. That way, energy storage makes a more than significant contribution to the national energy savings. The market will have to grow by more than 30 % to achieve this. This is not going to happen overnight; it will require a powerful incentive policy of the government (Bakema et al., 2007).

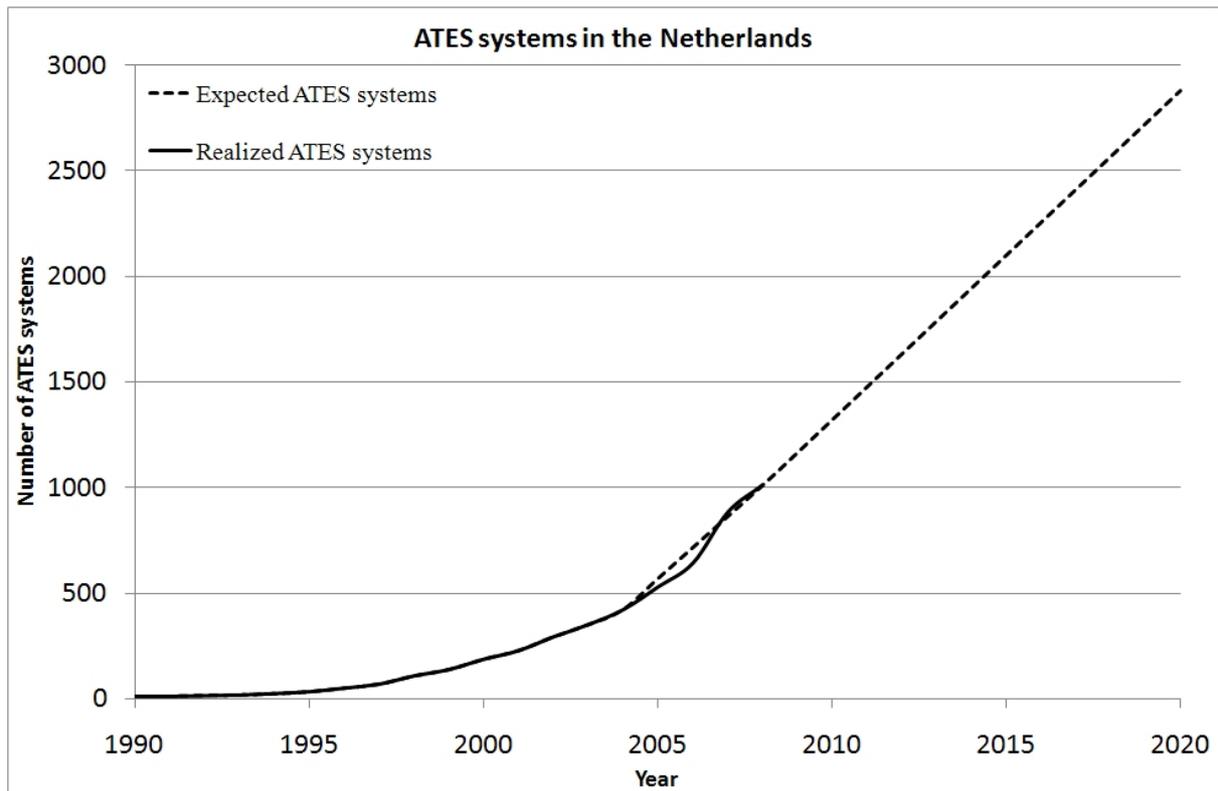


Figure 1. Number of energy storage projects in the Netherlands and prospects until 2020; prognoses based on yearly grow during the last five years

5. INCENTIVES

Energy storage growth will depend on a large number of external factors such as oil and gas prices, economic growth and CO₂ emission trade. Yet the government and the market can take their own measures to promote the technology.

Increase of scale

The government can promote the demand by imposing the use of sustainable energy for a share of the energy consumption in residential and non-residential buildings and greenhouses. In Amsterdam for instance, all new buildings must use sustainable energy if the payback period of the systems is five years or less.

More effective use of the subsurface must be promoted to avoid that every individual is going to build a separate installation which could cause unwanted interactions between systems. That will allow the development of larger, more efficient energy storage systems. Improved tuning between energy supply and demand is another requirement. Major heat producers can supply heat to consumers, and energy storage systems may contribute to balancing demand and supply by storing energy in the underground. Distributed district cooling and heating systems will be required to promote this. Figure 2 shows examples of a loop system connecting users and producers.

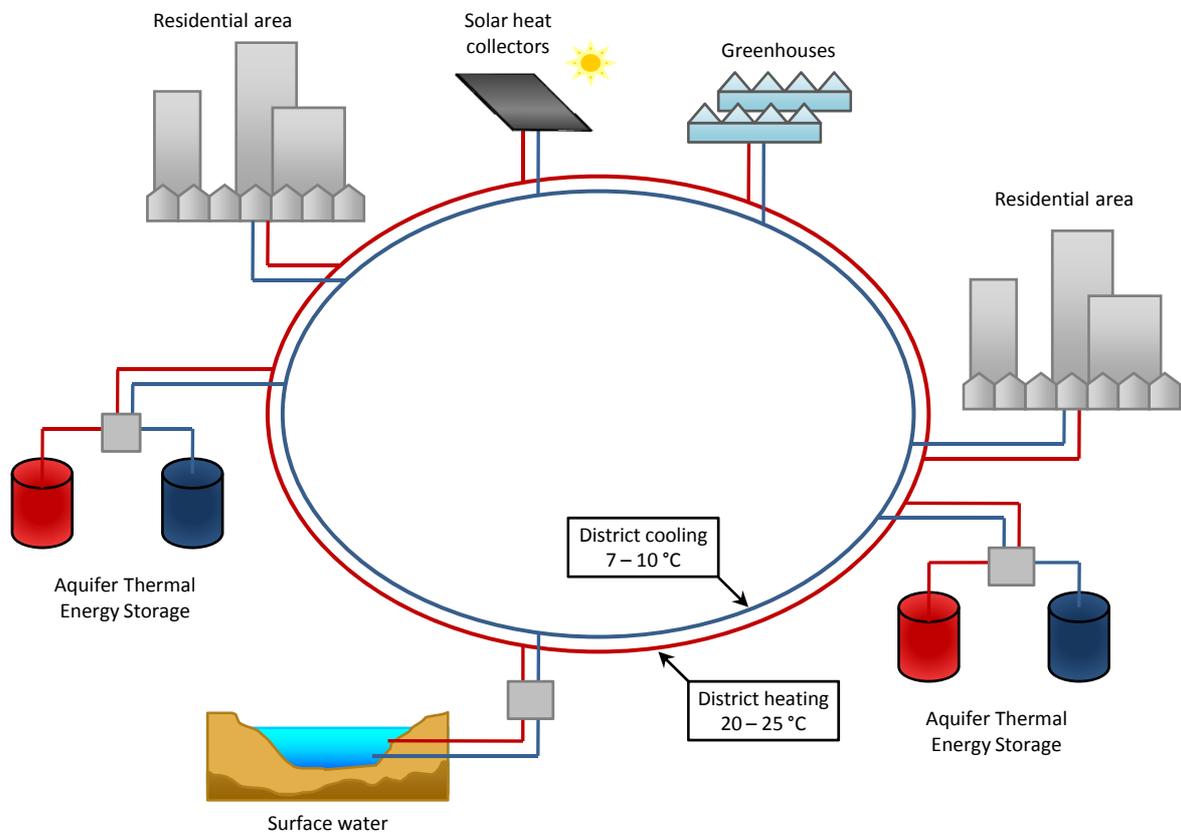


Figure 2. Example of a combination of users and producers of heat and cold

A fine example of such a system can be found in Amsterdam at the Oostelijke Handelskade. In addition to dwellings with a heat demand, a cruise ships terminal and an office tower are included in the total energy concept.



Figure 3. Oostelijke Handelskade - terminal and offices

Combination of solutions

Another encouragement comes from promoting the cooperation between public and private parties, creating synergy advantages. An example of this is soil rehabilitation where the extracted water can be used for cooling and heating. This certainly applies to long-term extractions. Currently, the municipality of Apeldoorn is studying the possibilities to combine rehabilitation and energy production. Over the years, extensive areas have been polluted with chlorinated hydrocarbons. The municipality will act as risk-bearing party and energy supply company, facilitating the extraction and infiltration of polluted groundwater. To finance this, they want the parties currently responsible for polluted areas to outsource their rehabilitation obligation to the municipality. Then the municipality will become owner of the pollutants, but with some additional technical effort in the groundwater system for energy storage, they can directly stimulate the biological decomposition of pollutants in the groundwater. With this scheme the municipality will supply energy while at the same time providing an integrated approach to complex pollution problems.

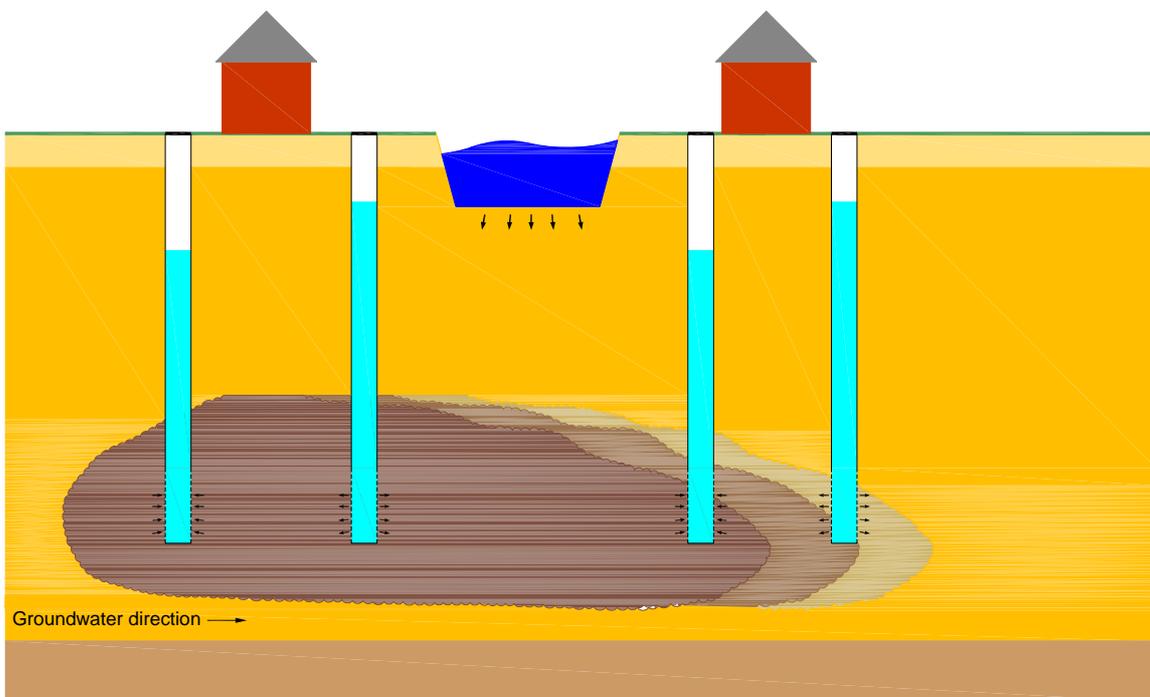


Figure 4: Cross-section of the municipality of Apeldoorn - pollutants flow

Financial basis

In many cases subsidies will be indispensable to stimulate the additional growth. The aim will have to be to make sustainable energy sources more attractive compared to conventional energy production. That will mean an additional incentive for users to opt for sustainability, and it will further reduce the payback period.

The free market system can be promoted by carrying out projects on a larger scale. That will improve the balance between supply and demand of heat as well as cold and provide certainty that both will be purchased. Purchase certainty can also be forced in large projects through contracts, but that should provide a financial advantage for both parties. The government may

make it more attractive to invest in energy storage systems by supplying low-interest loans and providing guarantees. The quality of the systems will also require attention.

Customised legislation and regulations

The ambitious government plans will not have much effect without legislation and regulations. In some cases the many different rules are contradictory and obstructing in particular large-scale projects. For instance in urban areas there is a considerable demand for energy storage systems. However, pollution with organic solvents is widespread in these areas. For that reason the Soil Protection Act prohibits the extraction of groundwater for energy storage. Raising the legislation level will create opportunities to combine rehabilitation and energy supply and to make good use of polluted subsoil.

Clearer regulations for the use of the subsurface are required as well. Currently, the principle applies, first come, first served. Rearrangement and organisation by the government may shift the focus to the public interest. For that reason local authorities will have to take the lead in spatial planning to ensure that the baselines are defined in master plans. Figure 5 shows an example of such organisation.



Figure 5. Organisation of sources at the Science park of Amsterdam

6. LESSONS LEARNED

There are major opportunities for energy storage internationally, as well. For instance, many European cities are situated in deltas with excellently suitable aquifers. Yet, while in the Netherlands large-scale energy storage has passed its infancy, in many other countries energy storage is still considered highly innovative. Practical experience in the Netherlands has shown that increased growth is only possible if the authorities have the courage to impose strict environmental requirements and to create the proper legislative and financial

frameworks. That way, private parties will be prepared to make long-term investments in sustainable technologies.

International cooperation is required to exchange knowledge and experience, to attune legislation, and to create stimulation and education programmes. That will make large-scale development of energy storage a major international issue as well.

7. CONCLUSIONS

The government's aim is to strongly promote the use of sustainable energy in order to realise the ambitious targets for 2020. By 2020 the CO₂ emissions will have to be reduced by 20 %, energy savings of 20 % must have been realised and 20 % of the energy must come from sustainable sources. Energy storage may make a significant contribution, but that will require a 30-% annual growth.

For this purpose the government will have to define new frameworks and to stimulate the demand for sustainable energy by making sustainable use mandatory and through financial incentives and support. Balancing supply and demand is another spearhead. That will also make it possible to design larger and more efficient systems, with various users connected jointly to one energy network. Legislation must be simplified and amended to promote the sustainable use of energy and to make conflicting interests subordinate to the energy targets. With this objective and with the measures package we must be able to realise a major step towards sustainable cooling and heating of buildings, greenhouses and industrial processes by 2020. And not only in the Netherlands. Cooperating intensively and learning from practical experiences on a European level will have a positive influence on the realisation of an ambitious increase of sustainable energy savings throughout Europe and beyond. But above all: we must just do it!

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