
Whitepaper - Energy neutral from home to district



Energy neutrality, from home to district, is already being done

In this white paper several parties are interviewed to show that on many levels, from home, via streets and neighbourhoods to entire districts, major steps are being taken towards energy neutrality, even in the production of energy.

NOM-homes, energy (over) production, buffering and sharing... these are only the first steps and often also feature in pilot projects. All parties are fully aware that if all these steps are properly monitored and shared, the process of energy transition can be sped up.

Although there is still a lot of room for progress and technological innovation in many areas, it will primarily depend on the ambition of federal and local authorities to make the right choices, based on the right vision, in the short and medium term.

The parties speaking in this whitepaper are ready for it.

Ambition

The Netherlands has great energy ambitions. We aim to ensure that everyone can live in an affordable, energy neutral and comfortable home within 20 years. To achieve this, the government, construction sector and housing associations have great ambitions. In broad terms, the 2017 coalition agreement states the following:



- At the end of the government's term, 30,000 to 50,000 existing homes will be independent from the natural gas network.
- In 2050, the entire stock of approximately 7.5 million homes must be sustainable.
- A natural gas network in new residential areas is no longer the standard.

This approach to the energy transition takes place not only at a home level, but also involves changes at the street, neighbourhood and district levels. The following three chapters provide a glimpse into the world of the pioneers that are making the Netherlands energy neutral, from home, street and neighbourhood to district.

1. The energy neutral home

More and more frequently, the government is stimulating initiatives to make homes more sustainable. In recent years, for example, the NOM (null-on-meter) home has become a household name in the Netherlands.

A NOM home generates as much sustainable energy as it consumes. This includes heat and energy consumption of the residents. In the case of (new) construction of a NOM home, the contractor issues an Energy Performance Guarantee (EPG). The tenant pays no energy bill but pays an Energy Performance Fee (EPV) to the corporation.

Jan Willem van de Groep, founder and director of the energy module producer FactoryZero, indicates that there are 5 hassle-free steps towards a NOM home.

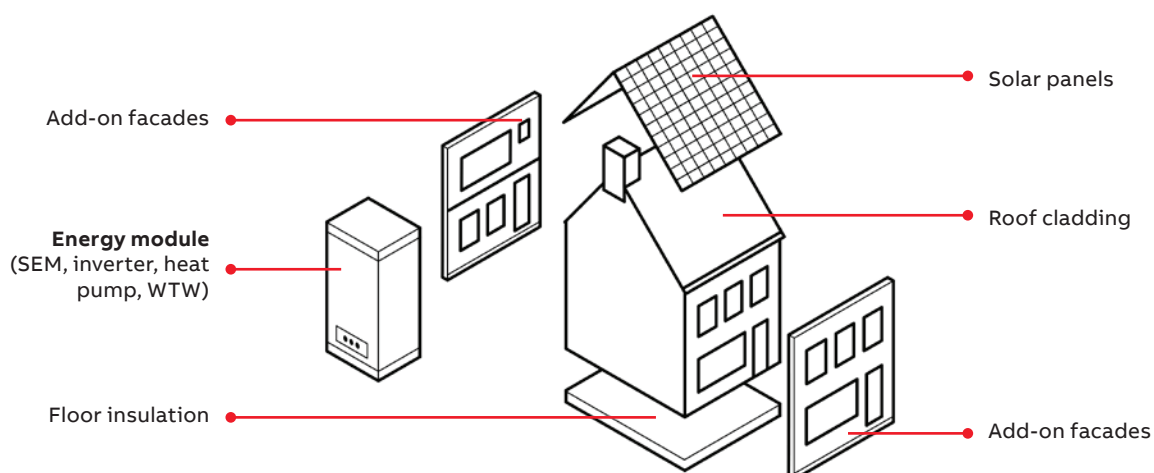


—
NOM house

Step 1: Limit energy demand and determine insulation solutions.

The goal of insulation is to reduce the heat demand of the house by heating less expensively and more sustainably. It is important to see the house as a coherent system, of which insulation and heating installations are a part. Examples of insulation solutions include:

- Cavity wall insulation using wools, such as mineral wool, or by blowing flakes and pearls into the wall
- Durable wool, such as cellulose, made from paper waste
- Hard sheets of polyurethane, PIR or PUR



Step 2: Determine the systems to generate energy.

To generate energy, there are direct/primary systems and indirect/secondary systems.

- Direct systems harvest energy and convert it into electricity. Think of solar panels for electricity, solar thermal energy systems, a sustainable heating network or wind turbines.
- An example of an indirect generating system is a heat pump. This uses electricity to extract heat from the air.



Solar energy



District heating



Wind turbines



Heat pumps

Step 3: Determine the other (smart) systems in the house.

Heat supply systems, such as underfloor heating and radiators, work with a water source. These are so-called water-side systems, which are fed via a water pipe.

- Soil heat pumps provide low temperature heating, hot tap water and passive cooling.
- Air heat pumps supply low temperature heating and generate hot tap water.
- Earth-air heat exchangers (EAHX) are a collective solution for low temperature heating in flats. An additional combination heat pump must be used per house to further upgrade the heat.
- Electric climate systems, such as infrared, are a good option for “all-electric” homes. Infrared costs energy but can be controlled intelligently using motion sensors.

—
NOM homes



Step 4. Who should do what with the EPV?

The builder wants to give a performance guarantee and the resident wants to see this. The corporation wants to demonstrate that the house meets the energy performance criteria, so that it can request an EPV from the tenant. Many parties monitor the energy performance of homes, particularly system suppliers using special monitoring modules. This creates a role shift, in which the builder has fewer responsibilities and housing providers are responsible for the quality and therefore also the EPV. The suppliers provide a guarantee on their part or module, such as installation, roof, facade or the inner package. Based on this, the builder can give a guarantee to the resident.

Step 5. Communicate with future residents the right way.

We recommend parties to involve the residents in the entire transition (during renovation) or realisation (for new construction) from a central point is a necessity: ask for understanding from the residents in adjusting their behaviour to achieve the objectives.

New construction

In new buildings, the residents get a house with the most modern features, but it is important to explain well how to deal with these - for example, what normal use is and what the optimal climate conditions are. Good information is indispensable for good handling.

Renovation

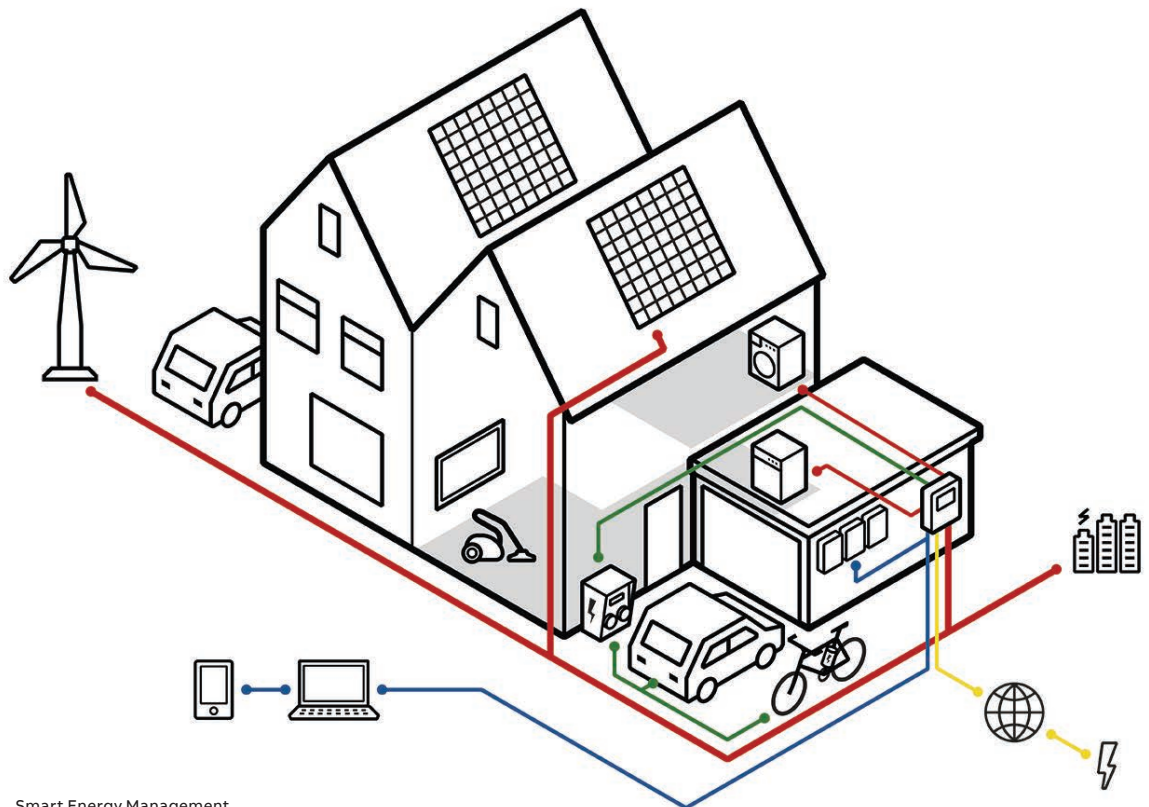
For residents whose home is being renovated, information is even more important. They are making a big change to the house they know and that will take getting used to. This requires good advance guidance for the residents.

Building a NOM home without hassle

Installing and connecting E and W installations in a NOM home is complex and labour-intensive. These installations have already been connected and integrated in an energy module, which provides installation efficiency. Each module is tested before installation so that the technicians are guaranteed to install a working device. The central heating boiler is removed, and a new module is installed within four hours. As a result, the loss of hot water is kept to a minimum and the resident in question suffers as little nuisance as possible. Crucial to this energy module is ABB's Smart Energy Management module (SEM), which monitors, visualises and where possible controls the installations and stores data in the cloud. This means that the house is also ready to take part in the energy market of the future and that the resident can react well, for example, if energy prices are low due to a lot of wind at sea.

Integral Smart Energy Management system

The SEM module monitors energy consumption per house and responds to real-time data, which means that the E and W installations are well coordinated and securely store all information in the cloud. This allows a house to be monitored, giving residents a better insight into their energy consumption. Through this, they can access and see that the promised results are achieved. In this way, the housing corporation and installer can also monitor the housing on expected versus actual consumption and thereby meet the annual Energy Performance Guarantee (EPG).



2. The energy neutral street & neighbourhood

Last summer, Stedin, ABB and Enervalis launched the Hoog Dalem 2.0 pilot, with the aim of trading smart energy locally. As a result, locally generated energy is used locally and a positive contribution is made to the entire energy system. Within the pilot, 16 households can generate and sell energy to local residents. Households trade their energy via block chains in which all transactions are recorded. Enervalis supplies the operating system for the residents, makes the EWF (Energy Web Foundation) block chain link and creates the transactions.

Acquiring experience

With this pilot, the parties respond to the changing needs of customers and market parties and investigate whether such a local market is a suitable alternative to the current netting scheme. At the same time, they gain experience with block chain technology that enables a more efficient exchange of energy between energy consumers and sustainable energy generators. In addition to the sustainability concept, the idea of independence also plays a role: storing the self-generated electricity and exchanging it with the neighbours. Until recently, power only went one way: from the power station to the end user. Now generation and consumption are going both ways. Network operators, market parties and users must communicate with each other and exchange power to distribute and collect energy as efficiently as possible.



Micro grids

In Hoog Dalem, we work with small networks, micro grids inside the house, that are connected to the main grid. Using software, they can support each other. If one household is on holiday, the solar panels work as usual and one of the neighbours can use the generated electricity.



Hoog Dalem 2.0: All-electric and self-sufficient

Kees Jan 't Mannetje is a Business Developer at ABB. Why is ABB participating in the High Dalem 2.0 pilot? What is the role and contribution of ABB? What are the expectations? What are the changes hoped for?

“The Hoog Dalem district may be all-electric, but it is not self-sufficient. Energy consumption from a heat pump is higher than with gas, so it is interesting to generate your own electricity. Placing more solar panels is an option, but that extra generation could be a problem for the Stedin transformer. In addition, unnecessary storage of energy disappears due to ‘storing it yourself’. That’s why Stedin asked us what we can do to keep battery storage flexible and keep the energy in the same street. In Hoog Dalem 2.0, we answered this by allowing the residents to exchange energy and to store it locally.

First local energy market

To this end, ABB installed Smart Energy Management modules (SEM) in 16 homes. In addition, battery packs with a capacity of 12 kW/hour each have been placed at 3 homes. Together, they form a virtual chain in which the residents trade energy with each other. One local resident generates energy so that the other can charge his battery pack. The settlement is done automatically via a platform based on block chain technology. This makes it the first local energy market in the Netherlands. This ensures that residents are more aware and therefore more efficient with their energy consumption. They keep a close eye on their consumption and can deduct their generated energy from the bill.



—
All-electric

Energy stays in the neighbourhood

For ABB and Stedin, it means that we keep the energy in the Hoog Dalem district. In many neighbourhoods, there is a large supply of electricity from solar panels. If that supply becomes too high, the inverters switch off the solar panels and no energy is generated on a sunny day. SEM modules ensure the best possible balance between supply and demand. The solar panels do not have to be switched off and so the return for the residents increases. The district transformer does not have to be increased and the district can become energy neutral.

Not only monitoring, but also controlling

The SEM modules work based on software from Enervalis. This company has a lot of experience in

control and communication devices, such as 1,000 charging stations in The Hague. With the help of the Enervalis software, we are taking a step further than other solutions. For NOM, the monitoring and visualisation of measurement units is necessary to demonstrate the Energy Performance. With SEM, we add the possibilities of 'controlling' and 'intervention'. In view of flexible energy tariffs, you want the home to consume as much as possible during a low energy tariff. Residents who switch from gas to electricity have to get used to the fact that energy is cheaper during the day, and therefore less so at night. Think of the difference between day and night power tariffs. Solar energy should be used during the day. This is still the habit for many people. Hoog Dalem 2.0 should help with this."

Floris van den Herik is a home owner in the Hoog Dalem district. Why does he participate in the High Dalem 2.0 pilot? What drives him to participate? What are his expectations? What are the changes he hopes for?

"After finishing the first project in Hoog Dalem last year, we were asked as residents if we needed a follow-up: I certainly did! I would like to contribute to the energy transition and am also very interested in technology. During the first project, we as residents received a battery package to store the energy from solar panels. Using an app, we could monitor energy generation. The dishwasher and washing machine were given a 'smart start' function, which enabled the devices to be automatically switched on during a peak in solar production if we had prepared them for this. I was enthusiastic about the completed project, so I called on my neighbours to also participate in Hoog Dalem 2.0.



Visualization

**Nice idea**

I think it's a great idea to set up a local energy market. The energy that I have generated but can not use immediately, I make available to my neighbours. If I am not at home during the day, the generated energy from my solar panels is stored in a battery. And if my neighbour is at home, I can deliver my energy directly to him. Basically, it should work without you putting any work into it. For this purpose, ABB's Smart Energy Management module (SEM) has been installed in my meter box, which monitors and adjusts my energy consumption and - using the Internet - communicates with the SEM modules of my neighbours. Because SEM distributes the peaks in generation and use as smartly as possible across 14 households, this ensures the most efficient use of energy. What is more, we do not have to pay taxes: the government does not play a role. The accompanying battery pack was too big for the meter box, but fortunately I still had space in my storage room. Another advantage of the previous and current project is that I got to know my neighbours better.

Success

I hope that Hoog Dalem 2.0 will be a success, that ABB, Stedin and Enervalis will gain learning experience with technology and that we can set up a local market on a small scale. If everything is right, I will not notice anything. The expected benefits of the project still have to be demonstrated in practice, but I am very confident about this. Unfortunately, there are also some hidden costs due to the use of a battery. Normally, my energy meter goes back, because I generate energy with my solar panels (the netting arrangement). Now that I am storing the energy in a battery, I have to deal with switching from alternating to direct current and vice versa several times. Through that, I lose some of the energy, which costs me money. I have no problem with that, because I like to participate in this development. The replacement of the netting arrangement with a return subsidy and the local energy market will hopefully offset this disadvantage. That way I can make some money from it in the near future."

3. The energy neutral neighbourhood

NET REINFORCEMENT IS NOT THE ONLY SOLUTION

Jan Pellis is a strategist at grid operator Stedin and is responsible for the pilot High Dalem 2.0. Grid operators play a central role in the changing energy landscape. How does he think the role of Stedin will change? What are the problems he comes across? What should be done differently?

“As Stedin, we are responsible for gas and electricity grids, down to the meter box. That demands our attention every day, but at the same time we look at the future, the energy transition. Because the Netherlands is going to make a massive switch to all-electric, we must reinforce the current grids. But developments are going so fast that only reinforcing them will not be enough now. We should therefore look for other solutions. For example, leveling off peaks in the grid and not having the demand from the grid occur all at once, but spread it. We must use smart solutions such as storing energy from electric cars and storing energy locally. These elements were part of Hoog Dalem 1.0. (See chapter 2)

Net reinforcement?

We take it one step further in Hoog Dalem 2.0. Residents can share supply and demand of electricity through a local market that runs on block chain technology. As a grid operator, we can use this local market to utilise flexibility in the supply and demand of the users, reducing the burden on the grid. With that, we can postpone reinforcements of the grid. This could, for example, be a good solution for areas that are moving away from natural gas and will use and produce much more electricity as a result of the arrival of heat pumps and solar panels. Maybe not as a definitive solution, but at least until a grid reinforcement has been realised, and this will not be a superfluous luxury given the thousands of neighbourhoods that will become more sustainable in the coming years.

Local energy markets

Hoog Dalem 2.0 is a good example of a sustainable, all-electric neighborhood. The pilot is in line with the increasing trend of local initiatives and energy collectives: the so-called ‘local energy communities’. Our challenge is how we can

facilitate it, coordinate it with each other and keep the energy in the neighbourhood without being disconnected from the net. Because if the wind blows hard on the North Sea, the neighbourhood can provide an extra solution or storage by taking extra electricity. The Hoog Dalem 2.0 pilot offers a locally attractive energy picture and, moreover, the entire system can benefit.

Blueprint

As Stedin, we do this together with partners and without aiming to become the owner of the local market. We want a good system for the future and for other parties to be able to join in. Together, we make a blueprint for the coming years, which we then want to share with the outside world. This also changes our role: we did not do this five years ago. In the past, we were 100% focused on infrastructure, but in this energy transition we have to offer more. Of course, we remain responsible for the quality of the network, but we now also talk with partners and customers about digitisation, the development of platforms, the availability of data and the distribution of supply and demand in the grid.

Fair distribution

Because supply and demand come together, factors such as sociality and ‘honesty’ play an increasing role. In other areas too, the ‘fair distribution’ concept is becoming increasingly apparent. The energy transition is not expensive for those with low incomes. No, it is a fair distribution. The Hoog Dalem 2.0 pilot is a step in towards. Together, we want to use it as well as possible and involve people in our energy systems. People do not want to think about that and don't have to. Intelligence ensures that everything works automatically and comfort is immediately accessible. That encourages residents to participate.

SUSTAINABLE WITH SOCIAL COMPONENTS

Spencer Schools is responsible within the Bo-Ex housing corporation for making thousands of social rental homes energy neutral. How does it intend to do this big job? What are the problems it comes across? What tips does it have for other housing associations that want to follow?

Schools: “Primarily, Bo-Ex is going to help people who have trouble getting a house to get an affordable home. We do this in a sustainable manner and this automatically leads to lower CO2 emissions. This is in line with our creed: good things come to those who make them happen. We use the energy neutral construction of homes to achieve our renewable energy goals. That starts with lowering CO2 emissions.

Energy positivity

For this, Bo-Ex looks stringently at where renewable energy comes from and how we can keep it affordable. This can involve integral insulation and ventilation, in which generation and demand reduction are both important, determining aspects. For the sustainability of energy consumption, local generation is interesting and requires more than just a label B. We look broader and add the concept of energy positivity. In other words, we want to add something positive, a social component, in the form of an energy surplus that we can redistribute. With that, we are taking a giant step.”



Integration of sustainable sources



Charging infrastructure for shared electric cars



Large-scale storage in battery



Inverter per house



Energy-efficient flats

Following a feasibility study, Bo-Ex is currently testing an integral concept in a 10-story block of flats in the Overvecht district of Utrecht with approximately 58 homes. The aim is to reduce the monthly housing costs and to limit the emissions of CO₂. Via a windmill and solar panels, part of an innovative renovation, these flats generate more energy than the residents consume. Schools: “We store the surplus in batteries of electric shared cars using block chain technology. For example, a resident can pay for two hours of car use with his energy surplus. We test the same circular principle with the washing machines in the houses. With the supplied energy, the resident can pay for a wash. Not only are the residents happy with these extra possibilities, it is also interesting for the supplier. They can develop other business cases and business models for their products and services.”

Industrial thinking

Besides block chain technology, industrial thinking is also an important part of this test. Various companies have developed intelligent systems for the most optimal heating, ventilation and insulation. The equipment and electronics have been incorporated in the new facades that are assembled on site. This way, Bo-Ex can renovate a house in one day. Schools: “Through this, we significantly disrupt the traditional building process. As a third step, we want to scale up to the entire flat complex and then go on to the other 5,000 homes of the same type, Interval, in Utrecht. We want to tackle those in the coming years.”

Convincing is difficult

Convincing others of this vision is difficult, but: seeing is believing. Schools: “As soon as possible we want to provide evidence that the residents’ comfort increases and their energy consumption decreases. To the residents, we constantly underline that we want to do it together. That they are in the driver’s seat and are allowed to think along with the architect regarding his designs. We also adopt a new approach internally. It can take some getting used to. That is why we always communicate the content: the ‘why-question’ is pivotal. Everything revolves around affordability and sustainable benefits derived from it. Together, we have agreed that a solution must first work 100%, only then will we go live.”

Corporations

Finally, Schools reports: “We are fortunate that other corporations are joining in. They increasingly recognise that we must work together and value each other. Making the environment more sustainable is not a game of capture the flag. Look at your colleagues and learn from them. We can bundle our questions and jointly purchase from suppliers. We expect that we can quickly take serious steps forward in this area.”



Energy neutral from home to district

It's already being done



Dealing well with energy is becoming increasingly important. And with the right solutions, it's possible too!

With the theme 'Energy neutral from home to district, starting here', ABB shows what is possible. Discover the energy neutral home, which is prepared for the future and meets all the monitoring conditions of NOM and EPV homes. Learn how complete control over energy optimisation and savings is possible in the energy neutral building. See how in the energy neutral street and neighbourhoods, households can generate, store and use energy at favourable times or sell to neighbours and discover how the energy neutral neighbourhood of the future generates collective energy through an energy cooperative. We are happy to share our story!



ABB b.v.

Electrification Products

George Hintzenweg 81, 3068 AX Rotterdam, The Netherlands

P.O. box 301, 3000 AH Rotterdam, The Netherlands

Phone number: +31 (0) 88 26 00 900

E-mail: nl-tech-EP@abb.com

www.abb.nl/lowvoltage

© Copyright 2019 ABB. All Rights Reserved

We reserve the right to make technical changes or change the contents of this document without prior notice.

No part of this publication may be reproduced in any form or means, electronically, mechanically, by photocopying, recording or otherwise, without prior written permission from ABB.