0 ON THE METER

THE DUTCH APPROACH FOR ENERGY EFFICIENT RENOVATIONS

EFL

EFL Topic Group Energy Efficient Housing, April 2016

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EFL ENERGY EFFICIENCY –

NET ZERO RENOVATION

Introduction

Chaired by Henk Visscher (TU Delft), on April 19 2016 the EFL Working Group Energy Efficiency met at the Technical University in Delft. During the event, experts were invited to share their knowledge, experiences and show cases of projects within the field of net zero renovations. Topics included details for the technique, the building process, financial model and experiences and examples.
EFL members contributed with discussing their experiences with energy efficient retrofitting within their local context.
Ron van Erck of 'Energiesprong' presented the concept of the Dutch program for the renovation of social and private houses to net zero dwellings ("0-on-the-meter"). Some of these projects have already been realised, and many others are being developed. The concept consists of innovative techniques for insolation, efficient heating and renewable energy generation, the use of prefabricated elements, short renovation processes, integrated building processes, new financial models and energy use performance guarantees.
EFL member Van der Leij Construction contributed to the discussion by presenting their practical experiences.
As a construction company they are involved in the development and transformation of buildings with the ambition of zero on the meter projects. The refurbishment of their product "at home a new house" can be finished within 10 days.
Together with the construction concept Climate Construction, they developed their product for sustainability. The process consists of improving the facade of the house with installation, and applying renewable energy. Engineer Marco Ghirardello of Solar Techno, provider of PV systems, updated the attendees on the latest developments of innovative solar panels and innovations in the storage of electricity in the PV panels.
This interesting day ended with a field visit to a Growing Green project in Delft. This gave all attendees the opportunity to visit an apartment that had undergone a makeover to a zero on the meter apartment. Led by the contractor (Smits Vastgoed) and a representative of Woonbron (housing association), all questions were answered about the details of retrofit and the process.
This report presents an outline of the presented information and to keep all members updated on the developments within this sector. It starts with the approach of Energiesprong in the Netherlands and what net-zero energy means.

Prof. Henk Visscher (TU Delft) en
Joost Nieuwenhuijzen (EFL)
May 2016

THE DUTCH APPROACH OF ENERGIESPRONG/STROOMVERSNELLING

Stroomversnelling is the new name for a Dutch initiative formerly known as Energiesprong. To deal with the problem of the energy efficiency of buildings, this team has developed a method to transform existing homes into net zero energy homes, see figure 1. Zero on the meter is based on reducing energy demand by isolating dwellings and providing them with new technologies. By using new technologies (prefabricated facades; new smart heating and cooling installations; insulated rooftops equipped with solar panels) the house generates as much energy as it needs. With an innovative financing model, the money people save on their energy bill is used for the required renovations.

All technical elements (heat pomp, ventilation, hot water, invertor) are stored and integrated into the new house design. In the latest models, this is all integrated in the façade. In total, this design is placed over the “old” house. There is room for personal tastes and styles. But in the end, from the outside it looks like a new house. As such, construction company Van der Leij presents their project as “At Home a New House”.

With government supported instruments, this initiative aims for a solution to be effective by addressing the problem in a sufficient manner: it needs to be adaptable by masses. To create the right market conditions for this to happen, Energiesprong was set in the market to coordinate the process and work with all stakeholders. The first step was to secure a first market for net zero energy houses, which consisted of an initial group of social housing associations joining forces. Also government regulations were adjusted to allow social housing associations to charge tenants their energy service bill. Financial institutions contributed with an evaluation of the new refurbishment to provide affordable and easy financing to the social housing associations.

figure 1

BUSINESS MODEL

As shown in figure 2, in the situation before the refurbishment, the tenant pays rent to the housing association and an energy bill to the utility. After a net zero energy makeover, the tenant still pays rent to the housing association. But in addition, the tenant gets an energy plan with a bundle of heath, hot water and electricity for appliances. In return, tenants pay an energy fee to the housing association. In the Netherlands, this fee is the same amount as their energy bill. This baseline of this bundle is set on their energy consumption of the last three years. If new tenants move in, this is set at a new default. Because the energy is mainly produced by PV and other renewable energy (heat pump) and therefore ‘free’, the received amount from the energy plan is used for the amortisation of the investment.

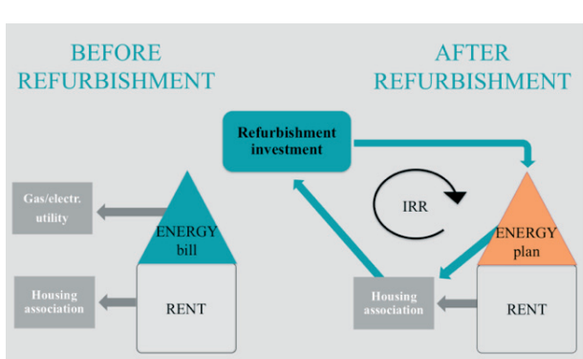

figure 2

PARAMETERS NECESSARY FOR SUCCESS

To let net zero energy houses succeed and improve the energy efficiency of the housing stock, it needs to be adopted at scale. There are four parameters necessary for this to happen:

1. **Quality**: The retrofits need to be good. The makeover comes with a 30-year warranty guaranteed by the company delivering the solution. This includes both the warranty on energy, but also on the comfort and the indoor climate. This warranty also makes financing of a bank much easier and and helps people trust the new technology. As a construction company, Van der Leij also gives warranty on the techniques. The makeover includes a maintenance contract.
2. **Non-intrusive**: As there is never a good time to give your house a complete makeover, the refurbishment needs to be done within one week. This requires suppliers to think about pre-fab. Industrializing the process is necessary to get to the right the price-quality level.
3. **Affordable**: The savings on the energy bill should pay for the retrofit. As industrialization has not been picked up yet, the price is still high. The business case consists of a combination of energy costs savings and required maintenance work of the houses. These two budgets are combined in an investment that allows for the refurbishment.
4. **Improve look and feel**: People are not interested in changing their house just to solve a technical issue. If you want innovations to be picked up by masses, you have to make them feel good about a solution. The suppliers play a crucial role in attracting a larger group, and key is to deliver a nice house where people want to live in.

figure 3

INDUSTRIALIZATION AND MASS CUSTOMIZATION

In contrast to normal refurbishments, the costs of this makeover are known. The prices for a full zero net energy makeover is now set at 40.000-45.000 €. But these prices drop when knowledge continues to accumulate and innovation is spurred through advancing prefabrication and industrialization. It is a standard product, but every house and tenant is unique, which requires flexibility to adapt. All houses need to be individually customized, thus important is getting very accurate measurements of a house, as pictured in figure 4. Also the ability of 3D printing needs to be taken into account. Processing this data in a building information models (BIM), leads to mass customization rather than full industrialization.

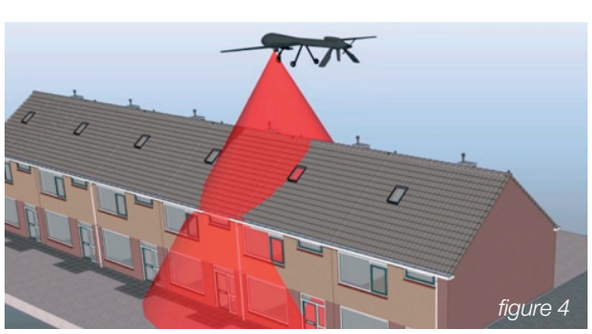
figure 4

The new technologies are delivered as plug and play. The innovations used to create zero on the meter include:

1. An **installation column** of lightweight steel is developed which contains components of a heating pump, boiler and a ventilation unit. This installation can be put everywhere in the building and can de adapted to personal tastes.
2. An **integrated solar roof**, focused on both water retaining and smart shells.
3. **Energy hat on the roof**: solar panels, also possible for high rise buildings. These can be up to one-meter high. The supplier of the solar panels stays in close contact with the architect. The architect is designing the figures of the energy.

4. To increase efficiency, **heat pumps** are place under the hat. As such, they make use of the heat that is produced under the solar panels. The hat and the solar panels can rotate; and profit of the different orientations of a building.
5. **Wired internet** in all walls.

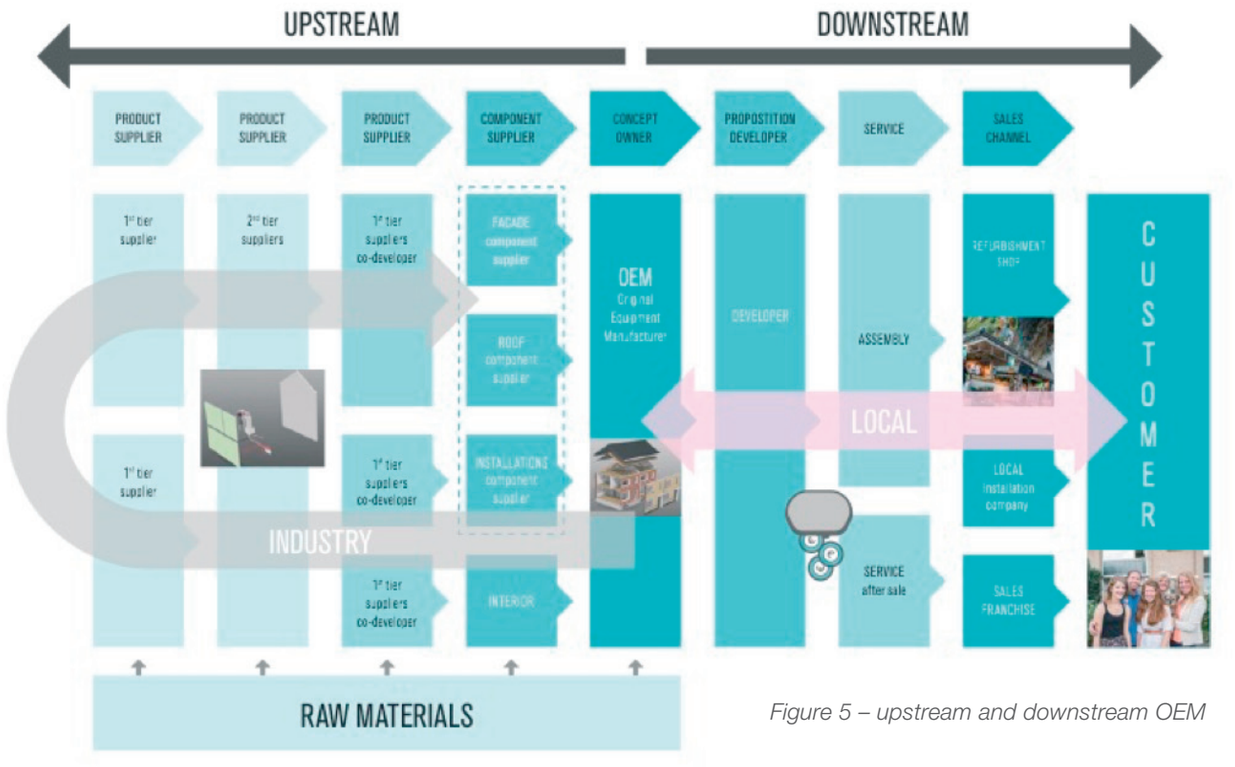

Figure 5 – upstream and downstream OEM

Figure 5 shows, how in an industrialized system, there is co-development with suppliers. No one has all the knowledge to create such a complicated product. To end responsibility remains in the hands of the The Original Equipment Manufacturer (OEM). Upstream, this company is in charge of the 1st tier, 2nd tier and 3rd tier suppliers. On the other hand, downstream there is a sales challenge. The task of Energiesprong is to recreate the supply chain in total. This is a complicated manner as all companies work in structures, and have different interests. This makes it hard to create something in a market which is not yet there.

INTERNATIONAL SCALING AND CHALLENGES

Besides the Netherlands, Energiesprong has a working budget and a team in both the UK and France.
The UK is 6 months ahead of France, and the first makeover of 9 houses will take place before the end of 2016 in Nottingham.

In France work needs to be done on optimizing the business case and what the makeovers mean for tenants and the housing stock. This process has been speed up by two types of European subsidies. The first is Horizon 2020, which helped setting up Energiesprong in France. The money is put into topic groups to explore how the Dutch case is replicable in the French context and to identify the main obstacles to innovation.

The key differences between the Dutch and the French context are as follows:

1. The **contribution of tenants** to energy savings. Whereas in the Netherlands the refurbishment is fully financed by energy savings, in France this cannot exceed 50% of the total costs.
2. Due to a change in law, Dutch tenants can, instead of **paying the energy bill** to energy suppliers, pay the same amount **to the housing association**. With this money the housing associations pay for the retrofit. In France, this is directly paid to the energy suppliers
3. Dutch tenants receive **compensation** for each day of work on their house. In France such a composition is not available.

After exploring the feasibility of Energiesprong in France, financing the pilot sites will be the next step.

The second European subsidy is INTERREG, which supported a pilot site in Longeux with mostly single family houses. This approach has to show to what extent Energiesprong is a feasible option for housing companies in France. There is also support from the French Government. The construction companies are joining in a later stage, after the demand and the financial template are fixed

In general, every country requires different skills and attitudes, Energiesprong needs to focus on understanding the local (housing) context and how the investments fits into the business models in place. However, the main challenge between different countries remains how to make people do something differently and how to tenants involved.

TRIME is a project run in 7 housing companies within five countries, aiming to train tenants in lowering their energy bill. Results of this EU funded project (it originated within EFL) show that tenants are still not aware that they can do something about energy efficiency. As such, they need to focus on how to get them involved and how to best reach out to them. This requires many communication skills and patience. Partners are among other EFL members Eigen Haard, Circle, Vilogia, Polylogis and Havensteder.

THE PRIVATE SECTOR/ HOME OWNERS?

As the private sector is hard to enter, net zero energy housing is now focused on the social housing market. Besides, social housing companies have certain regulations which are absent for homeowners. Moreover, the current combination of financial risk and not having a retail plan in place makes it hard to convince home-owners. There is still uncertainty what the impact will be on the value of a house, which makes an asset management strategy easier with housing associations.

NET ZERO IN PRACTICE – GROWING GREEN CASE STUDY IN DELFT

Growing Green was formed through a consortium which included constructors, a housing association, architects, engineers and the municipality of Delft. For a case study, Woonbron (the housing association) provided a multi story apartment building where Growing Green started with one dwelling. The renovation project focused on not only improving the indoor climate and the energy efficiency of the apartment, but also on the safety and the quality of use. In the end, this benefits its future value and the overall sustainability. This dwelling was set up as a learning project offering the opportunity to monitor what is there now. The whole house is plugged with meters and provides much information on the carefully defined performance indicators. This projects makes it possible to see if, and how, the theory corresponds with the existing situation. With this information the concept can be constantly adapted and improved. Figure 6 shows the apartment after the renovation.


figure 6

In collaboration with the TU Delft and TNO, performance indicators on the indoor environment and the energy usage were determined. The concept is based on a better energy efficiency, as such the first step was replacing replacing the existing façade with timber. This was followed by the creation of a good insulation and adding the technical core inside of the dwelling. The makeover was engineered in such a way to make use of big elements, which could all be prefabrication. This makes it possible to control most of the parts being made. Depending on the makeover (e.g. with or without kitchen and bathroom makeover), the refurbishments can be done when the tenants lives there.

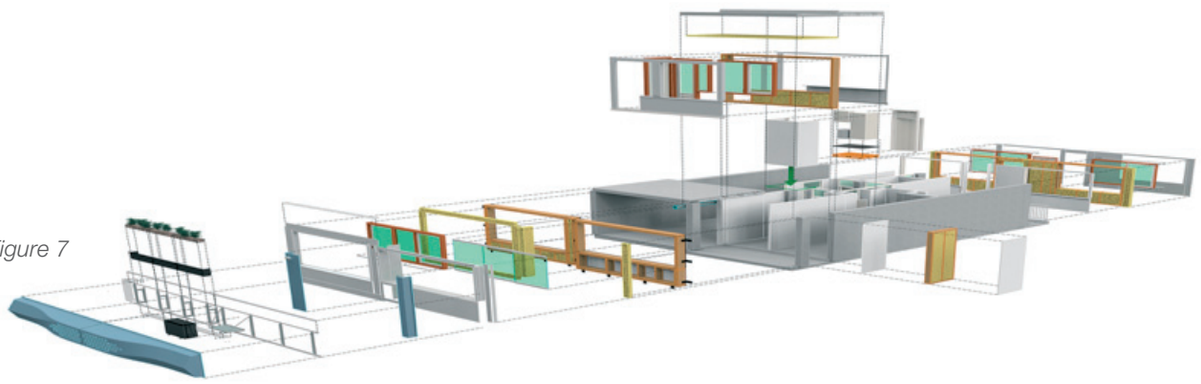

Figure 7

The concept is a perfect example of an integrated design, see figure 7, this includes:

- A very energy efficient air water heat pump was placed on the dwelling. To diminish the noise created, a 3D printed element was placed around the machine. Every dwelling is disconnected from the grid and has their own energy efficient solution.
  The air water heat pump is also used for domestic use and stored within the dwelling. From here the heat is distributed to the different rooms.
  This was accompanied with an extensive user guide to make is easier for tenants to apply all the technology.
- Thermal Insulation is directly related to the energy consumption of the building. With the applied insulation, there is a risk of moist in construction. To not make more problems than you had before, one needs to be very careful. Figure 8 shows the thermografic situation before and after the makeover. In the second situation it is clearly visible that less warmth is leaked than before.

At this point the growing green concept is still very expensive. The first project cost 70.000e. However, the core element is costliest, but as this can be adapted, some of the engineering costs can easily be cut out. The toolbox is now present; it just needs to be made suitable to another context.

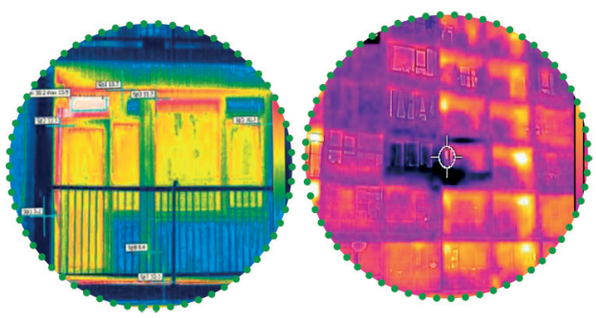

Figure 8 – Thermografic before and after

INNOVATIVE SOLAR PANELS – NOGRID

Solar Techno is a company founded in 2009. They are involved with the distribution; design and engineering and consultancy related activities to solar systems and the photovoltaic market.

The photovoltaic market is cost competitive against purchasing cost of electricity for house owners in mainly all of the world. The market on storage systems based on lithium battery is starting now. At this point, storage is not convenient in Europe without subsidies. It adds circa 0,10 €/kWh to the electricity cost. The predictions are that storage system prices expected to go down by 15 % a year. Moreover, Storage system not convenient in Europe if net metering is for free. As such, the next step is solid state lithium batteries.

Solar Techno has worked on the development of new energy systems and storage products. Their latest product is NoGrid: A modular storage system that can be installed directly on the rear of each photovoltaic module, see figure 9. NoGrid has 1 kWh of available storage capacity and 500 Watt of continuous power. To create a large rand more powerful system, it is possible to use a plug and play system to connect multiple batteries. In a later stage, it is expected that the batteries can also be connected to the net. But before this is possible, the

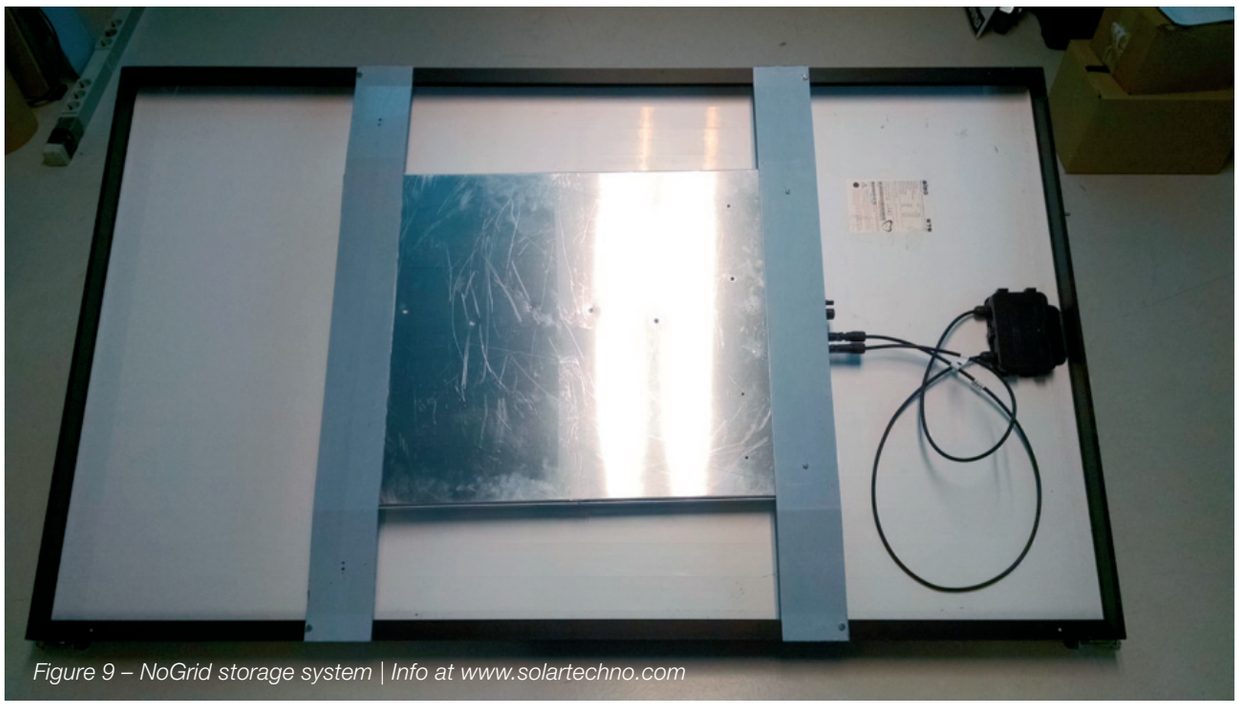

Figure 9 – NoGrid storage system | Info at www.solartechno.com

safety requirements need to improve. Depending on the market, this can be a very innovative solution. An Interesting customer can be the military, as costs for electricity to them are very high. But also for the larger social housing providers, integrated PV panels with storage capacity offer interesting challenges.

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