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ISBN: 978-84-16724-10-9
Depósito legal: A 331-2016

Diseño y maquetación: Roberto T. Yáñez Pacios
Imagen de portada: Galiano Garrigós Arquitectos
Corrección de pruebas: Tahar Kouider
Impresión y encuadernación: Universidad de Alicante

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ICAT 2016
12th - 14th May, 2016
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NO EVOLUTION BUT REVOLUTION

The future of the Dutch terraced house

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Abstract. Dealing with the environmental problems is one of the biggest challenges within the field of architectural technology. Solutions to this problem are mostly exclusively sought in materials and computer technology. However, far more attention should be paid to humans and their role in this problem. This paper presents a small part of our bachelor thesis, which started as an investigation on the Dutch terraced house and through research ended as a study on the human behaviour and motivation. The first part of this paper, the evolution, is focussed on the traditional way of problem solving. The second part, the revolution, is focussed on human behaviour and motivation. These two studies put together lead to our conclusion: The only way to structurally solve our environmental problem is to revolutionize our way of building by involving the human interaction into our solution instead of forcing it out.

Keywords: environmental problems, terraced house, human, behaviour and motivation.

1. The evolution of Dutch terraced house

The terraced house is deeply rooted into the Dutch housing culture. 61% of the Dutch population lives in a terraced house. Many of them were built from 1960 to 1972 to house the growing population. Nowadays these
houses no longer meet the sustainability standard set by the Dutch government.

Over the years the layout of the terraced house hasn’t changed much. The only part that went through an evaluation is the facade. Having a high heat resistance has become increasingly important and as a result of this the facade of new houses went through a transition while old houses were left untouched.

![Figure 1. Evolution of the wall](image)

The Dutch government decided to take care of the outdated houses in a structured way by raising the heat resistance in combination with the use of “green” energy sources and put out a report called: “Towards a climate neutral housing stock in 2050.” This report triggered the question: How climate neutral will the Dutch housing stock become if this 2050 policy in regard to housing is pursued.

1.1. TOWARDS A CLIMATE NEUTRAL HOUSING STOCK IN 2050

Europe has set targets to lower the CO₂ emissions by saving energy and lowering the usage of fossil fuels. The report “towards a climate neutral housing stock in 2050” is the translation of the European report to the
Dutch housing stock and is based on the Trias Energetica. This is the order in which steps have to be taken to reach a climate neutral housing stock.

Trias Energetica;
1. Energy savings
2. Renewable energy
3. Clean and efficient generation of non-renewable energy

Based on the Trias Energetica, four different scenarios were developed, all having a different action intensity based on costs: limited, wide, deep and phased deep. Limited is the most cost effective by slightly improving the energy label and generating as much renewable energy as possible with solar panels and using cleaner non-renewable energy. The deep scenario is the most expensive by renovating the house to meet the highest energy label and fully provide for its own renewable energy.

To find out whether this leads to a climate neutral housing stock a house from De Stroomversnelling, an ongoing mass-scale renovation project was chosen to make a comparison between the house before and after the renovation. This renovation is done according to the deep scenario. From this house energy the consumption was calculated in EnergPlus and a life cycle analysis (LCA) was calculated with data from the Dutch Institute for Buildingbiology and Ecology (NIBE).

1.2 ENERGY AND ECOLOGY

The main focus of the governmental plans is saving energy. By adding insulation less energy is used to heat or cool the house. This results in lower CO₂ emissions. Besides lowering the CO₂ emissions the monthly energy costs go down as well. This makes this option excellent to sell to house owners.

The renovation in accordance to the report decreased the energy consumption by 85%, from 14700 kWh to 2250 kWh per year. When the climate change, as predicted by the Royal Dutch Meteorological Institute (KNMI), is taken into account a decrease in energy consumption of 75%
from 9950kWh to 2450kWh is seen. This can be explained by an increase in the need of cooling and a decrease in the need of heating. Nevertheless this is a huge difference.

Besides the Energy consumption there is an ecological issue. To decrease the energy consumption extra layers of material were added. These extra layers of material need energy to produce and recycle. Some materials will never be able to be recycled and thus create waste. The Dutch government leaves this part out of the equation. This may be done because these documents are not accessible to most people due to the lack of knowledge and more importantly: the direct effects in contrast to energy consumption do not show any direct benefits like lowered monthly expenses.

To give insight in the impact of the renovation the ecological impact was compared in four categories: emission, depletion, importunity and land usage. As shown in table 1 adding insulation grants an increased impact of 50% compared to the original building. Adding the solar panels to the roof adds another 100%, making the impact of the solar panels about the same as the creation of the complete original house. When looking closely at the distribution of the CO$_2$ impact it is noticed that 75% of the impact is coming from the foundation. This can be explained by the way there has to be built in the Netherlands. This changes perspective because the renovation of the wall has 200% more impact than the existing wall and the addition of solar panels adds another 400% impact in building materials.

<table>
<thead>
<tr>
<th>TABLE 1. LCA Impact.</th>
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<tbody>
<tr>
<td>Untransformed</td>
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<tr>
<td><img src="image" alt="Graph showing the impact distribution" /></td>
</tr>
</tbody>
</table>

- Foundation
- Original
- Transformation
- Solar Panels
1.3. DISPLACEMENT

According to the governmental plans CO₂ reduction is the key in creating a climate neutral housing stock. But how much will this improve upon the current situation? To make the renovated and original house comparable they have both been made all-electric and powered by grey energy sources or green energy sources from water and wind energy. These are the first four lines in the graph. The fifth line is a combination of a renovated house with solar panels. While the solar panels do not emit CO₂, they have to be replaced every 25 years and thus create the staged increase.

TABLE 2. Total CO₂ emissions.

This results in a situation where solar panels are a huge improvement over the existing grey energy sources. But when this is compared to green energy sources from wind and water it appears to be emitting far more CO₂. It becomes just a new form of grey energy. Better still, when using green power it is better in terms of CO₂ production to not renovate your house at all. It will take 85 years to win back the CO₂ produced by the renovation.
This is far longer than the average lifespan of a Dutch house and this does not even take all other forms of ecological impact into account.

1.4 CONCLUSION

Following the report “Towards a climate neutral housing stock in 2050” will not provide for a climate neutral housing stock. Following this report does reduce the amount of energy used and thus the CO2-emissions. But by reducing the operational energy the government seems to have forgotten that there are more factors to take into account when creating a climate-neutral house, like the impact of materials. This can be explained by the fact that cleaning up the mess we have made can’t cost a single extra penny. Instead of opting for the cleanest solution this report is based on solar panels while there are already cleaner energy sources like wind energy. Instead of striving for a viable future all we do is look at our wallet and thus we will never get any further than fiddling with the margins.

2. Human interaction

A displacement should never be a solution, but current ways of dealing with the ecological problem always lead to this. The building industry has to realize that relying on optimisation and newer technologies alone will never lead to a climate neutral environment. In the end the human behaviour in the building determines how well a building functions and how much energy it uses. Therefore it is of the upmost importance to possess knowledge of the human behaviour. In fact the main question of this paper shouldn’t be: “How climate neutral will the Dutch terraced house become if the 2050 policy in regard to housing is pursued?” To address the real problem it should be: “How can man be motivated to act in a more climate neutral way?” To answer this, both behaviour and motivation have to be addressed.
2.1 BEHAVIOUR

Every human action is part of their behaviour. There are different types of behaviour and this study focusses on behavioural reaction. This is behaviour which results from changes or unexpected events. When for example someone does something embarrassing and as a response to this starts scratching his head it is called displacement behaviour. This chapter discusses two types of behavioural reactions: rebound effect and short-term thinking.

2.1.1. Rebound effect

A rebound effect is a behavioural reaction just like displacement behaviour. While this is mostly caused by optimisations there are more factors to be considered. The first behavioural reaction is moral self-licensing and can be demonstrated in the following example: a person installs solar panels to pay off his moral debt caused by his racing hobby. Mental accounting is another behavioural reaction linked to the rebound effect. This works in the following way: in his mind a person has a fixed amount of money set for transportation. If the fuel costs go down his budget stays the same, allowing him to drive longer distances for the same price.

The main rebound categories caused by optimisations are: energy-, time- and material efficiency. Adding more and more insulation to the facade will not lead to a substantial improvement in the energy usage of the house. Our natural behaviour will make us consuming more energy by for example heating all rooms of the house instead of only the living room. As a result the actual energy savings are significantly lower than the potential savings. If a washing machine does its job quicker than before the user will tend to use the machine more often. If a new technology enables a factory to create 5 chairs out of a wooden plate instead of 2 the price of the chairs will go down. This means people are more likely to buy this chair. Because of this rebound effect more wood will be used and again a large part of the potential saving is lost.
For every category there is one catalyst to slow down or speed up the rebound effect: money. This means that an economically good period increases the effect of the rebound effect. Ironically enough the report “Towards a climate neutral housing stock in 2050” suggests to intensify the renovations in economic good times. When looking at the rebound effect this is the worst time to act because money is the catalyst of the rebound effect.

2.1.2. Short-term thinking

The rebound effect rarely is a deliberate action to damage nature. Mostly someone isn’t even aware of the fact that he is causing damage. It is difficult for humans to see the long-term consequences of their actions. An example of this is smoking behaviour. From an individual perspective smoking may be desirable because a brief moment of relief is enjoyed. However, smoking increases the health risk for the individual in the long term. In addition to this it affects others. In the short term by causing annoyance and in the long term by increased shared health care costs. Yet he decides to take a cigarette because he prefers enjoying his moment over the interest of the group and his health on the long term. While smoking has a direct effect on someone his life, the effect on climate change is more abstract. The actions of a person that contribute to climate change are often reflected much later and far outside his perspective. This makes it difficult for someone to act in a conscious way and explains why climate change does not provide people enough reasons to change their way of living.

2.2 GUIDANCE

To prevent the short term enjoyment from being damaging on the long term, the effects of this moment of joy have to be made visible. Our society is known for the fact that often the easiest and cheapest solutions are the environmentally worst solutions. For example there are the disposable products, broiler chickens and the subsidized solar panels. These products offer a good short term result for the user, while on the long term they are
damaging the environment or other persons. To stop people from using this, and damaging the environment, these short term rewards must disappear.

The way to achieve this is to give insight in all sold products and label them with the total amount of ecological impact that this has caused. To avoid excessive simplification by taking only energy consumption in the operational phase into consideration, this impact has to include the full disassembly to its natural resources; even if this requires extremely complicated processes. This way will force people away from these polluting products and stimulate companies to develop newly designed products. This insight will also provide the information for the psychological needs in motivation.

2.3. MOTIVATION

To make changes to someone’s way of living and reduce the ecological impact he has to be motivated to embrace these changes as well. Edward L. Deci and Richard M. Ryan describe the way human motivation works with the three psychological needs: autonomy, competence and relatedness. When these needs are not met it will severely decrease the motivation of that person. In the case of the ecological impact, humans are restricted in their psychological needs and thus become demotivated. To get the people motivated it is important to see how the motivational principles can be applied to architecture.

2.3.1 Psychological needs
It is often heard that individuals do not believe their actions contribute to the ecological problem. To relate to the ecological issue it has to be made clear that humans are the cause of this problem and therefore must be part of the solution. Fortunately there are already signs that humans feel related to this issue. Biological products are bought more often than ever and the second reason to buy solar panels is because it is thought to be ecological.
Besides being related a person needs to be autonomous. At present the government creates regulations in the form of building codes. On the one hand this provides for good quality homes but on the other hand space for autonomy and initiative is restricted.

To be competent the user has to be able to learn and make progress. Besides that the user is looking for information that directly confirms autonomy and competence. This information has to be widespread available. Education has to be offered to make everyone feel competent in working to a climate neutral solution.

An example of a recent technology that tries to include the psychological needs is the smart meter, a device that shows your energy consumption. By changing your lifestyle (autonomy) you can change your energy consumption and immediately see progress or decline (competence). But it does not completely fulfil in the psychological for two reasons: it lacks relation to the ecological issue and is built to simplify, making it too smart to really challenge you.

2.3.2 The locus of causality
Besides the strength of a motivation there is the origin of a motivation: the perceived locus of causality. Someone can try to get high grades to make their parents feel proud or he can try to get the high grades because he sees this as important for his own development. The first example has a strong External Perceived Locus of Causality (EPLOC). He acts because he does not want to be punished or disappoint his family. At the moment his parents stop caring about the grades he will drop his class. The second example has a strong Internal Perceived Locus of Causality (IPLOC). He learns because he wants to become smarter, because he thinks it is interesting to learn this. As a benefit his family is happy, but that does not contribute to his motivation.

This is clearly visible in architecture. The moment the government drops the funding for solar panels, less people will buy them. Since the profit gained by them is the main reason solar panels are bought. The motivation to fixing our ecological problem has an EPLOC. The only way
to get people acting towards fixing the ecological problem is by giving them a motivation with an IPLOC.

2.4 PLACEMENT OF HUMAN MOTIVATION.

How can man be motivated to act in a more climate neutral way? Our current way of living is based on rewarding on the short term. The cheapest and often easiest solutions are the most environmentally damaging. This creates a situation where the user has to choose between direct comfort and the environment in the long term. Research has concluded that in this situation humans are most likely to choose their own comfort.

![Figure 2. Current system](image)

The only way to get the user acting in a climate neutral way is to provide a short term reward that makes him satisfied and this short term goal has to lead to the greater goal: a climate neutral housing stock.

![Figure 3. New system](image)

The ultimate goal is achieved when the created short term goal has a motivation based on an internal perceived locus of causality. To be motivated the psychological needs must be met. An environment has to be
created in which the user has freedom and can be fully autonomous. To feel competent human interaction has to be directly noticeable in positive and negative ways. This creates a situation in which acting in an environmentally conscious way rewards you with comfort and prestige. If someone decides not to do so he limits himself. This is fully opposed to the needs of a human to strive to self-development and appreciation.

3. The Revolution of the Dutch Terraced House

This leaves us to the final question: what could this mean for the Dutch terraced house? Although the governmental motivations to creating a climate neutral housing stock are good, they are using the wrong tools to get there. Current solutions lead to passive houses, static objects that exclude interaction with its dynamic owner. This is fascinating because the world is changing faster than ever. It is entirely possible that all we need in 15 years is a single room and a pair of virtual reality glasses. All the energy and materials put in the renovation of the rest of the house will be wasted. This is an extreme example but this is actually happening. The average floor space of the Dutch terraced house measures 125m², suited to house 4 persons: two adults and two children. However the average occupation is 2.1 persons per house. This means roughly 50% of the Dutch housing stock is not tuned to the needs of the user and left unoccupied wasting space and materials. The Dutch housing stock is like an XXL T-shirt. Everybody can wear it, but it does not really fit any of them leaving them less comfortable than they could be. A house has to be created that really fits the dynamic needs of the user.

To implement this in the Dutch terraced house only a framework with standardized dimensions should be offered as displayed in figure 4 (first icon). This frame has to be filled with different components changing in materialization, window opening sizes and efficiency. But this frame should also allow changes in volume and floor space. These elements have to be interchangeable inside houses but also between different houses to extend the lifespan of that component, creating less waste.
But just switching to modular building is not the solution. Human interaction has to be included into the design. However this modular frame provides a framework in which the user is free to shape it to his needs, making him feel autonomous. The adjustments he makes have to be felt immediately and he has to be able to learn from this, making him competent. For example increasing the thermal insulation of a part of his house can have a positive or negative effect on the users living comfort. After making this change he is able to increase it even further or remove it altogether without completely demolishing the house. To make this work, there has to be a reward on the short term, which on the long term provides for a climate neutral housing stock. The Dutch terraced house is a perfect subject for this matter because the user will want to self-develop and gain appreciation by creating the best living comfort, which now lies completely in his own hands.

4. Conclusion.

To build a climate neutral housing stock we don’t need an evolution of a static object that tries to fix everything for everyone. We need a dynamic
solution that incorporates human interaction and motivation, a revolution. There are multiple ways to achieving this and the challenge architectural technology should be facing in the upcoming years is to understand human behavior and create ways to implement this in architecture.

Acknowledgements

The authors would like to thank the following people and their organizations for the support given in carrying out this study. Amsterdam University of applied sciences, Ed Melet, Hans ten Voorde, Peter de Wit, Ronald van Gent, Elsbeth van Battum, Vera Rovers - TNO, Twan Hooff - TU Eindhoven, Linda Hildebrand - Hochschule Ostwestfalen-Lippe and Wenink/ Holtkamp architects.

References


ENERGYPLUS 8.2.0 [Computer program]. USA: U.S. Department of Energy.


GREENCALC [Computer program]. Nederland: Rijksgebouwendienst ,NIBE, DGMR, Alliander, TU Delft, Universiteit Twente.
NO EVOLUTION BUT REVOLUTION


OPENSTUDIO 0.8.2 [Computer program].USA: U.S. Department of Energy.


SCHOP, G.J., unknown. 2.1.4. Motivatietheorieën. Available from:

TROMP, N., 2013. Social design, How products and services can help us act in ways benefit society. This research is partly funded by the Dutch police - LAPV2010, and Estrade/Vestia Rotterdam.