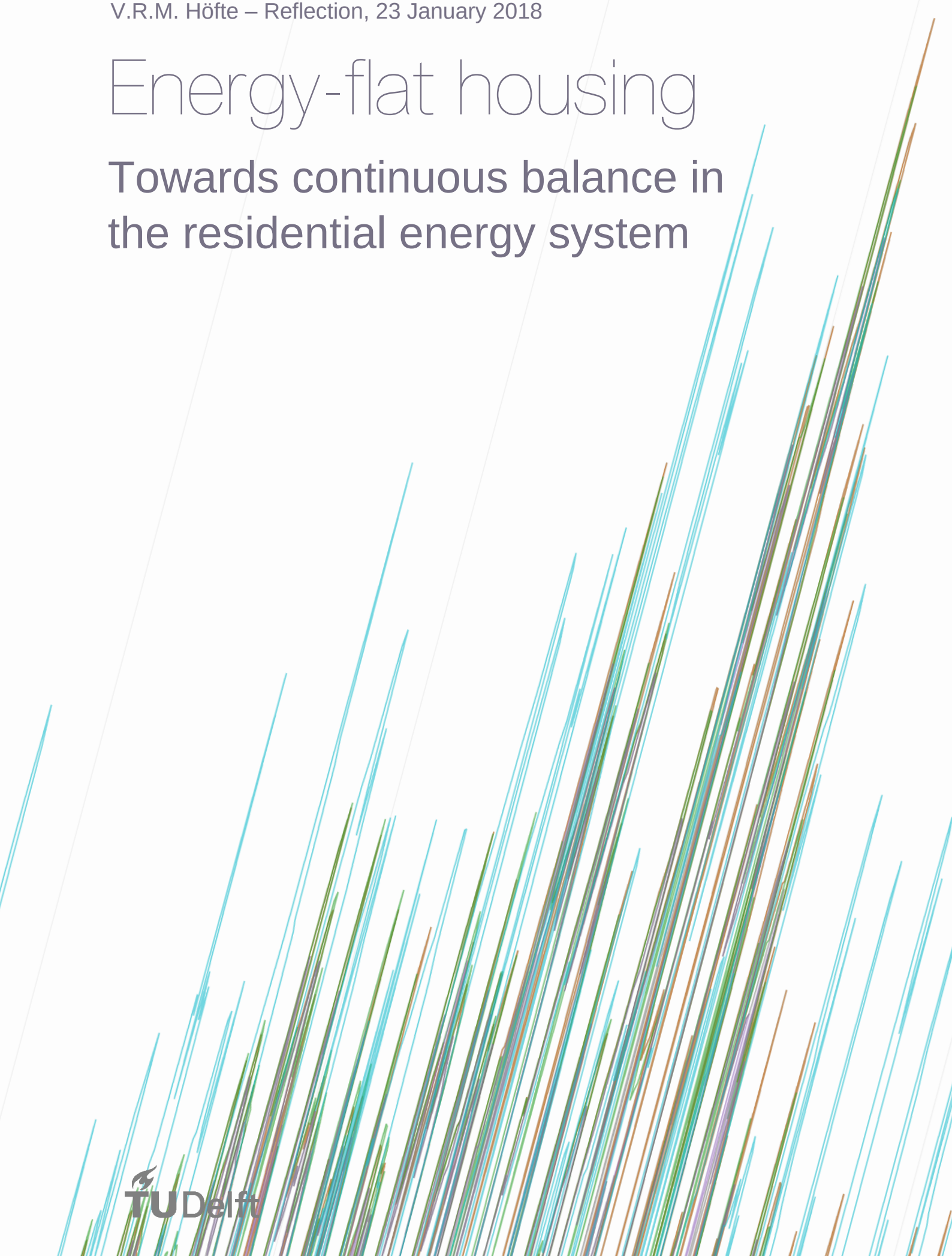
V.R.M. Höfte – Reflection, 23 January 2018

Energy-flat housing

Towards continuous balance in the residential energy system



TU Delft

This document is the final reflection of the graduation project for the assessment P5, as part of the MSc graduation project for the track Building Technology, Master Architecture, Urbanism & Building Sciences, at the Delft University of Technology. This document is published on January 23, 2018.

This reflection is also included in the final thesis report, but provided separately as requested by the Board of Examiners.

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1 REFLECTION

1.1 ACADEMIC

The graduation lab Sustainable Design Graduation, as part of the MSc Building Technology aims to emphasize on sustainability-related topics from a structural design, facade design and climate design point of view. Energy-flatness as a topic sheds a new light in the existing topic of sustainable buildings in terms of energy. It aims at making the current approach to sustainability more future-proof. The current approach is to reduce energy consumption, increase renewable energy production and thereby aiming for energy neutrality. This research explored the potential of energy-flat buildings, to reduce intermittent loads on the grid and thereby increase the effectivity of renewable energy production. Adapting the energy balance of a building, realizing energy-flatness in particular, considers the complete building as adaptation tool. Inherently, this research covers both facade design and climate design.

The topic of sustainable buildings and energy consumption of buildings is elaborately researched, making it easy to find decent literature to substantiate this topic. However, the scope is limited due to time limitations; one could easily fill a PhD with research to the boundaries and possibilities of energy-flat housing. Similarly, this results in the possibility of scaling the research. The opportunities for further research are broad. A SWOT analysis of the research approach is summarized in Figure 1.

Strengths	**Weaknesses**
structured by sub-questions elaborately researched theme	sequential structure scope is limited due to time limitations
Opportunities	**Threats**
possibility of scaling research design by research approach	scope not completely clear due to new topic using tools that are unknown to me

Figure 1: SWOT analysis of the research approach

The approach has mostly worked out effectively. The approach asked for a clear set of products for every sub-question, and because of this clear definition these products were provided. One remark, the potential delay of the sequential planning as was acknowledged during the P2, has become definite. Providing the parameter overview, the product of the fourth sub-question, took more time than expected. As a result, less time has been invested into the design of the individual energy-flat buildings. The elaboration on the parameter overview, however, is something I consider as a shift in design focus.

Design by research is the main method of creating an energy-flat design in this thesis. The project is characterized by a conceptual, abstract, but structured approach. The design tools are simplified to a set of building parameters that influence the energy demand and supply profiles. By analysing the effects of changing the parameters, the optimal energy-flat design is created. However, adjusting merely these parameters did not result in an optimal design. From that point, it became research by design. Several design solutions were implemented and analysed, eventually resulting in an almost optimal energy-flat design. Summarizing, the first stage of energy-flatness is achieved by design by research. The second stage, is achieved by fine-tuning the architecture by research by design.

1.2 PERSONAL

The first phase of the graduation project (until P2) focused strongly on the literature review and scoping of the subject. After the P2 I concluded, that this phase was characterized by the fluctuation between (the idea of) exactly knowing what you are doing, and founding yourself desperate between all the information and scoping decisions. The second phase (from P2 upon P3) had the main goals to finalize the literature research, set up the energy model and start with the early design. Once again, I have found that scoping the research seems the most challenging. At the P2 I was sure that I had a clear scope. Especially in the energy model and results processing however, I found that I was confronted with every little detail of the energy system of a building and had to make a logical decision whether or not to take it into account. Firstly, this is the result of using tools that were unknown to me upfront. Secondly, I assume this is the result of the introduced new definition of energy-flatness. The definition is new, and so is the scope of this definition. In the future, this might be prevented by brainstorming about the topic into detail. I assume that this way most relevant details will show up, and a choice of whether to account for them can be made.

My work approach is to define a clear structure, overview the complete approach and define clear goals, and then start the project. Within a graduation topic, this is not achievable. The project is too big and the field to explore is too unknown to overview the complete process at once. This inherently means that I must adapt my working method, and have to learn to work with the unknown in particular. Now, near the end of my graduation, I can state that this is a tough task for me. I found it hard to constantly work within uncertainties. Since P1 I have improved this though, by cutting up the project in smaller pieces and approach these in a structured way with clear goals. The only threat resulting from this; the goals and products per phase do not necessarily are one, coherent set of goals and products.

Nevertheless, I find the graduation process very interesting and it is education for sure. Although the process is tough, I am aware of this project making me a better designer, engineer and professional.

1.3 SOCIETAL

Sustainability is a hot topic. At the end of the 20th century, consciousness had to be created about the energy savings and climate problems. This task is still not finished, but the societal awareness

around energy savings and global warming has driven immense. Sustainability itself, has already become a marketing word. Although sometimes misused, this term creates awareness after all.

As awareness on sustainability rises, it is the role of scientists to look ahead and create the foundation for further sustainable development. Energy-flatness is a concept that is not directly necessary, nor directly applicable in practice. However, the exploration of the concept contributes to the foundation of future sustainable developments by researching the potentials and risks of solutions to future problems.

In the built environment, there is a shift towards decentralization in energy production. Renewable energy production is increasingly present within the residential or neighbourhood boundaries. Awareness of private energy supply creates awareness on private energy demand, which eventually results in the increased desire of private consumers to adapt their demand and supply in ways that are economically most feasible. Energy-flatness contributes to this by exploring the role of architecture in this rising desire. It helps the planet, by giving more control to the people, so they can have a bigger profit of sustainable design.

So, should be build energy-flat housing? Creating perfect energy-flatness for every individual building is realistic nor efficient. The need for balancing energy on the highest level of the energy system, however, will rise with the increasing share of renewable energy supply. Therefore, dwellings should be '*as energy-flat as is efficiently possible*'. The factor 'efficiency' in this sentence, strongly depends on the state-of-the-art technologies. Hence, the efficient level of energy-flatness will change over time.

Whereas energy-flatness is considered the next stage of energy-neutrality, energy flexibility could be considered the next stage of energy-flatness. By that, I meant that it would be ideal if a building is so energy-flexible that it could be perfectly energy-flat if it is desired, but that it could also create a shortage or surplus depending on the needs of the energy system that it is part of. Thereby, it would not only solve its own mismatch, but also contribute to solving the energy mismatch of other actors in the system.