The Smart Home

Logistical media, infrastructure and practiced places

By: Karin Hägglund

Supervisor: Staffan Ericson
Södertörn University | School of Culture and Education
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**Abstract**
This master thesis in media and communication studies explores the concept of the smart home, which by various industries within communication, information and energy business alongside property developers is expected to be the model for future living, housing and infrastructure development. Departing from a theoretical framework highlighting media and infrastructure as temporal and spatial phenomena, the analysis shows how the smart home arranges and manages both means of time and space due to its saturation of information technologies in the form of sensors, applications and data visualizations. The result of the study suggests that the smart home could be understood as a logistical medium, although the temporal bias present in the expectations on future living suggests that the purpose of the smart home is to sustain a flow of logistics and capital both over space and over time; the latter in terms of sustainability.

**Keywords**
Infrastructure studies, logistical media, energy infrastructure, smart grid, mobile privatization, time-axis manipulation, space management and organization, sustainability, future
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1 Introduction

It’s February 2017 in Stockholm, Sweden. In the flagship store of Telia, a Swedish telephone company and mobile network operator, a two-room apartment is staged. A bedroom, a living room, a kitchen. A bathroom with a washing machine. A hallway.

In the living room sofa, there’s a middle-aged man and an older woman sitting next to each other, He’s giving her instructions, explaining some kind of technology to her, perhaps her new phone. They have each been handed a cup of coffee. They’ve put the coffee on the living room table. On the table, a text explains something about the showroom we’re in. I can’t see exactly what as their paper cups covers parts of the text.

In this showroom of Telia’s, the smart home is put on display. In the apartment, there’s a smartphone or a tablet in each room. There’s a tablet on the kitchen sink showing how the smart refrigerator and the smart stove are to be managed from outside the home by an application. In the bathroom, there’s a tablet for reading magazines and books. The bedroom has yet another tablet installed to read a book or watch a move. In the hallway, there’s a desk placed for working from home with a laptop, speakers and a webcam. Further down the hallway, there’s a camera for surveillance. As with other devices in the apartment, the camera can be managed from an application.

The Telia showroom is marketed under the slogan “The future is here.” Although the visitors on the sofa seem fairly interested, Telia seems very interested and convinced of what future living will be like; convenient, entertaining and dependent on Internet infrastructure and data traffic.

As this thesis will show, the idea of the smart home is not only interesting for Telia in their business of selling devices and data traffic, but appeals to various industries in energy and communication technologies as well as property developers and several smart home projects have received public funding by the Swedish Energy Agency. Two of those projects will be featured in this study of the smart home as a center of logistics, but also as a place of certain practices.
1.1 Background

Smart Energy City is a project run by the energy company Fortum in collaboration with the energy, technology and home appliances industries ABB, Ericsson, Ellevio and Electrolux. The project is also funded by the Swedish Energy Agency by 25 percent and together with researchers from KTH Royal Institute of Technology (KTH), the project aims to develop new technologies for smart grids. The smart grid is an electricity grid where the energy supply produced by various kinds of renewable energy sources and demand among the end-consumers will be coordinated by digital technology and Internet connected domestic devices such as washers, dryers and radiators. The purpose of the potential technological advancements is to develop a commercial product for Fortum to sell to their customers, which in this case means housing- and property developers.\(^1\) (Fortum 2017a).

Beginning in 2009, the project was mainly a smart grid project called the Urban Smart Grid. Since then, Fortum has sold their energy distributing part of the company to Ellevio, which means that Fortum’s main business today is as an energy producer.\(^2\)

While the project started off as a smart grid project, today Smart Energy City includes the development of a smartphone and tablet application with both energy visualization and so-called smart home functions for each household connected to the smart grid. This application is installed on a tablet in the apartments of circa 150 families living in newly produced apartments in the sustainability-profiled neighborhood of Stockholm Royal Seaport [Norra Djurgårdssstaden] in Stockholm. The research conducted there, in the so-called Active House, aims to evaluate if the visualizations of energy consumption, including either its costs or environmental impact, will make the families change their habits when it comes to washing, cooking and charging their electric vehicles. The machines and devices used for such purposes will be managed and scheduled in this application, and hopefully the families will be willing to move washing and charging hours to other times of the day than mornings or evenings, times where there are load peaks in the energy grid which make the energy distribution more fragile. Thus, the hypothesis of the Smart Energy City project is that people may become more engaged in their energy consumption by this application, and by using it and sending information to the grid operator who will be able to plan and distribute

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\(^1\) Göran Frendin, project manager at Fortum, phone conversation 04/05/17
\(^2\) Anders Nilsson, PhD student and researcher at KTH, interview 05/03/17
\(^3\) Göran Frendin, project manager at Fortum, phone conversation 04/05/17
the total energy demand during the day in order to balance load peaks. The purpose is to be able to get a more stable energy distribution in the future, when renewable power sources such as wind or solar power will be small but many, yet very weather dependent in their efficiency\(^4\). (Fortum 2017a)

The Future Alley project is located to the mid-sized town of Västerås. The project is run by the companies Mimer and Mälarenergi, the local and publicly owned housing and energy companies in the municipality of Västerås. Future Alley is a continuation of a previous project called The Future Apartment five years ago, where the involved actors were not only speculating on future energy infrastructure but on what lifestyles in a digitalized Västerås would look like in 2026. (Mimer 2017)

Similar to Smart Energy City, the Future Alley is a research project related to the development of smart grids and a sustainable energy consumption. In the project, the households have access to a web application where their energy consumption and production is visualized. Each apartment has its own set of solar cells on their balcony, and the energy produced is balanced against the cost of the energy they buy from external producers (Mälarenergi, in this case). The application also includes so-called smart functions such as electronic door locks, a home/away button, a heat visualizing shower and water tap and remote controlled power sockets. The project is run in a newly renovated 1960s’ apartment building and includes 18 families trying out the system over a couple of years. (Mimer 2017)

While the Smart Energy City project in Stockholm aims to develop commercial technical solutions, the Future Alley project is more of a test scene where new technologies have been installed just to see what affect they might have and if they could be something that Mimer will standardize in their apartments.

\(^4\) Göran Frendin, project manager at Fortum, phone conversation 04/05/17, and Anders Nilsson, PhD student and researcher at KTH, interview 05/03/17
2 Statement of purpose
By studying the smart home and the expectations of the future life it presupposes, the purpose of this thesis is to analyze how ideas of infrastructure and media are materialized as smart homes and expressed in two cases of smart home development projects. What I aim to frame is the expectations on the domestic use of so-called smart technologies, and how such sites may affect the understanding of infrastructure and media as both a spatial and a temporal phenomenon.

2.1 Research questions
• What fantasies or ideas of a future life and housing are expressed in the two projects?
• In which ways do the smart home bring together ideas of time, space, infrastructure and media?
• How may the dashboards and the energy visualizations in the smart home applications affect the understanding of what infrastructure is and does?

2.2 A note on their research, and mine
The research part of the Future Alley project is conducted by RISE Interactive, where the researchers by interviews and observations have examined how the residents interact with the technologies and devices, and what they think of these solutions. As mentioned above, the research conducted in the Smart Energy City project by KTH aims to evaluate if the application and visualizations change the consumers’ behavior. Thus, if the research in Smart Energy City is of a more technical and instrumental character, the research approach in Future Alley is more of an anthropologic kind. (Nilsson5, Önnevall6)

The main difference between those research projects and mine is the research object; while they focus on users and their encounters with the technology, my focus is the smart home as a materialization of ideas of infrastructure, time and space. Simply put, their research focus is what works and what does not. My aim is not to evaluate the technologies per se, but to use the very visions surrounding these two projects as my empirical material to analyze ideas of infrastructure and media.

5 Anders Nilsson, PhD student and researcher at KTH, interview 05/03/17
6 Elin Önnevall, researcher at RISE Interactive, interview 05/11/17
3 Previous research
In this section I will summarize previous research on so-called smart technology relevant for and related to this study and to the field of media and cultural studies in general and infrastructure studies in particular. As the examples below will show, infrastructure studies of smart technologies are often data-oriented with a focus on digital technology and big data, and what social consequences this contemporary data paradigm might have.

Smart cities, smart grids and smart homes are the concepts that will be featured in this chapter. They are not only concepts frequent within academia; perhaps they are even more of a buzz word outside of it. The concepts are seemingly more established as a research object within technology- and engineering sciences, where, as this review will show, the technology is expected to fulfill expectations on economic as well as environmental sustainability. However, this literature review will summarize previous research on smart technology that connects ubiquitous data with certain spaces, such as cities, regions or homes, in order to situate my own study in this field.

3.1 Smart cities
Kitchin (2013) defines smart cities as urban environments that are

(…) being instrumented with digital devices and infrastructure that produce ‘big data’. Such data, smart city advocates argue enables real-time analysis of city life, new modes of urban governance, and provides the raw material for envisioning and enacting more efficient, sustainable, competitive, productive, open and transparent cities.

(Kitchin 2013, p. 1)

Besides the digital infrastructure, smart cities are often meant to signal creativity, entrepreneurship and innovation; to be a hub in the knowledge economy (ibid. p. 2). According to Kitchin (2013), varying definitions of the smart city still have an underlying “neoliberal ethos” (p. 2), and his research on digital infrastructure and big data departs from the notion of such a market-driven context to which he relates the development of so-called smart cities. Kitchin’s take on smart cities is therefore how big data shapes and reshapes urban development and city planning as data processing become the main way of both analyzing and organizing urban spaces.
Kitchin’s (2013) overview article of smart urbanism gives examples of what kind of data is collected in various smart cities, and how it is presented to the citizens in return. As one of the examples, Kitchin mentions the city of London, where live feeds of real-time data are being communicated to citizens through what have been termed ‘city dashboards’. For example, in the London case, developed by CASA at UCL, citizens can find out real-time information about the weather, air pollution, public transport delays, public bike availability, river level, electricity demand, the stock market, twitter trends in the city, look at traffic camera feeds, and even the happiness level. These data can also be mapped. This is complemented by the London Dashboard, a data visualisation site that tracks the performance of the city with respect to twelve key areas—jobs and economy, transport, environment, policing and crime, fire and rescue, communities, housing, health, and tourism (…). Rather than simply providing the raw data, these sites produce visualisations that aid the interpretation and analysis, especially for non-expert users, and allow citizens to monitor the city for themselves and for their own ends.

(Kitchin 2013, p. 7)

On the topic of such urban dashboards, Mattern (2017) writes: “The ideal display offers a big-picture view of what is happening in real time, along with information on historical trends, so that users can divine the how and why and redirect future action” (Mattern 2017 p. 75, emphasis in original). The urban dashboard is thus a compilation of events gathered from various data collected throughout and about the city. Regarding the aesthetics of urban dashboards, Mattern (2017) notes that they “often mimic the dashboard instrumentation of cars or aeroplanes” (ibid. p. 77) in their attempt at displaying real-time and historical data for monitoring, managing and controlling purposes related to different forms of “performance”, also noted in the quote by Kitchin (2013) above. As the dashboard example show, the data collected throughout and about the smart city is expected to attract interest among its own citizens and provide them with this information by different kinds of visualizations.

In her book Beautiful Data, Orit Halpern (2014) tracks the history of the idea behind smart cities among architects and city planners during the second half of the 20th century, departing from newly
developed urban areas in such as the city of Songdo, in the Incheon Free Economic Zone located in South Korea. Halpern (2014) describes such “testing grounds for the future of human habitation” (ibid. p. 2) as commodity cities:

Marketed as machines for the perfect management and logistical organization of populations, services, and resources with little regard for the specific locale, these products are the latest obsession in urban planning. (…) Marketed as a “smart” city, it is sold as the next frontier in computing — an entire territory whose sole mandate is to produce interactive data fields that, like the natural resources of another era, will be mined for wealth and produce the infrastructure for a new way of life.

(Halpern 2014, p. 2f)

Unlike London, Songdo is a new city still under construction, with data infrastructure as a fundamental part of the construction and city planning. In her study of Songdo, Halpern (2014) notes the shifted view of the potential of the masses since the mid-twentieth century. The notion of the “mass” were central in criticism of the culture industries among Frankfurt School thinkers, but also in general, the “mass” had negative connotations of being a non-independent, non-thinking collective — an idea often explicitly projected on supposedly brain-washed masses in communist regimes (Halpern, 2014, p. 19). Yet today, the belief in the masses has changed, expressed as “our contemporary valuation of collectivity, social networking, and analytics” (ibid.). As Kitchin (2013) and Mattern (2017) point out above, Halpern (2014) too enhance the fact that visualized feedback is a central feature in smart city projects, to provide citizens with information of the city’s “performance”.

3.2 The smart grid

So far, unlike in technology and engineering sciences, the smart grid is an unestablished object of research within the field of infrastructure studies, perhaps since its features is covered by other concepts such as studies of big data and digital infrastructure. However, as mentioned in the review of smart urbanism above, technology based on big data sets are not only applicable to the city itself but also to its systems of energy and water infrastructure. McLean, Bulkeley, and Crang (2016) present a study of the Pecan Street Project, a smart grid project in Austin, US; a project seemingly similar to the projects that will be explored this study. The study by McLean et al. (2016) includes interviews with 16 involved actors in the Pecan Street Project, such as representatives of the city-
owned energy and water companies, the University of Texas, the Austin Chamber of Commerce, city planners and private companies. McLean et al. (2016) note the expected roll-back of the state as a market actor further on, as the project is regarded an experiment for encouraging technological development on a deregulated energy market. Thus, the Pecan Street Project in Austin as well as other smart urban projects as mentioned by Kitchin (2013), is situated in a neo-liberal context where solutions for economic and environmental sustainability is handed over to the market. As McLean et al. (2016) put it: “The ‘smart’ concept (...) has become an umbrella term for a largely ecological holistic modernisation policy to create environmentally sustainable economic growth.” (McLean et al. 2016, p. 3250) The authors also point to how the smart grid hands over the responsibility for a sustainable energy and water supply to the consumers in the individual households instead of the energy companies. McLean et al. (2016) highlights the differences between social groups in their possibilities of making the “right” choices in such a smart grid system. Thus, the authors recognize the conflicts between such goals of economic, environmental, and social sustainability and the authors main point of criticism regarding the smart grid project in Austin is from a social-economic perspective. Similar to Kitchin (2013), the analysis made by McLean et al. (2016) centers on the economic context surrounding these smart infrastructure projects in relation to the specific technologies of data collecting.

3.3 The smart home

This thesis will work with the concept of the smart home according to a definition and description similar to this one, borrowed by Borgia (2014) and computer sciences:

Homes/buildings in a smart city will be outfitted with a myriad of sensors and smart devices (e.g., broadband gateways, mobile phones, laptops, PCs, TV, speakers, appliances, plugs, surveillance cameras, lights, window shades, thermostats, and meters) that, integrated with communication technologies within buildings and residential homes, give rise to a wide range of applications. Home automation systems are certainly attractive since they allow to control everything remotely via web applications. Some applications use the simplest capabilities enabled by IoT [Internet of Things], such as applications for security purpose (e.g., video surveillance, intrusion detection, access management), for plant management and maintenance (e.g., fault detection, asset management/maintenance), for service
automation (e.g., HVAC, lighting, irrigation), and for entertainment systems (i.e., distribution of multimedia throughout the home).

(Borgia 2014, p. 10)

Compared to the concepts of smart urbanism.smart cities, the concept of smart homes is less established as a research object within the field of infrastructure studies. i.e. as an object consisting of the home as a space saturated with Internet connected devices (more commonly conceptualized as the Internet of Things, IoT). Studies on domestic digital devices have more explicitly focused on big data, integrity, surveillance or labour.

In Kitchin & Dodge’s (2011) terms, the smart home may be categorized as code/space:
“Code/space occurs when software and the spatiality of everyday life become mutually constituted, that is, produced through one another. Here, spatiality is the product of code, and the code exists primarily in order to produce a particular spatiality. In other words, a dyadic relationship exists between code and spatiality.” (Kitchin & Dodge 2011, p. 16). With their explicit software focus, Kitchin & Dodge (2011) address the relationship between certain spaces where events occur that involve both humans and software. According to the authors, these spaces call for studies of software infrastructures in order to examine how code and the production of code affect these kind of human-software coproduced spaces (ibid.).

As mentioned in the beginning of this section, infrastructure studies on smart cities and smart technology in general have mainly focused on software, data and the consequences of and conflicting interests in big data processing. Cultural studies have also been made on mundane devices generating data. In an article by Pink et al. (2017), the researchers study how data generated by wearable devices become meaningful in people’s everyday lives, with the aim to understand how “data becomes part of how human experiences, routines, improvisations and accomplishments are played out, how they shift and change and how and why they matter to people.” (Pink et al. 2017, p. 10). From a different perspective, Bakardjieva & Gaden (2012) analyze such wearable devices in relation to Foucault’s theory on “technologies of the self” and thus relate the phenomenon to practices of discipline and power.
In general, this thesis will follow a technical definition of the smart home similar to Borgia (2014). The following section will present a theoretical framework deriving from media theories to understand how media and infrastructure constitute notions of time and space. This perspective of choice also aim to challenge concepts of practiced spaces and events such as Kitchin & Dodge’s (2011) code/space by focusing on infrastructure as distribution, i.e. not only as action; neither will its main focus be the very goods, people or populations that are being distributed.
4 Theory

In an article from 2011, David Morley argues for a turn in media and communication studies towards studies of transportation, to challenge the understanding of the era of digital communication as an era of geographic upheaval and the dissolvement of distances in a world of global connections. This turn poses a criticism towards “any communications studies which fails to problematize the correspondence of culture and territory” (Morley 2011, p. 744), i.e., to not only study the “symbolic, institutional and technological dimensions” of communication (ibid.) but also as actual spatial movement and places. This study of mine will depart from such a stance, aiming to understand media and infrastructure as means of transportation.

As the previous chapter on various concepts of so-called smart technologies shows, studies have been made following what Morley (2011) refers to as the European, Marxist approach to “a materialist theory of communications,” (p. 747), where focus have been on the political economy and socio-economic consequences of managing “smart” territories by big data processing. However, the main focus of this study of two cases of smart home development projects will not be of the very goods being transported, either be it data, people or energy. Rather, this study will follow the North American tradition of understanding media and infrastructure, with the focus being the transportation itself, its relation to and effect on notions of time and space.

Hence this study departs from and understanding of time and space as two separate, yet constantly related axes. This compilation of media and infrastructure theories aim to reveal these inherent relations and contradictions between media and infrastructures as temporal and spatial phenomena, to support the following analysis of the smart home.

4.1 Media as infrastructure

As Morley (2011) notes, the North American tradition of media and infrastructure studies derives from Innis (1951/2008) analysis of the materialities of a medium in relation to time and space:

A medium of communication has an important influence on the dissemination of knowledge over space and over time and it becomes necessary to study its characteristics in order to appraise its influence in its cultural setting. According to its characteristics it may be better suited to the dissemination of knowledge over time
than over space, particularly if the medium is heavy and durable and not suited to transportation, or to the dissemination of knowledge over space than over time, particularly if the medium is light and easily transported. The relative emphasis on time or space will imply a bias of significance to the culture in which it is embedded.

(Innis 1951/2008, p. 33)

In his wide-spanning historical overview following the development of papyrus, parchment and paper alongside the rise and fall of empires, Innis points to what he calls “the bias of communication”; that a medium either has the capacity to spread knowledge over space or over time. As stated in the quote above, a light medium such as paper has the capacity to spread over vast distances while a heavy medium such as clay or stone is durable over time, but less easy to distribute over space. Addressing this bias, Innis’ (1951/2008) reasoning shows the related yet contradictory relationship between time and space when it comes to communication and transportation.

Since it was published in 1951, Innis’ (1951/2008) chapter on the bias of communication has reached canonical status and points to the relation between media and infrastructure on one hand, and time and space on the other.

4.1.1 Logistical media

Following Innis (1951/2008), Peters (2015) suggest the term infrastructuralism as a way of “understanding the work of media as fundamentally logistical” (p. 37).

Logistical media have the job of ordering fundamental terms and units. They add to the leverage exerted by recording media that compress time, and by transmitting media that compress space. The job of logistical media is to organize and orient, to arrange people and property, often into grids. They both coordinate and subordinate, arranging relationships among people and things. Logistical media establish the zero points where the x and y axes converge.

(Peters 2015, p. 37)
In Peters’ (2015) terms, logistical media are considered as media of communication. Peters (2015) uses the term to exemplify how clocks, calendars and sundials are media by their work of organizing the abstract notion of time into specific units, with or without directly referring to celestial movements of the sun and the moon. Peters’ (2015) analysis build upon an understanding of media not merely as carriers of semiotic messages between sender and receiver, but as organizers of time and space. Thus, Peters suggests that media work on a deeply existential level, although the medium itself may seem mundane, barely noticeable and lacks meaning in the semiotic sense.

This thesis will follow Peters’ interpretation of the work of media which points to the close relationship between media and infrastructure, a relationship that might as well be understood in terms of media as infrastructure as his take on media as fundamentally logistical points to its capacity of distributing, although the goods could be abstract such as units of time. In such an interpretation of media as infrastructure, it is a phenomenon that works both temporally and spatially, as well as it simultaneously is both temporal and spatial in itself as following summaries of infrastructure theories will show.

4.2 Theories of infrastructure

As mentioned above, this study of the smart home will build upon theories of infrastructures as means of transportation and distribution. These theories presented below aim to serve the analytical attempt at understanding infrastructure as a temporal and spatial phenomenon, by departing from its appearances, geography and representations.

4.2.1 Infrastructure intelligibility

Introducing the term portal technologies, Parks (2012) suggests that the study of mundane outputs of media infrastructure such as the satellite dish

(...) emphasizes how people come to access, imagine and understand infrastructures, not only by demystifying their seamless operation in everyday life, but also by understanding them as material forms — sites, nodes, parts, pieces, objects to be seen, engaged with, handled, felt and investigated.

(Parks 2012, p. 64)
In Parks’ (2012) example, the satellite dish is such a portal technology which makes otherwise vast, and to a various extent concealed, infrastructures intelligible to people. Although the actual users in the projects are not the research object of this study, Parks (2012) theory of the importance of portal technologies motivates the study of the applications used to manage and monitor the smart home. As the analysis will show, several usually physical outputs of domestic infrastructure such as light switchers, thermostats and on/off buttons are featured in the applications which means that the physical output is complemented by a visual one, which is the one that will be analyzed as a part of the smart home. Thus, this study will focus on these supposed daily sites of infrastructural encountering, as they according to Parks (2012) is important for a democratization of infrastructure knowledge — which partly is what these smart home projects is about; to attract attention to and knowledge of energy distribution and consumption among the users.

According to Parks, the intelligibility of infrastructures is “interwoven with the politics of knowledge, place and aesthetics” (Parks 2012, p. 67), and stresses the notion of infrastructure visibility, which she suggests challenges the ordinariness and mundaneness that otherwise characterize infrastructure sites in everyday life; they often tend to seem invisible until either moments of usage occur or when the system fails (Parks, 2012).

4.2.2 The politics of infrastructure
While sharing Parks’ (2012) notion of infrastructure as interwoven with ideology and aesthetics, Larkin (2013) takes a stance against the idea of infrastructure as mostly invisible. According to Larkin (2013), besides being systems of transportation and distribution, infrastructures have aesthetic dimensions both regarding their form and function, as modern ideas of linear progress through which we gain freedom are deeply rooted in the idea of infrastructures as means of transportation and movement (Larkin 2013).

Thus, Larkin (2013) suggests that the technical function of a road is to “transport vehicles from one place to another, promoting movement and realizing the enlightenment goal of society and economy as a space of unimpeded circulation.” (Larkin 2013, p. 333). Local and national projects of infrastructure are not only constructed for distribution purposes, but as a way to participate in a visual narrative of modernity and circulation and in a “conceptual paradigm of what it means to be modern.” (ibid.). In this sense, infrastructures could be understood as such objects of fantasies and become “the vehicles whereby those fantasies are transmitted and made emotionally real” (Larkin
2013, p. 333). As such, infrastructures are not only mobilizing transportation, but form us as subjects as they shape our dreams and imaginations (ibid.). Thus, the political address of infrastructures work on a deeply emotional level to signify progress and freedom by the means of transportation, and not only the goods or people that are being transported.

From that perspective, infrastructures are not an invisible background, as they come to symbolize ideas of modernity and are objects on which individual and common fantasies and desires are projected (Larkin 2013). It is by such a statement that Larkin (2013) departs from the often-mentioned statement of infrastructures as invisible until they break down, as he claims that infrastructures are “(...) signs of themselves deployed in particular circulatory regimes to establish a set of effects.” (Larkin 2013, p. 336). Because of this symbolism and self-representation of infrastructures, what Larkin (2013) refers to as the “poetics” of infrastructures, the hierarchy of form and function could be rearranged, making it possible to recognize the form of infrastructures as important as their function as means of transportation and logistics.

According to Parks (2012), infrastructure intelligibility is linked to certain practices or modes of perception where infrastructure seemingly appear out of its own mundane nature at certain points in time. Larkin (2013) focuses less on such modes of temporal appearance and suggests that infrastructures carry with them certain ideological beliefs and collective dreams in themselves. Although Larkin (2013) does not write so explicitly, he could be interpreted as understanding infrastructures as both a temporal and spatial object, and that both what they do and what they are carry political and ideological meanings.

4.2.3 The geography of infrastructure
Starosielski’s (2015) *The Undersea Network* is a study of what she describes as the “geography of undersea networks” (p. xi). Visiting landing sites of undersea Internet cables, Starosielski (2015) literally anchors the Internet, with all its supposed clouds and wireless connections, onto the surface of the earth. Starosielski departs from the notion of the Internet as a geographical network instead of the more general understanding of the Internet as consisting of social networks established between people independent of their location. While the digital data, distributed as light signals through the undersea fiber optic cables, is incredibly light and travels across vast distances in what seems to be no-time, its temporal capacities depends on spatial infrastructure. Thus, while it compresses time by its speed over distances, it still requires land, water and other material to do so. These material and
geographical requirements are, as Starosielski (2015) points to, embedded in cultural and political settings which in turn affect where this infrastructure is located and commercial investments are made.

In her study of the Internet as a spatial network, Starosielski (2015) does recognize time and space as these two separate yet related axes by pointing to the difference between representing space (place, volume) as an event (time), and describing its spatial characteristics by other means. This is shown as Starosielski (2015) describes two types of chronological narratives on cable networks:

Despite the spectrum of effects that these technologies have had — supporting both democratic interchange and empire building — cable systems rarely surface unless they fit into one of two narrative structures. The first, connection narratives, focus on the design and technological development of an undersea cable: the plot typically unfolds in chronological order, beginning at the point of the cable’s conceptualization and ending with its implementation. The second, disruption narratives, describe an unexpected disconnection of the cable and detail the threats not only to transmission but also to a broader cultural order. (…) Narratives of both types end at the moment when cable traffic is initiated (or reinitiated), and thus they do not actually depict the cable while it is in operation.

(Starosielski 2015, p. 67)

According to Starosielski (2015), these narratives of chronology and disruption serve as “a strategy of cable insulation: they are discursive surfaces that transmit dominant ideologies and decrease people’s awareness of infrastructure, thus appearing to reduce potential disruption and protect the flows of power routed along cables.” (p. 68) In relation to Parks’ (2012) theory of infrastructure intelligibility as gaining from encounters with portal technologies and system failures, such operations and events would fall under the category of chronological narratives as descriptions of infrastructures in time.

Throughout her expedition along the transoceanic cables of Internet infrastructure, Starosielski (2015) thus finds insulation and interconnection to be the apparent logic of these networks, reflected in the cultural geography around these nodes. Referring to Zygmunt Bauman’s term “liquid
modernity”, Starosielski (2015) suggests that these well insulated communication networks facilitates such a liquid modernity, where global powers demand an increasing fluidity independent of places and tight social bonds, and free from fences and barriers impeding such a flow. Yet Starosielski concludes: “However, the fluidity of global information systems leads to the breaking down of some spatial barriers but is predicated on the construction of elaborate strategies of insulation, fixed structures that shelter power from natural and social threats (...)” (ibid. p. 232). Hence the insulation make sure that cables are safely kept from risks of harm by external damage, whether environmental or unintended or intentional sabotage.

Starosielski (2015) argues for new narratives able to publicly acknowledge these cables and the materialities of global connectivity. Narratives suggested by Starosielski are what she calls nodal and transmission narratives, which offer a discourse of global communication networks as spatial rather than temporal and thereby show “(...) cable using publics the realities of the system’s operation, the dynamics of its capacity and use, and the intricacy of infrastructure protection.” (Starosielski 2015, p. 69).

Cable landings, Starosielski (2015) means, is often well documented events covered by news articles as well as enthusiastic private photographers. As mentioned above, such narratives of undersea cable networks are often temporal rather than spatial in their depiction of the cables in terms of either connection or disruption. Writing on a photo series on cable landings by Taryn Simon, Starosielski (2015) suggests that photographic representation of a geographic network could as well be a nodal narrative:

In this approach, the cables are first marked as ‘hidden’, yet the image renders them as bare, seemingly accessible, and surrounded by open space. The gate around them does not appear to be an adequate mode of protection — anyone who approaches might easily reach over it to touch the cables. Since they are discursively marked as off-limits, we must assume that the cables are protected in some other way. The imaging of this open space thus draws our attention to the invisible structures of security that remain outside of Simon’s frame. Although it shows us the cables themselves, the photograph also directs our attention to the lack of information we have about signal transmission.

(Starosielski 2015, p. 83)
Such a photo series is depicting the security, the insulation, as representations of the cable network itself. As such, the network of transoceanic Internet infrastructure need this insulation to keep up the logistics; it may not be the cables themselves that needs insulation, but the uninterrupted flow of information.

### 4.3 The home

As this study will focus on the relation between the smart home and infrastructure as a temporal and spatial phenomenon, it is also relevant to understand the temporal and spatial aspects of the home from several points of view; architecture, time management and of the home as a location and a space.

#### 4.3.1 Architecture as mass media

Writing on the work and thoughts of architects Adolf Loos and Le Corbusier, Colomina (1994) suggests an understanding of architecture as mass media: “The house is a device to see the world, a mechanism of viewing.” (Colomina 1994, p. 7). As a medium, architecture as something representative in its own right. Following thoughts of Loos, Colomina shows his reluctance against news reports on and photographies of architecture. Colomina explains why:

Architectural magazines, with their graphic and photographic artillery, transform architecture into an article of consumption, making it circulate around the world as if it had suddenly lost mass and volume, and in this way they also consume it. It is not a question of the ephemeral character of the medium (obviously Loos does not object to writing). The problem for Loos is that photography is not able to interpret architecture; otherwise the latter could live in the former. (...) Leaving aside the difficulties of language interpreting architecture, what Loos realized was that photography makes architecture something other, transforms it into a news item. And the news item is, in itself and apart from the fact to which it is referring, an event (...).

(Colomina 1994, p. 44)
Thus, architecture is neither its building nor its photographic representations, as architecture consist of mass and volume and in itself produce images. Therefore, Colomina writes, Loos’ claimed that good architecture is to be described, but not represented; “Architecture in all its possible manifestations — drawing, photograph, text, or building — is, after all, only a practice of representation.” (Colomina 1994, p. 273). As noted by Starosielski (2015), this analysis of architecture as mass media, as producing images and representations, also shows the dual axes of time and space; the contradiction in representing space in terms of moments and images.

4.3.2 Visualizations as time management
In an article by Halpern, LeCavalier, Calvillo and Pietsch (2013), the city of Songdo is described as a test-bed for experimental data processing: “The phrase test bed emerges in the engineering literature to describe a controlled and often isolated development environment in which to test the operability of new technologies, processes, or theories for large systems.” (Halpern et al. 2013, p. 290) According to the authors, Songdo is a test-bed for urban life a product in itself. The place of such smart cities is therefore irrelevant, as the value of the territory is not based on the very land or place but its population and their actions captured by ubiquitous computing; a multitude of sensors capturing data on various aspects of urban life, producing vast data-sets to be processed and correlated. Thus, the land and the infrastructure in such a territory are being built on the premise of potential data wealth; a territory in which the population itself and the data it generates is more significant than the individuals that make up the population (ibid.).

This kind of data-driven urbanism is characterized by calculation, and what is developed in a experimental test-bed as Songdo is methodologies of calculation rather than research with an end-point, a fixed result. It is therefore not important what happens, just that it happens for data to be generated, calculated and analyzed (Halpern et al. 2013).

In her book on Songdo and ideas of vision and reason behind cybernetics and city planning, Halpern (2014) points out the centrality of visualizations; to store data in a digital archive and to retrieve information in real-time, where the seemingly instant result of data processing is presented as visualizations. According to Halpern, the visualizations come to function as a kind of time management, to bridge the time lags between “collecting, analyzing, displaying, and using
interfaces” (Halpern 2014, p. 22). Therefore, Halpern means, the “work of visualization is thus temporal — to modulate and manage this time lapse.” (ibid.).

In terms of time management, what the ubiquitous and calculative computing the smart city does then have similarities to Friedrich Kittler’s term technological media which “process ’real time’ as a temporal event” (Krämer 2006, p. 96). Technological media, by not referring to symbolic time, thus have the capacity to manage and manipulate time. Kittler (as explained by Krämer 2006) calls this time-axis manipulation:

> The most basic experience in human existence — and this is relevant because man is, after all, a physical being — is the irreversibility of the flow of time. Technology provides a means of channeling this irreversibility. In media technology, time itself becomes one of several variables that can be manipulated.

(Krämer 2006, p. 96, emphasis in original)

As the empirical material will show, visualizations presented in the shape of a dashboard is a central feature in the smart homes included in this study. Therefore, the notion of real-time is central to the smart city (Halpern 2014) as well as to the smart home.

**4.3.3 Lived and practiced space**

Following Starosielski (2015), the home could be interpreted as a geographical spot, a fixed location on a map. The housing and property developers participating as interviewees in this study set up such places, houses and buildings, for a home to be located in. Between these walls, the home is a non-moveable object. However, as Raymond Williams (1974/2003) suggests, the development of communication and broadcasting technologies such as the television connected the otherwise closed domestic sphere to the outer world, without the viewer having to leave the private setting of the home. Williams (1974/2003) refers to this phenomenon mobile privatization. Mobile privatization could be interpreted as broadcasting media compressing space, yet Williams point to how such a compression causes a specific cultural effect, which is the relationship between the private and the public, and how the public becomes accessible without the viewer having to leave its private setting. As such, broadcasting media provides mobility (Williams 1974/2003) independent of geographical locations of private or public character.
In turn, the notion of home as a place could be put in contrast to the home as a space, following de Certeau’s (1984) understanding of space as a practiced place. de Certeau writes:

On this view, in relation to place, space is like the word when it is spoken, that is, when it is caught in the ambiguity of an actualization (…). Thus the street geometrically defined by urban planning is transformed into a space by walkers.

(de Certeau 1984, p. 117)

Thus space, in de Certeau’s (1984) terms, is not understood from a strictly geographic point of view, where the home would be a fixed location; de Certeau’s notion of space is of a temporal character.

However, both Williams (1974/2003) and de Certeau (1984) are here interpreted as addressing the lived and practiced aspects of space. Williams as pointing to how the experiences of space, i.e. lived space, are affected by media technologies of sound and light transportation, thus overcoming distances and yet maintain barriers between the private and public. de Certeau’s (1984) take on space, on the other hand, gives space a temporal character; as something that occurs at moments in time.

de Certeau’s (1984) suggested definition of space as a practiced place will he be set in relation to Andersons’ (2010) term anticipatory action. As the analysis of the empirical material will show, the smart home projects are surrounded with anticipations of the future; of future living, on technological development — and of future threats, mainly articulated as climate changes. The latter is a kind of threat that according to Anderson (2010) is acted upon in the present by anticipatory action, which “…have been deployed in liberal democracies to govern a range of events, conditions and crises” to avoid threats to liberal-democratic life (Anderson 2010, p. 779). According to Anderson (2010), future threats such as climate changes differ from systemic interruptions and breakdowns as they are “potentially catastrophic” (ibid.).

Therefore, the practiced space could also be interpreted as a part of an anticipatory action, by which the future is made present as it is acted upon here and now through practices of calculating,
imagining and performing in order to “ensure that no bad surprises happen” (Anderson 2010, p. 782). As such, the smart home may not only manage temporality in terms of real-time, but also manage the future by certain practices; imagining housing developers, calculating computers and residents performing according to what is predefined as a sustainable lifestyle.
5 Method
The method used to collect empirical material this thesis is of an assemblage character. This means that the material used in the following analysis is of varying character with the main purpose to grasp the very ideas and fantasies of the smart home. Together with the theoretical framework, the empirical material will work to support an analysis of how ideas of infrastructure and media are materialized as smart homes and expressed in the two selected cases. The choice of doing a case study is not only to be able to narrow down on the smart home as a concept, but also to be able to relate the details of such a phenomenon and the expectations thereof to other ideas, such as sustainability, on a more structural level (Jensen 2002, p. 239). The selection of the cases and how the material was collected and processed are described below.

5.1 Selection of cases
There are several reasons why I have chosen to focus on these two Swedish projects, Smart Energy City in Stockholm and Future Alley in Västerås.

First of all, what motivates a study of these two projects are their futuristic claims in combination with resources and investments of important size. Apart from economic investments from the involved companies they have received public funding from the Swedish Energy Agency, which means that both private and public investments are being made to develop technological solutions both for a Swedish market and for markets abroad. With the combination of both public and private investments together with academic research being made, I find these two projects to be influential on the local housing markets where they are situated, as well as contributing to an influential discourse on what good living standards are. Therefore, both projects are rich with ideas not only on how to develop the best apartments for people to live in, but also how this kind of living will affect society for the better. In the middle of all this we find both digital and energy infrastructure as a key component for organizing domestic space in a way that is meant to ensure environmental sustainability.

Secondly, I have chosen Smart Energy City and Future Alley as cases for this study partly of pragmatic purposes, although similar projects have been carried out in for example Hyllie in the south of Sweden. Since I have been located in Stockholm during the period of writing, the involved companies and their representatives were easy to access and visit for demonstrations and interviews. While Smart Energy City was my first chosen case, I came to know of Future Alley later on. The
reason for choosing a second project to include in my study was for me to be able to collect more material to analyze. As the analysis will show, the difference in locations and project organizations do not seem to affect the ideas of the smart home and future living.

5.2 Material

5.2.1 Interviews
The interviewees that make up the main part of the empirical material in this study are two project managers at property companies involved in the Smart Energy City project, and one business developer at Mimer, the company running the Future Alley project. The choice to interview these three persons in their professional roles was because of their place in the chain of product development. As both projects aim to develop the interviewees’ products, I found it interesting to interview these persons that neither are the producers of the technologies installed, nor the end-users of it. Rather, these interviewees represent the supposed customers of these smart products, as the aim is to develop business-to-business products. In contrast to business-to-consumer products, the end customer is therefore housing companies and not the residents themselves. Although Mimer’s main purpose is not to develop commercial solutions, still the project serves to develop their own product.

The reason behind my decision to interview people at these positions was to capture their expectations on the smart home and of infrastructure, although they lack the specific technical knowledge on how it works and the experience of using it themselves. Their positions could also be reflecting the belief in the involvement of the many. The benefits of this technology are thus partly different between these housing companies and the end-users, as the former gain lower energy rates in their properties while the end-users gain convenience. As customers eventually deciding to install this technology in their buildings, the housing companies are also an influential actor in the general development of digital infrastructure as their decisions on living standards do effect the many looking for a place to dwell.

The study also includes an interview with an architect behind one of the buildings that make up the Active House in the Smart Energy City project. The reason for this was to understand the possible attractiveness and visions of smart technology from an aesthetic and build-technical point of view.

The four respondents were:
• Mats Nissling (MN), project manager at Bonava, involved in Smart Energy City
• Johan Ehnström (JE), project manager at Erik Wallin, involved in Smart Energy City
• Ola Jonsson (OJ), architect at CF Møller, main architect at one of the buildings that have come to make up the Active House
• Mikael Söderberg (MS), business developer at Bostads AB Mimer (commonly known as Mimer)

The interviews were made in April and May 2017. The interviews were semi-structured, and they all took place at each interviewee work place respectively, except the interview with Mikael Söderberg at Mimer, which took place in Mimer’s show room named the “The Future Apartment”.

For each interview I used a brief interview guide to get a bit of the respondents role in the project and background information on how and why they got involved in or initiated the project. As the interviews progressed, the interviewees were encouraged to speak more in visionary terms on their expectations on smart homes and digital technology in general, and how they thought it would affect life, living and property development in the future.

All interviews were made in Swedish and they were all recorded and later transcribed. The purpose of recording and transcribing were to be able to capture the very formulations of the interviewees in order to quote them as correctly as possible. The transcriptions also served an important purpose when sorting out relevant material and quotes that would work together with the theory to support the analysis. This sorting was made by identifying common themes such as the future, transportation and the car industry. After themes and relevant quotes where identified, I translated the quotes from Swedish to English. In the translations, I have tried to remain as true to the original expressions as possible which at times forced me to do more of direct translations instead of finding the proper English expression. As Swedish speaking, I found this to be the best solution to present the expressions of the interviewees and my interpretation of them in a manner as transparent as possible.

Besides a former project developer in the Smart Energy City project, I also spoke to the main researchers in each project to find out more about the academic involvement, and to people involved in the development of software used in the projects to find out more about the applications and visualizations that are included in the analysis. These interviews were either carried out by phone or Skype, or by me visiting them at their work places. I also made interviews with Anders
Nilsson at KTH and Elin Önnevall and RISE Interactive which were first thought to make up a part of the empirical material. However, as the writing of the thesis has progressed, the information and the experiences they shared with me turned out to be better suited as background material to both projects.

5.2.2 Applications
Part of the material that make up the analysis consist of screenshots of the applications developed and used within the projects. These applications are what the residents use to interact with the system; to manage heating, monitoring their own amount of energy and water use, compare their consumption with others, check the electricity price and so on.

I have not had access to the applications myself during the analysis, although the applications were presented to me by business developer Eric Fagerström at Tingcore/Fortum and by Mikael Söderberg at Mimer respectively. The screenshot from of the application used in the Active House project is taken from a folder named “Home Sweet Home” that were sent to me by Fagerström, meant to present the project to involved families. The screenshots from the application in the Future Alley project were sent to me from RISE Interactive upon my request. Therefore, these screenshots have not been analyzed from a user perspective, but by looking at their design and aesthetics in a way that relates to the themes that also are to be found in the interviews, promotion and research material and in the theory.

5.2.3 Promotion and research material
The following analysis is also based upon material from the project’s websites, and other material such as a booklet and a promotion film from the Smart Energy City and Future Alley projects. The promotion film was published at the Smart Energy City website, also available at Fortum’s YouTube channel, introducing the Active House. When visiting the Future Alley show room, I got a sample of the Future Catalogue, a booklet of forty pages that were handed out to the participating residents as a part of the research conducted by RISE interactive.

The promotion video is published in an English version with English subtitles, and is the one that I have used in the analysis. The Future Catalogue is in Swedish, which means that I have translated the quotations in the analysis. The quotes from the Smart Energy City website are taken from the English version, while the Future Alley website is in Swedish and the quotes are thus translated by me.
5.2.4 Text analysis
As the following analysis will show, all the empirical material has been analyzed on a denotative, manifest level. The purpose of the analysis, and the very nature of this study, are not to explore latent meanings or motivations behind the interviewees’ or involved companies’ involvement and interests in these project and smart home developments. The reason for this is also partly because of the study object itself; in this thesis, media are not understood as merely a semiotic technology, which is why I will not analyze the material on a semiotic, symbolic or discursive level in order to understand the work of media as defined in the theory chapter.
6 Analysis

Despite their partly different backgrounds, the projects Smart Energy City and Future Alley aim to contribute to smart grid development by installing so-called smart technologies in the apartments that are included in the projects. According to the presentations of the projects, Smart Energy City involves 150 families living in these smart apartments in three different properties, while the Future Alley project involves 18 families in the same building.

The apartments are equipped with different devices that have an Internet connection. The idea behind the smart grid is to digitally connect things such as refrigerators, washing machines and tumble dryers to the power grid for the grid operator to know where and when energy is needed, and where it is possible to reschedule the usage of each device in order to get a more even energy distribution and avoid so-called load peaks in the electric grid, i.e. when a lot of people are using energy at the same time.

While the grid operator is able to see and manage the energy consumption in the households connected to the smart grid, the devices, along with other sensors such as hot water meters, thermostats, and power sockets, also provide the residents with data on their own energy consumption. This data is visualized in an application where each household is provided with this information, the environmental impact of their energy consumption and/or (differs between the two projects) the energy price. As the households also have access to local solar cells, their energy production is also visualized in the applications.

Departing from the empirical material, this analytical chapter will start off with an attempt at understanding what is meant by “smart” in the two projects.

6.1 Just what is meant by “smart”?

On the project website for Future Alley, a site hosted by the local and city-owned landlord and property owner Mimer who runs the project together with the energy company Mälarenergi, the smart grid is presented as follows:

To meet the climate challenges, we need to be more energy efficient and switch to more renewable energy such as solar, wind and water energy. The electric energy we
demand needs to be produced at the very moment it is being consumed. Today, there
is no signal system that shows how energy is produced and the incitements for
consumers are too small to make them adjust their energy consumption to times
when the supply of environmental friendly electricity is better. When energy
production becomes more weather-dependent, the power grid needs to be able to
organize, so that usage increases when there’s a lot of energy, and decreases when
the supply is lower.

Together with Mälarenergi, we have installed a smart grid. This means that the
residents have an electricity subscription where their energy consumption is
measured and charged hour by hour, possible to keep track of by their computer, TV
or mobile application. If they use less electricity when it’s expensive and more when
it’s cheap, they’re able to save both money and the environment. (…).

(Mimer 2017, my translation)

The purpose of the Future Alley project is also to “analyze how to develop sustainable lifestyles in
renovated apartments by new technologies for smart grids and solar power” (Mimer 2017, my
translation). The implementations and try-outs of this kind of communicative energy infrastructure
thus come with promises and hopes for sustainable lifestyles, which smart devices at home will help
to achieve.

In Smart Energy City, the smart home-part of the research project is called the Active House. At the
project’s website, it reads:

The Active House will soon welcome 150 typical families into untypically smart
apartments. Because in these apartments there will be a lot of things that can make it
easier to change the way you use electricity. There will be smart plugs that can turn
off machines in stand-by mode or switch off lights when they aren’t used. There will
be smart thermostats that can lower the temperature when you sleep or when you are
away. And there will be smart washing machines, dryers and ev-chargers [electric
vehicle-chargers] that can be set to start when electricity is cheap. Or when there is a
lot of clean electricity in the system.
Every family will have a tablet that shows how much electricity they’re using, how much it costs and how much carbon dioxide the usage is generating — right now or on a yearly basis. The tablet also lets them make the settings they find best for their electricity usage. And when monitoring all this, we will learn as much as possible, to find out what changes are needed to make it even easier to be energy smart.

(Fortum 2017a)

In both projects, price and environmental impact is used to encourage users to move their energy consumption to other times than mornings and evenings, to balance load peaks in the power grid. The rhetoric surrounding the projects clearly connects the smart grid and its domestic outputs to a necessary shift towards environmental sustainability to “face the climate challenges” in a future scenario of renewable energy sources and higher energy demands. Compared to the economic incitements of lower energy costs, the rhetoric of sustainability is more explicit in the use of the word “smart” than economic arguments, although the latter is also meant to motivate the users to make smart choices.

As previously mentioned, the Future Alley project in Västerås did not start off as a smart grid project *per se*. It started out from another project a few years earlier when Mimer celebrated 90 years in business. That project, named the Future Apartment, was a vision of how people would live in 2026, at that point about fifteen years ahead in time. The project was later developed further into the Future Alley project, where a property built during the 1960s’ building boom was completely renovated and updated with new, smart technology. On Mimer’s website, the project is described as follows:

At Allmogeplatsen 25–29 in Vallby, Västerås, one of Mimer’s buildings with 19 apartments have been rebuilt. During the first two years, those who live in Future Alley will participate in a project on how to use energy smarter through their behavior. This means that they will be able to see how much energy they use and get tips and advice on how to reduce their usage. Researchers are tied to the project and those who live in Future Alley will be interviewed on a couple of occasions. The purpose is to see how smart energy can be used and integrated in a satisfying way.
In Future Alley, the residents can join in and make a difference. And live in a really modern apartment, at the same time.

(Mimer 2017, my translation)

Thus the meaning of the word “smart” varies from describing the very characteristics of the energy itself, the capacities of the technological solutions and an informed and conscious behavior among the users.

**6.2 Imaginations of future living**

This part will focus on ideas and expectations of life in the smart home as expressed in the two projects. The analysis departs from a promotion video, a booklet and interviews.

**6.2.1 Everyday life in the smart home**

On the webpage where the project Smart Energy City is presented, there is a two-minute promotion video introducing the Active House by a staged scenario picturing everyday life in the smart home. The video (Fortum 2017b) starts with aerial photos of a green landscape with trees, a creek and a small road with a person walking on the side of it; in the next scene, the view pans over the creek and a pier with a couple of leisure boats attached to it. The camera flies over a house with solar panels on the roof before the second part of the films begins. A text over the images reads:

More electricity will be used in the future  
Consumers will take conscious decisions and  
the share of renewable energy with solar and wind increases  
This places higher demands on the power system  
We are researching a smarter power system in the Stockholm Royal Seaport  
that can handle future demands and ensure a sustainable supply of electricity

A bit speeded up, the film then shows a man in his 30s arriving home. As he parks his car, he attaches it to the charging pole before carrying a bag of grocery to his apartment. Inside, he uses an application on a tablet on the wall and switches it from “away” to “home”, and puts the bag of
grocery on the kitchen sink. Before he starts preparing dinner, he loads the washer with a bunch of clothes picked up from the sofa and uses the tablet to schedule when he wants it done. Then he starts cooking; he chops vegetables, cooks two salmon filets and puts a baking dish into the oven. He sets the digital panel on the oven to “potato gratin”.

![Fig. 1. Stills from the Active House promotion video.](image)

Before dinner is ready, he changes his shirt and dims the lights. He goes on by lighting a couple of candles before the doorbell rings. A woman of his age arrives, they greet with a hug before sitting down at the table. As the video ends, they raise their glasses in a toast, smiling and laughing. As in the first part of the video, a text reads over the images:

- Adjust the temperature and lighting
- Charge the car when it is cheapest or best for the environment
- Do the wash when it is cheapest or best for the environment
- Dim the lights in selected rooms
Lower the temperature in the apartment
Together we are working towards a sustainable energy society

The final line, “Together we are working towards a sustainable energy society” reads over the image of the man and woman having evening dinner. Regardless of their relationship, the situation is obviously a quite intimate one, with lit candles and wine while sun sets and darkness falls outside the kitchen window. The video’s background music is a chill house tune, until the final scene when a man’s voice can be heard, singing “I’m on my way”.

Although the application includes energy visualizations, the man, seemingly caught up in his everyday activities of preparing dinner and doing laundry before his dinner company arrives, only uses the scheduling and dimming functions in the application. In this video, the man does not contemplate over his energy consumption by watching the app — at least not in this scenario. The speed of the video suggests these scheduling and dimming functions are easy to use in a hurry, and the moment of intimacy and contemplation is rather set to the dinner than to the use of the application.

As the examples above show, the expectations on the user of this smart home technologies are for him to become energy smarter, to use smart energy in his smart apartment. When it comes to the Active House, being “energy smart” is to use plenty of electricity run devices, but in a “smart” way that sends information to the smart grid on when and where electricity will be needed. Such a future is described as follows:

Right now it may seem like science fiction, but soon we will hopefully be driving around in electric cars, traveling in electric buses and transporting things on trains and trucks that also run on electricity. And with faster broadband and more stuff in ‘the cloud’ more of us will work, shop and laze around online — we’ll simply be using a lot more electricity. And this is ok, since things that run on electricity don’t emit any greenhouse gases. As long as the electricity they run on is produced in Sweden, anyway.

(Fortum 2017a)
In the Future Alley project, a booklet titled “The Future: For research purposes” [Framtiden: Iforskningssyfte], also referred to as the Future Catalogue [Framtidskatalogen], was handed out to the families and tenants living in the 18 apartments where the new technologies have been installed. As RISE Interactive, who conducts the research in the Future Alley project, was called Interactive Institute at the time, the introduction page of the booklet reads:

This catalogue helps us researchers at Interactive Institute Sweden ICT to develop new products and services for the future. Your answers will be an inspiration to us and at the same time contribute with new knowledge on what people would like future living to be like.

(Mimer & Interactive Institute n.d.)

The Future Catalogue consists of 40 pages with short texts and photographs from staged scenarios in the show room, which is located in one of the renovated apartments. The catalogue holds suggestions of what technology can contribute to in future scenarios of smart living. The respondents are encouraged to contribute with their own thoughts, comments and suggestions in certain fields in the pages, but also wherever they feel like adding something on what ideas they like and dislike.

The imagined apartment in the Future Catalogue has various sensors installed. In the kitchen, temperature settings for the chosen recipe is downloaded to the stove, and the stove itself makes sure that it is “making the pot perfectly cooked and never burned”. Stove and oven could be turned on and off from wherever by an application, which in turn can send reminders if for example the stove is left on when everyone have left home. The same goes for doors and windows; if you forget to close them, you get a warning notification right before you are about to leave. When you are away on holiday, the lights could be turned on and off as if you were home. The catalogue also suggests a caring function, consisting of sensors that send an alarm to your friends and family if you have not been moving around for a while. This would alert them to check up on you and make sure you are OK.
Fig. 2. Spreads from the Future Catalogue.
By installed sensors, the refrigerator knows and tells you when food is about to get too old, and it could order what’s missing and suggest recipes from what is already in it. It could also show when it has been open for too long. The indoor plants have a built-in system that makes it possible for them to water themselves if you forget to do so, and sensors in the pots tell you about the plants’ needs and when they are ready to be harvested. The water bowl for your pet also refills itself when empty. In the bathroom, the washing machine automatically starts when it is full and the level of solar energy production is high. The laundry basket sorts out the laundry itself, and the vacuum cleaner knows when cleaning is needed and starts when nobody is at home. Sensors on the bathroom mirror is able to smell and tell you whether you need to take a shower or not.

The living room is a space for relaxation “after a week of hard work”, for example by watching a movie. Sensors in the rug on the floor make the viewer feel as if walking on grass, when grass is walked on in the film. Lights and scents are adjusted to fit the current activity in the room.

In the bedroom, the bed has sensors and is able to adjust to your temperature, and the light and temperature in the room are adjusted for sleep and waking up. In the bedroom, there is also a “built-in alarm connected to traffic information. If there are problems with traffic jam you are woken up later.” The catalogue also suggests a “decorative installation” in the shape of a tree to “remind you to relax without using electricity, when electricity is expensive and when the load in the grid is unbalanced.” A mirror in the hallway also has sensors to read your facial expression and it provides information on what to wear according to today’s weather forecast and your mood.

Future living as presented in the Future Catalogue is saturated with data and information to improve living standards, including better sleep, relaxation and entertainment. Data is to be extracted from the bodies of the residents as they move, sleep, smell and express moods; from the refrigerator, washing machine, and films; from organic plants and their pots; and from the surrounding city. The food logistics is either reduced to a minimum of transportation by smart plantings, or automatized as the refrigerator manages the shopping. The fantasy of future living that reads from the catalogue is one of automatization and information technologies on one hand; technologies for saving and producing energy on the other. The material in the catalogue presents an apartment where the home as a place for convenience and relaxation is improved, and together with the new technologies the apartment reduces the environmental impact.
In my interviews with project managers from two of the housing developers involved in Smart Energy City, I asked them what attracted them to participate in the project with the properties they had built in Stockholm Royal Seaport, two out of the three properties that make up the Active House.

In my interview with MN, project manager at Bonava, he told me that first of all it seemed like an interesting solution and that it would be interesting to see how it would affect their clients, the ones who would live in their apartments. While Bonava had worked with energy visualizations and other concepts to reduce energy consumption earlier, MN says that the Active House started off as a continuation of such things, but with some new stuff to it. From their perspective, the smart functions added to the Active House is a way to create customer value, to add convenience to the energy project. MN is convinced that smart technology is here to stay, and that it is a growing market. Especially in the US, he says.

MN: (…) It’s just about finding the right focus on what costumers wish for, while they, while we have to make sure it functions well. And it could, today we have for example lights control but it may become more functions to it so that you can control much more from your phone, I think you will, will be like in the node all the time, that you’ll be able to control from your phone wherever you are, you know. Your home, your part of the neighborhood, or your house, if you have your own house. If you get home then this technology may sense like ‘Now this person is getting closer, so I’ll light up the house…’ maybe.

JE, project manager at the housing developer Erik Wallin, tells a similar background story of their involvement in the Smart Energy City project; how it started off as a project where energy consumption was to be visualized in the apartments. He explains its continuation:

JE: Then all of this have started to drift off in another direction towards different possible functions, to get safety and the possibility to turn lights on and off, even when you’re at work you can turn the light off at home, and so on. (…) Our feature in this is that this could be… you know, a cool thing to offer our customers. And it’s fun to join in on such a project, where we could learn something and understand more… But we had really no super high, you know, expectations, that this would be
something that made our clients… it’s just something extra for our clients, it’s not something that in itself would get the apartments sold.

KH: What was it that seemed attractive about this [project], or interesting?

JE: What was interesting was new technology, really. Besides that, I mean, first of all we could join in for free, we didn’t take any huge economic risks. (...) But we soon realized that this, this is such a big investment, there’s millions being pumped into this project you know, by big Swedish companies, so we realized that this, this will work, you know.

JE goes on by describing some of the functions in the applications that he thinks will be useful in the system.

JE: One thing, one such feature that I [inaudible], it’s this thing with light scenarios in the apartment, that you can dim the light, to lower the light directly from the application and not have to walk all the way to the wall to dim the lights, and there’s a lot of dimmers in our houses because of their size … So that was a feature, that, that’s something you actually could use. And then there’s also all this stuff we mentioned earlier, to include safety in this with camera surveillance and all. And since it would be possible for you to have it on your phone as well, not just on this app at home, it would be possible to, like, check the status at home, check up on your kids or whatever, there’s a lot of such features.

To these housing developers, energy efficiency was one of the arguments for joining the project, but perhaps even more the possibility to add “customer value” to their products: the apartments. From their perspective, the added features in the Active House besides the visualizations of energy consumption is a way of improving convenience and quality of everyday life. The potential change of lifestyles to balance load peaks and raise consciousness about environmental issues are thus combined with improved living standards, most often articulated as convenience. As the following section will show, this convenience in everyday life is often related to logistics.
6.2.2 Logistics in the smart home
As mentioned earlier, the fields of domestic improvements presented in the Future Catalogue are thought to be managed by sensors and means of transportation of information and other goods, including everyday logistics like grocery shopping. Such a scenario is also mentioned by project manager JE at Erik Wallin, as we talk about the Active House in the smart Energy City project:

JE: I heard about, eh, it’s actually quite scary, but … Amazon, in the US, they started out as a bookshop on the web basically, and now they’re gigantic. And then they, apparently they’re promising … In vast areas all over the US, they’re promising direct delivery of orders, in one day. (…) This means that you’ll be able to buy but a liter of milk and get it delivered the day afterwards. Or in two days, maximum. It’s such an incredible … logistics, you know. You can actually buy the stuff and then get it delivered, like, straight away. So logistics wise, it’ll change society a lot, if this trend is here to stay. And even reach Sweden, you know.

In my interview with OJ, the architect that have been working on one of the buildings making up the Active House, I ask him about what he thinks housing and living will be like in the future. He is quite convinced that food logistics will change in the future:

OJ: It’s insane that everyone goes to the store every day to buy grocery. Not that anyone enjoys it, but they do it because they know that if I order from Mathem [an online food store], I’ll get a quite sad avocado, I want to be able to choose my own avocado. Then it’ll be like: ‘Karin wants her avocado this way. Then she’ll get it delivered today.’ So this … this will all come eventually, you know.

As in the Future Catalogue, future technologies as imagined by OJ are sensory, as they would sense and pick the right avocado, and then transport not only the information but also the avocado itself.

MS works as business developer at Mimer who runs the Future Alley project in Västerås and in my interview, I ask him what he thinks future living will be like for Mimer’s tenants. He answers that most things probably won’t change that much, although a lot of other things will be “radically different”, such as the way we travel. He continues:
MS: My theory is that in twenty years from now, it will be forbidden to drive a car by yourself. You have to leave the driving to the car itself, you know. And because of that you won’t need a car, you can just order your transport. You’ll pick up your smartphone, or whatever it is that you have in twenty years from now. And say: I want to go from [gives an example] to [example]. And then a car shows up and takes me there. When I don’t use it, it will be doing some transportation somewhere else. So these gigantic parking lots we see in our neighborhoods, they are probably history in twenty years.

Similar to project manager JE, and the architect OJ, MS says that another thing that might change is how we buy our food. “Maybe we’ll only do it online in the future; maybe not”, he says.

KH: Do you think that the way you plan and develop properties will change because of this [how we would travel, drive, order food and so on]?

MS: Yes, I think we need to have a more industrialized production. (…) A higher degree of prefabricating where you have ready-made modules put together at the construction site. There won’t be many constructions where you build piece by piece, unlike today where you build every plank, every stick separately. It will be more like the car industry, having subcontractors delivering complete systems. (…) For efficiency reasons, I think it’ll have to be like that. (…) Today, the car industry is still building different cars out of the same platform, you know. I think it will be like that even in house construction. Our needs, our fundamental needs, are not that different.

MS says that some might find these module-built houses boring and monotone since they would all be constructed from the same modules, and uses the car industry as an example of module-production resulting in products that still differ from each other and yet consisting of the same components. Although my question was aiming more at how the properties, in terms of spaces for living, will be affected by this in the future, his answer says something about the possible future of Mimer’s business in building and planning housing properties — and that a good example of a more industrialized production is the car industry.
KH: What do you think of this smart technology, then?

MS: It’s really up and coming. That’s how it is. We probably haven’t understood yet how much will happen. That’s why I think it’s going to be more, you know, everyone will have their own device of course, their own display, their own … laptop … Today there’s more in a phone than it was in a computer ten years ago. And it will just go faster and faster. So … I think, you need to make this development possible, but I don’t think that … as property owners we are way too slow. We won’t be able to keep up with this, it’s up to us to give others the opportunity to do business, to collaborate with others.

To MS at Mimer, but also to JE at Erik Wallin, there is an eagerness to try out these technologies and to use their properties as such test sites for new innovations, as the development seems unstoppable anyway.

However, the architect OJ does not think future buildings in themselves will be affected by new technologies, as if everyone would just need “a small room by the size of four square meters and a pair of 3D-glasses”, he says. In OJ’s view, what is most problematic with new technologies and screens is the risk of losing touch of “reality”, as in one’s surroundings, including other people.

KH: How do you think future media usage will affect architecture?

OJ: Well, in best case … I mean, when you see children … you get a bit scared, you know, that … their eyes are turning all square. [I hope] that … media will help people get in touch with reality, not the other way around. (…) If there is natural daylight with sun and all that, and then go sit in a dark room to look at some TV-screen lighting up the room, there’s a contradiction in that. And that’s where I think all the amazing technological knowledge new generations have, it should be used for something more valuable than to sit and build Minecraft-cities. (…) You know, technology is a part of everything you use to put a house together. I don’t think, and
this sounds very conservative, but artificial worlds are very exciting and all that, but I don’t think that it’ll necessarily affect architecture a lot.

Asking OJ how much he thinks architects will consider new technologies in future work, he says that information technologies have to be involved in a natural way, “without it being something you have to constantly think about.” Information technologies also have the potential to make the house itself “interact with its surroundings”:

OJ: Houses can interact with their surroundings, [and] I think it is important, this synergy, that the houses breathe a bit, together with the city. I think there’s a lot of opportunities there, with technology. In some sort of information society. (...) To exchange goods and favors, even service; there might be a car mechanic in the same house that can help me, like, for a cup of coffee, you know. Instead of going to a garage on the other side of town. (...) So I think there is an … interaction, and information, about what you can find in your neighborhood. I think IT will help and be a bit like, as the world also have been, and always is in different ways, that interaction between people, it doesn’t always have to be physical but you can get to know your surroundings and even local—, in the small scale, by such technology. I think … cool. A lot of experiments are being made with facades that recognizes people on the street, you could really have such a thing.

Unlike modern architecture as a photographic way of looking, i.e., as a medium producing representations (Colomina 1994), future buildings in OJ’s vision will produce (inter)actions with the surroundings by involving information technologies with the architecture in “a natural way” that makes the houses “breath a bit together with the city”. This could be interpreted as an architecture that moves from being a medium producing representations in a semiotic realm (as in the analysis by Colomina 1994), to being a medium that produces real-time (as in Kittler’s definition of technological media, in Krämer 2006).

OJ also hopes for information technology to help the “incredibly analogue housing market” in Stockholm, to match those in need for a bigger apartment with those in need for a smaller one. He suggests that information technology could be helpful by matching people that could live together, a
bit like the suggestions made after watching a movie in streaming services such as Netflix: “If you liked to live with this person, you may like to live with this person too.” What OJ sees as the main benefit with new technology is therefore not necessarily just automation of for example grocery shopping for convenience purposes, but:

OJ: (...) to use technology and energy for things that are important and meaningful. (...) Because, it’s not supposed to make people passive. You now, people, mankind, are herding, one should interact with people, one should interact with activities. And that’s where technology can help. Instead of making things worse.

Thus OJ’s idea of information and actions also seems to be related to making urban life more efficient; to save time by finding a car mechanic in the same house instead of going the other side of town, or to speed up the rotation, the time of wait, in the housing market. Yet there is also a spatial dimension to this notion of efficiency, as reflected in MS’s prediction on the future absence of parking lots. According to MS, one of the reasons that these parking lots will disappear is that the value exchange is too low; too low to build big parking lots for having cars standing still. Following Starosielski’s (2015) terms of flow and insulation, the space that make up the parking lots could be interpreted as impeding such a flow of both logistics and capital. In this case, parking lots are an obstacle to this notion of flow; being inefficient, as they are being a place of — and actually for — inactivity.

The logistics of the smart home are thus not only about transportation of information and goods and providing convenience by saving time spent on transportation for the user. The logistics are also of an organizing character; it could organize people waiting for an apartment to rent; or time, in terms of real-time; or space, in terms of having cars in circulation instead of building parking lots. The organization of space could also be understood in terms of mobile privatization (Williams 1974/2003), as the applications available for each household in which features such as light switchers, safety alarms and so on are to be managed, have the same effect as broadcasting media; bridging private and public spaces as the smart home (private space) could be watched from public spaces, or wherever the user might be located. This notion of mobility and its relation to the applications in the smart home will be developed further in the following section.
6.2.3 Applications and visualizations

As noted by Kitchin (2013) and Mattern (2017) in their studies of smart cities, a central feature in the smart homes in this study is the dashboard. In these cases, each household have their own tablet or log-in to a web application where data regarding their energy consumption is visualized on this dashboard, along with other features such as switching lights and sockets on and off, and a home/away button to adjust lights, temperature and other devices depending on whether anyone is at home or not. In the applications, the energy price is also included as well as the production rate of the local solar cells. By the time this study was carried out, the applications did not yet include the safety features as mentioned by the interviewees, although they were under development.
Fig. 3. Dashboard in the Future Alley web application.

Fig. 4. Dashboard in the Active House tablet application.
Looking at the Active House dashboard (Fig. 4), the inspiration from the car industry is apparent in the aesthetics with various meters on a black, quite shiny background; a similarity also apparent in Mattern’s (2017) findings. According to Erik Lundgren, one of the developers that worked with the application and its visualizations, the idea was to create a “cool” and engaging visualization of energy consumption by some sort of speed meters. This speed meter idea came from Fortum, Lundgren says, as they assigned his firm to build the application. Although different versions of the application were developed during the design process, the energy visualizing meters lasted throughout the continuous iterations.

However, there is a difference between the speed meter in the car and the speed meter in the Active House application. While a speed meter in a car shows effect (the performance of the motor: how fast you are going in relation to distance and time), the meters in the application show how much energy (fuel) you have been using, like the fuel meter in the car. Different from the car though, is that the amount of fuel as visualized in the application is not limited; the fuel meter counts upwards instead of down to an end of fuel supplies. Although the meter in the application visualizes the amount of energy consumed, the car-inspired aesthetics rather refer to performance than to the amount of fuel the performance requires. This design reflects what seems to be the key strategy to a sustainable future in this context as the main purpose of these project is not to use less energy demanding devices, but to secure their performance by making energy consumption more efficient.

The inspiration from the car industry is not only present in the aesthetics in the Active House application. As in the interview with business developer MS at Mimer cited earlier, the car industry is mentioned by several of the respondents as an answer to business management and to a shift towards sustainable energy production. At the end of my interview with JE, project manager at Erik Wallin, he wants to add another thing he came to think of regarding energy, as Smart Energy City started off as a smart grid project aiming to reduce environmental impact by digitally connected electric devices at home.

JE: What I think is up and coming a bit is to charge energy in the apartments. Today they have developed these batteries that … with an incredible capacity. So it would be possible to charge these batteries in the basement, for example. With sun energy.

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7 Erik Lundgren, front-end developer at HiQ, phone conversation 05/31/17
(…) So the car industry, they are you know like test pilots in all this, they work a lot with batteries to get rid of fossil [fuels]. There, the development has reached really far. And we can join in a bit. So I actually think this is up and coming. Definitely.
(…) I am no specialist at this stuff but that’s how I perceive it [laughter].

As space taken up by apartments pay more than shared spaces in a building, JE mentioned earlier how it is more profitable for them to build bigger apartments that fit a washer and a dryer instead of building houses with smaller apartments and a shared laundry room. Therefore I ask him how they would look upon such a battery space in the basement, as it would be placed in the shared space of the building.

JE: Well, since the batteries lower—, they are … I know that they … Tesla are testing-, there are these big plants where they will look at, these gigantic sun plants … to charge batteries as well. And those batteries, they are incredibly efficient, and they aren’t … Their size is reduced, so you know … And it’s no environmentally friendly stuff in those [batteries], lithium and all kinds of shit, you know, but they are incredibly efficient.

As the answers shows, the idea of the battery basement is apparently of a more visionary character than concrete ideas operationalized into business models including the costs of building for such battery spaces. Thus, the charging house is still more of a dream than reality. Still not sure of the exact future of energy consumption, JE seems quite convinced that the car industry is on to something, and that they as property developers can “join in” on the advancements on energy efficiency made there.

The car industry is also present when I ask MN at Bonava what he thinks a future home will look like. He answers:

MN: I think there will be a lot more than smart functions at home. If we look at the US, in America, there’s a lot more there than we have here, the market is bigger there. But I think that it will be more like … just look at the car industry: more safety, perhaps you’ve got lock functions so that you know when it’s locked, there’s
fire alarms, burglar alarms and so on, that’s related to all this. It’s already out there today, but I think it will become more and more of a standard, to include such things in buildings.

In this quote, the car industry serves as an example of a developer of safety technologies and safety solutions that might become standardized in future property development. Together, these three references from the different interviewees implies that all of them find solutions in the car industry to obstacles in their own business of developing housing properties, i.e. in the production of a vehicle for transportation, though their own products have been particularly immobile — until now.

Apparently, the car industry is the first example that comes to mind of how business is run — and continues to run — while converting to more sustainable energy sources and keeping up with business at the same time. An industry producing something that has been synonymous with pollution, perhaps even the symbol for it, does now seem to hold the answer to energy usage and logistics in a fossil-free future.

This suggests that the answers on how to provide for fossil-free solutions is not expected to be found in the energy industry itself, but in an industry dependent on energy to exist at all in the intended sense: an industry of transportation and movement. As the citations from the respondents show, the car industry also serves as an example of economic sustainability in terms of industrialized business. It also is an example of safety development, as in an everyday prevention of unexpected danger and other unpleasant disruptions. To use Starosielski’s (2015) notion of flow, the car industry may serve as an example on how to sustain such a flow of unimpeded movement; it seems as if the electric vehicle is the capsule what will transport fossil-modernity into a renewable, sustainable and mobile future.

6.3 The smart home: Where the x and y axes converge

As the analysis has shown so far, the smart home is not only a central point for logistics of information, data and food, but could also be interpreted as a logistical medium (as defined by Peters 2015) in that it in itself organizes time and space. The distribution of digital data providing applications and dashboards with real-time information argues for an interpretation of the smart home as an organizer of time, besides from encouraging certain activities and practices in a sense
that will be analyzed further below. The notion of mobility, besides spatial transportation of goods, argues for the smart home as an organizer of space. However, considering time and space as two separate yet related axes, the smart home could also be interpreted as a logistical medium in the following sense defined by Peters (2015): “Logistical media establish the zero points where the $x$ and $y$ axes converge.” (Peters 2015, p. 37). This final part aim to locate such points where the temporal axis meet, and risk colliding with, the spatial one.

6.3.1 Activity and inactivity
As the implemented technological solutions that make up the Active House is developed as a product for the housing market, one has to keep in mind that the users of the system are not the primary costumers that buy the solutions, as the tablet, applications and the sensors devices are thought to come with the apartment. While the residents are the energy consumers that separately pay for their energy costs, the housing developers, property owners and energy companies have environmental standards to live up to by reducing the building’s total energy demand. The risk of the residents being inactive and not using the smart grid system shows that the energy customers themselves make up an important part of the product.

With the projects’ strong focus on environmental ethics, the matter of personal integrity and ethics regarding data collection does not seem to very relevant to the interviewees, perhaps as they are not the everyday users of the system themselves in the way that the residents are. At the very end of my interview with the architect OJ, he comes to think of a problematic scenario regarding surveillance:

OJ: But … well, we’re quite far off the project now [laughter] but I think it’s really interesting that it’s possible … with this technology that Fortum has now, the possibility to visualize what’s really going on behind the walls. And how you—, how your activity in the house affect the environment, and what consequences come out of that. So that you get feedback on what you do as well. But it shouldn’t be like, you know, a big brother-society, where you are controlled, where you get like, you get a ticket from the police for having thrown away too much garbage. There we’re, then we’re off wrong … But is should be something that helps you understand your lifestyle, you know.
In the Future Alley project, the main purpose is not to develop a product for the market but to “develop sustainable lifestyles”. The matter of personal integrity is of less priority in for example the Future Catalogue. Still, integrity issues are addressed a few times in the catalogue, as when the reader is asked: “What information about your home is OK/not OK for others outside your family to have access to?” There is also an underlying notion of risk or worry in the question: “How would you like it if your smart home would help you to look after your plants, pets and children? To what extent?”. In the Future Catalogue, the suggested risk for the users seems to be that the information technologies might go too far, i.e., extend across a limit beyond which the information technologies become more uncanny than convenient.

The risk of surveillance or reduced personal integrity is rarely understood as a risk for the users of the system, i.e. the households consuming energy. In these two cases, it would perhaps be the claim for personal integrity among the users that would put the projects at risk. Using the collected data on energy usage not only to manage the smart grid, but also to give feedback to the individual users on their own behavior, contribute to give these projects their collaborative character, as mentioned in the promotion video of Smart Energy City cited in the beginning of this chapter: “Together we are working towards a sustainable energy society.” (my emphasis). This also reflects Halpern’s (2014) notion of feedback being a democratic virtue (p. 243), as the quote from the promotion video shows how data visualization of one’s own lifestyle is understood as educative. In this case, being controlled is to be at risk of punishment for doing something wrong, i.e., surveillance is understood as being governed and risking punishment by the police.

Integrity claims could mean that users stop being active and collaborative by not using the system as intended. There is also a risk with the information of consumption and environmental impact not being interesting enough. JE, project manager, is however convinced that the technology in the Active House will raise awareness among the residents of how energy is consumed. The important thing is, he says, that users stay active, and he’s a bit worried that it may turn out that people stop looking at the application after a while. If so, he says, it must become something else, be developed further into something that keep users active.

JE: I think you need to develop more stuff so that you get more active … Because otherwise, I think that when this awareness has been raised, then it might subside a bit … Once you get the grip of something, you won’t look at it twice to understand it
a second time. It becomes a bit, you know, static, as you may be looking at it just once in a while. (...) It is extremely important that you develop services. That people want. So that it doesn’t turn into being just a gadget. That this doesn’t become a monitor that you look at once in the beginning and then there’s no interest left to look again, then it will be put away.

During the interview with the architect OJ, he tells me about when he visited the Active House and his impression of the smart technologies installed. He identifies the importance of the application being user-friendly to avoid inactivity:

OJ: What has happened with Fortum’s technology is that there’s an iPad in the kitchen, that everyone’s trying to get to know and become friends with. It has quite a good interface, really, but it’s still like … last time I went there the charger had fallen off, and … there is still a bit of running-in left to do, you know, and become friends with the system. (...) Earlier it used to be a meter slash warning system in the hallway in an ugly plastic box that you … that no one could understand at all. Now it’s a bit more user-friendly. But it’s a lot of functions included [in the application] so people get … a bit confused. (...) But it’s just for them to learn how to use it.

The lack of active usage and of knowledge on how to use the application thus come across as an obstacle and a possible disruption within the system.

According to Eric Fagerström at Tingcore/Fortum, who demonstrated the application to me and told me about how they had built it, the most difficult thing was to make the visualizations of energy consumption engaging and interesting8. Elin Önnevall, researcher in the Future Alley project, mentions that there were several “thresholds” among the technologies installed, making people less motivated to engage with for example the application9. Therefore, in the case with these two projects, it seems as if there is a risk to this sustainable smart home: that users don’t engage with the devices and the applications, whether they work or not. The aim for the smart home developers is to

8 Eric Fagerström, business developer at Tingcore/Fortum, interview 03/31/17
9 Elin Önnevall, researcher at RISE Interactive, interview 05/11/17
engage and activate their costumers, as it is this activity — the usage — that makes the system work as planned and hopefully also reduce the energy consumption.

However, this supposed activity and user knowledge is more related to energy consumption than to infrastructure intelligibility. As mentioned both by Starosielski (2015), Parks (2012) and Larkin (2013) infrastructure has a discursive tendency to only seem apparent when disrupted or damaged; yet this disruption may raise attention and awareness to a system of infrastructure not previously known that much about by its everyday users (Parks 2012). With the smart grid, the energy infrastructure is expected to get attention and awareness in everyday life; and its outputs to be easy to use and to understand. But while the supposed active consumers engage with their energy consumption, the awareness is not directed toward the system itself; but to the consumption data visualized in the application. The attention is therefore expected to be turned toward the home and data on its energy use, not the infrastructure system itself. The engagement with the smart grid technology is rather an engagement with one’s own residence and consumption; again, with the effects of energy consumed, its costs, and its environmental impact.

In her study of undersea Internet cables, Starosielski (2015) suggests that undersea infrastructure often is made visible by a chronologic discourse of disruption and connection. I would argue that the smart grid projects are also surrounded by a chronologic discourse by focusing on the effect of energy, i.e., by organizing when and for what energy is used. The smart grid and its components of smart devices forms a narrative of when energy is being used, and infrastructure comes to being in terms of actions and events. As the energy in these smart homes is not expected to be used continuously but to be turned off or down occasionally, the smart grid contributes to a discourse narrating infrastructure as apparent at moments in time. Apart from disruption and connection, we could thereby add usage/consumption to the chronological narratives mentioned by Starosielski (2015).

However, it seems as at a lack of interactivity with the applications and the smart grid system, the the spatial dimensions of the infrastructure would appear — the tablet would appear as “just a gadget”, to borrow JE’s expression in the interview quote above. As a spatial object, the tablet would then suddenly be a thing that is, not a thing that does.
6.3.2 The bias of the smart home

As it is the usage of the smart grid that makes it a technology for sustainability, its revelation as a physical, spatial object due to a lack of interactivity would perhaps challenge the concept of the smart grid as resource saving, as its own materiality would discursively appear in terms of more or less useless and unnecessary devices that take up space. Thus the centrality of smart home events and activities, such as doing laundry, adjusting lights, charging the electric vehicle and so on, seems crucial for the smart grid. And, as the smart home organizes time in terms of events and activities, it also organizes the reduction of energy consumption as an activity, as an event in itself; you need to be active (and use energy) to save energy.

The notion of the home as a place of events is apparent in the dashboard in the web application used in the Future Alley project (Fig. 5). While the application is called “There”, as in a spatial spot, the data is visualized by temporal means; as expected energy prices and as current or summarized energy production and consumption over the past day(s). It also shows virtual switches turning certain power sockets on or off, and the home/away button meant to be switched when residents enter or leave the apartment. As events (coming/going, turning something on or off), I would argue that these virtual buttons working to switch between different modes work along a temporal axis as well. This would show that the smart home is a location for time management, or to use Kittler’s (in Krämer 2006) term: time-axis manipulation.

Thus the Future Alley application “There” (Fig. 5) comes to explicitly describe a place (there) in notions of time (now, then, when). The definition of a place in terms of the events occurring at the particular spot is noted by de Certeau (1984) as he defines space as a “practiced place” (de Certeau 1984, p. 117). As mentioned in the beginning of this chapter, the various meanings and implementations of the word “smart” used to imply that the smart home is a place of smart practices. Although smart practices (environment-conscious choices, interactivity) constitutes this space, these smart practices are also encouraged by a temporal discourse on sustainability, where
the latter is understood as a future towards which we are heading without more or less disastrous disruptions (Anderson 2010).

In these two projects, Smart Energy City and Future Alley, the home as a practiced space therefore seem important to sustain the discursive understanding of sustainability as temporal; as something that occurs over time. Thus, the development and implementation of the smart grid and its smart home components is quite dependent on the idea of the home/space as a practiced place, as these home-related practices make up the data that the system requires. Again; the main purpose of the smart grid is therefore not about reducing energy demanding activities, but to avoid load peaks in the system and make energy use and distribution more efficient to avoid disruptions such as power failures. And what is a power failure, if not the disruption of flow?

This temporally biased understanding of the home, of infrastructure, and of sustainability, would explain why JE is excited about efficient batteries although they may contain “lithium and all kinds of shit”. The importance of a durable flow over time and a continuation of events weights heavier
than the physical and material properties of energy infrastructure and digital devices. Therefore, I would argue, the risk of inactivity within the smart home also puts the discursive understanding of sustainability at risk.
7 Conclusion
The purpose of this study of the smart home and the expectations of the future life it presupposes has been to analyze how ideas of infrastructure and media are materialized as smart homes. Departing from expectations on domestic use of smart technologies, the aim was to investigate how such sites may affect the understanding of infrastructure and media as both a spatial and a temporal phenomenon.

The future life as imagined by the interviewees and expressed in promotion and research material in the projects is a life characterized by convenience and sustainability. In the smart home, convenience is mainly a consequence of efficient technologies of information and automation. Future life is imagined as one where everyday logistics such as grocery shopping is automatically carried out by the refrigerator itself and delivered to your doorstep. Other logistics such as personal transportation is also automatic thanks to information technology, which in turn will make personal cars redundant; it would also be too expensive and too space demanding to build gigantic parking lots. Logistics and transportations in everyday life is thereby being time-efficient as there will be more time left for relaxation and entertainment. It would also be space-efficient in the sense that there will not be inactive but used places — understanding Starosielski’s (2015) notion of flow as central to the logics of information infrastructure, places of inactivity such as parking lots would impede such a flow of logistics and of capital.

Future life is also characterized by sustainable lifestyles. The residents of the smart home are expected to be aware of their energy consumption and make active and smart choices in their everyday lives to reduce it. Being active also means to interact; to include the smart home applications in everyday events such as doing laundry, cooking and adjusting the indoor environments by dimming the lights or turning down the temperature. Yet it is not only the residents and families in the smart home that will be (inter)active, but the very building itself will interact and “breathe together” with both its residents and its surroundings, i.e. by sensors gather data and distribute information to residents by data visualizations and to other physical objects.

Thus the technologies in the smart home, all brought together by the smart home applications, are not just providing time and space efficiency, but also time and space management. This conclusion builds from Kittler’s term technological media in which real-time, a central feature in the smart home applications, is an example of what Kittler (in Krämer 2006) refers to as time-axis
manipulation. The smart home applications also affects the notion of space in terms of the home as a lived space; the possibility to manage the home by afar by the applications would suggest that the smart home causes a state of mobile privatization (Williams 1974/2003). This interpretation of the smart home as an organizer of time and space would suggest that the smart home could be understood as a logistical medium, as described by Peters (2015).

By its emphasis on activities and time management, the smart home could be interpreted as a practiced place, i.e., a space which in de Certeau’s (1984) terms is defined by temporal events and actions. As such, the idea of the smart home has a temporal bias, in turn affecting the understanding of infrastructure as a spatial, and not only temporal, object. As Parks (2012) has noted, everyday interactions with infrastructure outputs may serve as moments that provides awareness and knowledge about the vast systems that infrastructures are. However, according to Starosielski (2015), chronological narratives are limited in their capacity as describing infrastructures as spatial objects, which may affect the understanding of them as geographic networks.

The temporal understanding of the smart home could therefore serve as a discursive insulation to the flow of logistics and capital. This flow and the importance of transportation is also reflected in the inspiration from the car industry apparent in the empirical material. Therefore, this study suggests that the smart home, perhaps besides the electric vehicle, are the means by which fossil-modernity will be transported not only along a spatial axis, but also along a temporal axis towards the future.
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