Energy efficiency left behind? Policy assemblages in Sweden’s most climate-smart city

Darcy Parks

Department of Thematic Studies – Technology and Social Change, Linköping University, Linköping, Sweden

ABSTRACT

Smart city experiments have the potential to reshape urban climate change governance. Smart city initiatives have been supported by international technology companies and the European Union for many years and continue to be promoted by national and municipal governments. In relation to sustainability and climate change, such initiatives promise more efficient use of resources through the use of information and communications technology in energy infrastructure. Experiments with smart city technologies such as urban smart grids have shown the potential to restructure relationships between energy utilities, energy users and other actors by reconfiguring the dynamics of energy supply and demand. But do urban experiments lead to institutional change? The aim of the article is to provide a better understanding of how smart city experiments reshape the urban governance of building energy use. Hyllie, a new city district in Malmö, Sweden, was home to two smart city experiments that contributed to the institutionalization of urban smart grid technology. However, the analysis of Hyllie’s policy assemblages shows that this institutional change could redefine sustainability at the expense of energy efficiency.

1. Introduction

Smart city experiments have the potential to reshape urban climate change governance. Smart city initiatives have been supported by international technology companies (IBM Global Business Services, 2009) and the European Union (European Commission, 2012) for many years and continue to be promoted by national governments (e.g. Government of Sweden, 2016). In relation to sustainability and climate change, such initiatives promise more efficient use of resources through the use of information and communications technology in energy infrastructure (Harrison & Donnelly, 2011). For example, smart electricity grids promise to shape electricity demand according to supply, which would allow for an increasing amount of renewable electricity production (Strengers, 2013; Verbong, Beemsterboer, & Sengers, 2013). Experiments with smart city technologies such as urban smart grids have shown the potential to restructure relationships between energy utilities, energy users and other actors by reconfiguring the dynamics of energy supply and demand (Klauser, Paasche, & Söderström, 2014; McLean, Bulkeley, & Crang, 2016).
Despite the popularity of experiments as an urban response to climate change (Bulkeley & Castañ-Broto, 2013), there are questions about whether urban experiments can realize their potential. They take place in existing cities and must wrestle with the obduracy of urban infrastructure (Bulkeley, McGuirk, & Dowling, 2016). They must also contend with the inertia of existing socio-technical systems, which extend beyond the confines of the experiment and the city (Hodson, Geels, & McMeekin, 2017). This article contributes to discussions about whether urban experiments contribute to long term change. More specifically, the aim of the article is to provide a better understanding of how smart city experiments reshape the urban governance of building energy use. Which processes serve to institutionalize the results of smart city experiments? In what ways do these processes contribute to the de-institutionalization of existing governance arrangements? This article focuses on the governance of building energy use because it a longstanding challenge that could be alleviated by the restructuring of relationships that urban smart grids promise.

Governmental efforts to reduce building energy use have long been complicated by split incentives, as costs and benefits are unevenly distributed between construction companies, buildings owners and tenants (Laustsen, 2008). Because of the limited effects of other policy instruments, building energy codes are a central tool for governing building energy performance (Smedby, 2016b). For example, the European Union’s directive on the Energy Performance of Buildings (EPBD) has required that member states regulate building energy performance since 2006 (European Union, 2003). The latest version of the EPBD set even stricter energy performance requirements by requiring ‘nearly zero energy buildings’ by 2020 (European Union, 2010). However, the 2010 EPBD and zero-energy building codes in other jurisdictions have redefined energy performance, allowing for on-site renewable energy production as an alternative to energy efficiency (Pan & Ning, 2015). While urban smart grids do not necessarily make buildings more efficient, their potential to reconfigure the dynamics of supply and demand could help to integrate more renewables and make the overall electricity system more efficient.

However, there exists a variety of governance arrangements for reducing building energy use (Bulkeley & Kern, 2006; Rutherford & Jaglin, 2015), which might complicate the implementation of urban smart grids. Using formal authority, some cities have created their own building energy codes that are more strict than national codes (Rohracher & Späth, 2014; Smedby, 2016a). In cities where local government controls land use planning, planners have given priority to developers who commit to sustainability ambitions (Smedby & Quitzau, 2016). Some local governments have used collaborative planning processes that promote learning and the formulation of a common vision (Smedby & Neij, 2013), while others have provided technical knowledge to reduce the cost of energy efficient building construction (Quitzau, Jensen, Elle, & Hoffmann, 2013). While these policies primarily influence the relations between local government and developers, they can also affect energy utilities. For example, passive house standards for buildings can conflict with policies of mandatory connection to district heating systems (Späth & Rohracher, 2015). The variety of existing governance arrangements, each with different constellations of actors and technologies, leaves the possibility that smart grids might conflict not only with unsustainable socio-technical configurations, but also with existing governance arrangements that aim to reduce building energy use.
There is little research on how smart city initiatives and urban smart grids intersect with the urban governance of building energy use. At the national level, research on smart grid governance has studied the spread of smart metres and time of use pricing (IqtiyaniIlham, Hasanuzzaman, & Hosenuzzaman, 2017; Ngar-yin Mah, van der Vleuten, Chi-man Ip, & Ronald Hills, 2012; Wallsten, 2017) and the implementation of smart grid policy through coordination groups (Ballo, 2015; Schick & Gad, 2015; Schick & Winthereik, 2013), but this research analyzes the influence on consumers rather than buildings. Some research on smart cities has raised concerns about the involvement of multinational corporations in urban environmental governance, but without analyzing the resulting impacts (March & Ribera-Fumaz, 2016; Viitanen & Kingston, 2014). Concerning the impacts of smart cities on urban environmental governance, Trencher and Karvonen (2017) show how an initiative in Kashiwa, Japan, ‘stretched’ from a focus on carbon dioxide emissions and energy efficiency to include health technology; Haarstad (2016a) shows that the European Union’s smart city funding was flexible enough to relabel existing urban sustainability initiatives in Stavanger, Norway, albeit with an added emphasis on cross-sectoral collaboration. These two studies show that the smart city label can be a flexible resource that central actors use to advance their own interests in urban environmental governance.

This article analyses the influence of two related smart city experiments in Malmö, Sweden. Both experiments took place in Hyllie, a new city district that will eventually be home to 9000 apartments. The first experiment was a collaboration called the Climate Contract, signed in 2011 by the City of Malmö, the energy utility Eon, and a municipally owned infrastructure company called VA SYD. The Climate Contract envisioned Hyllie as ‘the most climate-smart city district’ in the Malmö–Copenhagen region, and that it would ‘show the way for Malmö’s future development as a sustainable city’ (City of Malmö, Eon, & VA Syd, 2011, p. 2). The second experiment was the Smart Grids for Hyllie project, through which the City of Malmö and Eon demonstrated urban smart grid technologies. The Swedish Energy Agency provided support for this project, which ran from 2011 to 2016.

The results of these experiments were incorporated into a new planning programme called the Hyllie Environmental Programme (HEP). Released in 2015, it is a voluntary programme with the aim of encouraging developers to contribute to the city’s environmental ambitions for Hyllie. It provides the city administration’s perspective on how the governance of building energy use should occur in light of these experiments. It proposes policies for four aspects of building energy use: energy efficiency, smart grids, smart homes and renewable energy. But the programme’s voluntary status calls into question whether it reflects how the governance of building energy use actually occurs in practice. The insights of previous research suggest that one should pay particular attention to the influence of energy utilities. This article investigates whether the HEP tells the whole story about Eon’s influence on the governance of building energy use in Malmö.

The article proceeds with a theoretical perspective for understanding how urban experiments reshape urban governance. Section 3 then explains the empirical background in more detail, describes the method, and presents how the analysis operationalizes the theoretical perspective. Section 4 analyses four policy assemblages that constitute the governance of building energy use. Section 5 discusses how the analysis contributes a better understanding of how urban experiments contribute to institutional change. Section 6
concludes the article with reflections about how smart city initiatives reshape the urban governance of building energy use.

2. Policy assemblages: governance beyond policy documents

To study the influence of urban experiments requires attention to the multiple ways in which innovations reconfigure governance arrangements (Hodson et al., 2017). The concept of policy assemblage (Haarstad, 2016b; Prince, 2010), along with the similar concept of governance assemblage (Albrecht, 2015), conceptualizes governance arrangements as socio-material assemblages ‘that are (re-)produced by a continuous reconfiguration of relations’ (Albrecht, 2015, p. 384). In this perspective, existing governance arrangements are not stable structures, but rather of relations that must be continually reproduced to maintain their capacity to govern. Such a relational perspective acknowledges that ‘cities are in fact layered by the projects, ideas and conflicts of the past, and it is into these “messy” situations that abstract policies or policy ideas around low-carbon development arrive’ (Haarstad, 2016b, p. 6). The success of a new technology, for example, depends on integrating with existing relationships between organizations, or changing the minds of developers who have negative experiences with similar technology.

A policy assemblage perspective takes into consideration both human and non-human actors. While a policy is typically expressed as a written document, an ‘implemented policy is an assemblage of texts, actors, agencies, institutions, and networks’ (Prince, 2010, p. 173; quoted in Haarstad, 2016b, p. 6, emphasis mine). In an experiment, there are many different elements could be the embryo that eventually becomes an implemented policy: for example, a new technology, a policy goal, or a new relationship between an energy utility and a developer. An assemblage perspective helps to highlight how ‘agency is not located only in key actors, but largely distributed in several components of the assemblage whether human or non-human’ (Ureta, 2014, p. 232). Even powerful actors such as the city government and the energy utility might fail to implement a new policy if they cannot enrol the agency of other actors such as visions, buildings, and infrastructure. Similarly, an existing policy assemblage might lose its collective agency if a new technologies attracts the attention of developers.

The policy assemblage concept also contributes an understanding of multiplicity that helps to understand the interactions of new and existing governance arrangements. Ureta (2014) explains that ‘the components [of assemblages] are autonomous; they have agency and commonly belong to several assemblages at once’ (p. 232). The same building, technology, or organization might play different roles in different policy assemblages (see Figure 1). Farias (2010) writes that assemblages ‘collide with each other, overlap, interfere, and form a multiplicity that has to be managed, coordinated or even held apart’ (p. 14). A new policy assemblage might act in synergy with an existing one; alternatively, a new policy assemblage might conflict with an existing one and undo its capacity to implement a policy.

In summary, a policy assemblage perspective is attentive to the multiple ways in which different innovations might begin to reshape governance. It is a relational perspective that understands new governance arrangements in the context of existing socio-material relations. It also calls for analysis that extends beyond policy documents, as an
implemented policy depends on an assemblage of human and non-human elements. It suggests that policy assemblages can form around a variety of experimental results, such as a new technology or new inter-organizational relationships. Finally, it calls for attention to the multiplicity of governance, as policy assemblages might interact in synergetic or contradictory ways.

3. Context and research design

Hyllie is a new city district in Malmö. For decades, the city’s comprehensive plans pointed out the area for development, but it contained mostly fields and a water tower until the early 2000s. After the opening of the Öresund Bridge connecting Sweden and Denmark, the Swedish government decided to build a railway tunnel under Malmö that would speed up travel to Copenhagen. The tunnel included a train station in Hyllie, as the last stop on the Swedish side of the bridge, which spurred the construction of a city district with a commercial centre and residential areas. The train station opened in 2010; the commercial centre around it was soon home to a shopping mall, arena, conference centre, hotels and office buildings. Planning for the first residential neighbourhood began in 2007 and tenants moved into the first apartment building in 2013.

The climate-smart vision for Hyllie came late in Hyllie’s planning, with the Climate Contract and Smart Grids for Hyllie project both starting officially in 2011. Drawing on the ambitions of the Malmö Environmental Programme, approved in late 2009, the Climate Contract positioned Hyllie as a temporally and geographically delimited experiment that would help Malmö achieve its long-term environmental ambitions. After signing the Climate Contract, its signatories established three inter-organizational groups to operationalize the contract: a project group and two higher level decision making groups. Each of these groups had representatives from Eon, several city departments, and the municipally owned infrastructure company. This collaboration soon resulted in an application for the Smart Grids for Hyllie project, which the Swedish Energy Agency granted funding in late 2011. The project was originally to end in 2014, but the participants received two extensions, pushing the end of the project to 2016.
This article uses meeting observations, interviews, and documents related to Hyllie and urban planning in Malmö. Between September 2015 and May 2016, I participated in the monthly meetings of the Climate Contract project group, which had the practical responsibility for operationalizing the Climate Contract. In addition, I interviewed most members of the project group, as well as other city employees working with the two experiments: four people at the Environmental Department, including the project managers for the Climate Contract and the Smart Grids for Hyllie project; two people at the City Planning Office, including the project manager for the Hyllie Environmental Programme; and project group representatives from the Property Department, Eon, and the municipally owned infrastructure company. Eon’s representative in the project group was also their project manager for Hyllie. In addition, I interviewed representatives of four developers who constructed multi-family residential buildings in Hyllie. I recorded and transcribed all interviews and I wrote field notes directly after my participant-observation of meetings. The article also refers to several publicly available documents, published by city council and different city departments; these documents are included in the article’s references.

I coded the field notes, interview transcripts, and documents using concepts drawn from literature on socio-technical change and urban experimentation. This coding identified what actors identified as experiments or demonstration projects, what challenges these experiments encountered, how actors characterized existing governance arrangements, and what they saw as the results of the experiments. I used the coded material to select quotations for the article.

The analysis is structured around four policy assemblages. The HEP serves as the methodological starting point because it presents the city administration’s perspective on how governance of building energy use should occur – according to its four policies for energy efficiency, smart grids, smart homes and renewable energy. By following the actors (Latour, 2005), the analysis traces the process through which each policy assemblage emerged. It traces influences of existing governance arrangements in Malmö, the two smart city experiments, and other recent developments such as changes to national law. By analyzing the policy assemblage corresponding to each policy, the analysis shows which policies are supported by a coherent socio-material assemblage of actors, and which policies lack such coherent support.

4. The Hyllie environmental programme and Hyllie’s policy assemblages

The Hyllie Environmental Programme is a detailed document that reflects the results of the Climate Contract and the Smart Grids for Hyllie project. It consists of 20 voluntary policies, four of which concern the governance of building energy use. Each policy begins with a policy goal for Hyllie, followed by an explanation, and then a list of tasks for the developer, relevant city departments, and other stakeholders such as Eon.

The HEP follows previous attempts to encourage developers to contribute to the vision of the Climate Contract. According to the project manager for the HEP, the document was a response to confusion expressed by developers:

The idea with [the HEP] is that it should be a very concrete way of declaring the city’s environmental ambitions with Climate-Smart Hyllie. Where we also incorporate everything from the Climate Contract. And Eon and VA Syd. Part of the problem so far is that Climate-Smart Hyllie has been dependent on many different processes. And many different
documents. It’s been very difficult to get an overview, both as a city employee and for private developers. It’s been difficult to know how a specific project can be part of Climate-Smart Hyllie. And the intention with [the HEP] is to be able to answer that question. (Interview, autumn 2015)

The HEP responds to this confusion by providing detailed policies. This response rests on the assumption that developers will do as the city administration wants, as long as the city translates its overall ambitions into specific policies for developers. The city does have some influence – as the owner of undeveloped land, the city decides which developers get new plots of land to build on, and it can evaluate developers based on their previous projects. However, the city cannot force developers to follow the policies of the HEP in any individual project. It is rather a form of soft power that might help to persuade developers.

All of the 20 policies in the HEP correspond to the city’s overall environmental ambitions for Hyllie, which in turn correspond to the 2009 Malmö Environmental Programme. The four policies analyzed in this paper, which concern building energy use, are meant to provide developers with a meaningful translation of the Climate Contract’s ambition that ‘Hyllie is provided with 100% renewable or recycled energy’ (City of Malmö, 2015a, p. 8). The HEP, in turn, relates this ambition to the Malmö Environmental Programme’s ambition of making Malmö become ‘Sweden’s most climate-smart city’ (City of Malmö, 2009).

The following analysis uses the HEP as the starting point, but the HEP is only one element of each policy assemblage. Whether developers will follow the policies in the HEP can only be understood in relation to the other human and non-human elements, such as technologies, city plans and Eon. The list of tasks in each policy is little but a text unless it is supported by the collective agency of a policy assemblage.

4.1. Energy efficiency is left to the developer

The first policy in the HEP concerns energy efficiency. This policy is based on the policy goal that ‘Hyllie’s buildings are energy efficient’ (City of Malmö, 2015a, p. 10). Energy efficiency is not a new policy goal in Malmö; the city administration has targeted the energy efficiency of buildings for many years. However, the HEP reflects a change in Swedish planning law in 2012 that weakened the regulatory authority of city governments. Without the authority to set its own mandatory energy efficiency standards, the city was forced to adapt its policies. The result is a policy assemblage in which the city administration has a more passive role.

Malmö encouraged sustainable buildings in another city district called the Western Harbour, which the city developed in the early 2000s. Based on these experiences, the city established an Environmental Construction Programme that used a combination of regulation and negotiation. It defined three levels of energy efficiency, all more strict than national regulations, where the lowest level was mandatory. The programme also called for ‘a dialogue between the developer and the city administration, concerning which ambition levels the developer plans to achieve and what is appropriate for the project’ (City of Malmö, City of Lund, & Lund University, 2012, p. 8). A change to national planning law in 2012 prevented the city from settings its own mandatory level, and even though the dialogues remained legal, the city government cancelled the entire programme in 2016. A staff report in 2015 explained that the Environmental Construction Programme was created in response to a lack of certification systems in 2009, but that ‘development in
the industry has progressed and there are at present several different certification systems and industry groups for sustainable building' (City of Malmö, 2015b, p. 3). The city administration decided that certification systems available in the building construction market were sufficient to replace its own three-level standard.

The HEP reflects the new governance landscape without the Environmental Construction Programme. It specifies that buildings should be built to a standard that ‘is equivalent to Mini Energy Buildings, Passive House, Zero Energy Building or another established environmental standard with energy requirements stricter than the requirements of the National Board of Housing, Building and Planning’ (City of Malmö, 2015a, p. 10). The HEP also states that ‘it is clear that the energy efficiency of buildings is decisive for Hyllie’s potential to meet its environmental goals’ (p. 10). However, the HEP describes almost no role for the city administration. It leaves all responsibility for energy efficiency to the developer:

- The developer designs and constructs the building according to passive methods for low energy use. The building shall have low heat losses, low cooling needs, efficient use of heating and cooling, and low electricity use.
- The developer performs advanced energy balance calculations for the building. Cold bridge calculations are performed for all connecting elements.
- The developer performs advanced calculations of indoor temperatures. Well-insulated buildings run the risk of high indoor temperatures during the summer months and energy savings can be lost if residents install electric air conditioning units.
- The developer shows the building’s energy performance according to design in consultation with the City of Malmö during the building permit process. (City of Malmö, 2015a, p. 10)

The city administration’s only task concerns the building permit, where the developer is required to present calculations of the building’s predicted energy performance. But at the building permit stage, the city administration’s authority is limited to ensuring that the building meets national energy efficiency regulations.

While the HEP only describes a passive role for the city administration, the administration has a more active role in a new Environmental Construction Strategy that city council approved 2016. This strategy replaces the Environmental Construction Programme (hence the very similar name) and applies across the city, including in Hyllie. The new strategy is based on an ‘inspirational platform’ of seminars, workshops, guides and inspirational material (City of Malmö, 2015b, p. 7). The strategy reflects the perspective of developers who, according to the staff report, ‘expressed a wish to focus more on “marketing” the sustainability work that is performed together with the city administration’ (p. 6). In Hyllie, the strategy complements the HEP. The HEP states what the city administration wants the developer to do; the Environmental Construction Strategy provides additional resources to help the developer meet those ambitions.

The resulting energy efficiency policy assemblage enacts the reduction of building energy use as primarily the responsibility of the developer. The HEP communicates the wishes of the city administration, whose limited persuasive influence might push developers to act. It could also be that the marketing benefits associated with sustainable buildings encourage developers to build energy efficient buildings, and the promised inspirational platform might further encourage them. But aside from publishing the HEP, the city administration has a rather passive role in this policy assemblage.
4.2. Eon performs smart grid governance

In contrast with energy efficiency, the HEP does not leave the smart grid solely to the developer. The second policy in the HEP is based on the goal that ‘Hyllie’s buildings and facilities are connected to Smart Grids’ (City of Malmö, 2015a, p. 11). This policy assemblage is a result of the Smart Grids for Hyllie project, which produced new smart grid technology. This technology justifies Eon’s involvement in the developer’s building design process. There is a more active governance actor in this policy assemblage, but it is Eon, not the city administration.

Buildings were one of the three focus areas of the Smart Grids for Hyllie project. One of the project’s goals was the ‘demonstration, test and evaluation of control systems (DRC – demand response controller) for control of energy use in buildings, and the role of buildings as an integrated part of the energy system’ (Swedish Energy Agency, 2011, p. 7). A demand response controller is a computer connected to the building management system that receives Eon’s signals to reduce or shift demand for energy. Smart grids usually address the electricity system, and the Swedish Energy Agency’s justification for funding the Smart Grids for Hyllie project presented smart grids as ‘a key factor in creating a future low carbon electricity system’ (Swedish Energy Agency, 2011, p. 3). However, the project also addressed other energy carriers such as district heating.

This part of the Smart Grids for Hyllie project succeeded in developing a new technology. According to the final report, Hyllie’s developers and the suppliers of building control systems both worked with Eon to integrate this technology into buildings:

The project has had regular meetings with the developers in Hyllie who are very positive and have been active in the dialogue. The dialogue with suppliers of building management systems (BMS) has also been positive and has contributed to the development. (Swedish Energy Agency, 2016b, p. 6)

This collaboration allowed for tests in Hyllie, and the results demonstrated the technology’s potential – not for electricity, but for district heating:

The tests of demand reduction were performed in March and April 2016, where a total of 8 tests were carried out. Different degrees of demand reductions were tested, often in combination with pre- and post-heating, under different times of day. In this way, the buildings’ thermal inertia was exploited to reduce the risk that the buildings’ indoor climate would be noticeably impacted. The most common test case was carried out during morning hours with a demand reduction of e.g. 50% of all loads that could be controlled. It is under this time of day that the demand is highest, particularly on cold days. (Swedish Energy Agency, 2016c, p. 6)

These results showed that the technology could reduce heating demand without a noticeable effect on the comfort of residents. Thanks to these results, the demand response technology became the focal point of the emerging smart grid policy assemblage.

The HEP reflects the potential that Eon and the city administration see in demand response technology. It explains that ‘the intelligent Smart Grids energy infrastructure optimizes the use of renewable energy by balancing production and use in completely new ways’ (City of Malmö, 2015a, p. 11). It then describes a list of tasks for the developer and Eon:
• Eon keeps Hyllie’s actors up to date about Smart Grids and the connection of buildings to Smart Grids.  
• The developer contacts Eon early in the planning process for tender documentation concerning the connection of the building management system to Smart Grids.  
• The developer, together with Eon, identifies which installations (heating systems, cooling equipment, ventilation systems or other) are appropriate for connection to Smart Grids, and attends to the building’s connection to Smart Grids.  
• The developer connects the building management system to Eon’s locally installed component (so called Energy Manager) which is connected, via firewall and mobile internet, to Eon’s central Smart Grids system. Placement of this component is coordinated with Eon.  
• Eon continues the development and implementation of Smart Grids in Hyllie. (City of Malmö, 2015a, p. 11)  

This list proposes not only that developers connect their buildings to the smart grid, but also that they involve Eon in their building design. This involvement gives Eon the possibility to influence how developers design the energy systems of their buildings. While the smart grid is not mandatory for developers, Eon’s position as the energy utility – where it already sets technical requirements for connecting to the electricity and district heating grids – gives it an opportunity to realize this policy assemblage and push smart grid technologies.  

The final report of the Smart Grids for Hyllie project described how Eon saw the potential to solve problems in its local district heating and cooling grids. As part of the second project extension, Eon received permission to test the demand response technology in existing parts of the city. In relation to tests to alleviate bottlenecks in the district heating network, Eon wrote:  

> It is clear that the technology developer for and the lessons from this project can be transferred to other areas in Sweden with similar limits when it comes to improving the possibilities for production and distribution planning. Furthermore, future use of the technology can provide the possibility to avoid or postpone expensive costs for new infrastructure. (Swedish Energy Agency, 2016c, p. 8)  

These conclusions showed that Eon had reasons to continue developing the technology. The HEP’s smart grid policy fits well with Eon’s efforts to spread demand response technology within Malmö and beyond.  

With Eon’s central role, the smart grid policy assemblage differs from the energy efficiency policy assemblage. The smart grid policy assemblage emerged around a new technology; this technology’s design provided a justification for Eon to become involved in the governance of building energy use. Whereas energy efficiency depends on providing incentives to the developer – saving costs on energy, or the marketing benefits that come with sustainable building certification – demand response does not require large investments by the developer, nor does it inconvenience residents. This assemblage depends rather on Eon to spread and further develop the technology as part of its role as the energy utility. The HEP provides additional legitimacy for Eon’s involvement in the governance of building energy use.

### 4.3. An uncertain future for smart home technologies

The third policy in the HEP also builds on the results of the Smart Grids for Hyllie project. This policy has the goal that ‘Hyllie’s buildings exploit the possibilities provided by Smart
Homes’ (City of Malmö, 2015a, p. 12). In the Smart Grids for Hyllie project, the term ‘smart homes’ differed from smart grids; smart homes referred to technology for residents in multi-family buildings, such as energy visualization and mobile apps to control appliances. The Smart Grids for Hyllie project was not as successful with smart homes as it was with smart grids, which limits Eon’s ability to realize the smart home policy assemblage.

Hyllie’s developers were not particularly interested in smart homes. One of the goals of the Smart Grids for Hyllie project was the ‘demonstration, test and evaluation of HEM (Home Energy Management) systems that help the consumer optimize their energy use’ (Swedish Energy Agency, 2011, p. 7). However the project’s final report explained that only one developer with 54 apartments installed Eon’s visualization and control system. According to Rikard Roth, owner of the company that built and owns that building, other developers were not interested in Eon’s smart home solution:

There are only two buildings in Sweden that use it. It’s us and [a demonstration building owned by Eon called] Hallbarheten in the Western Harbour. It’s just those two. So far. The other developers – I don’t think any of them have nibbled on that [offer from Eon]. So they chose other ways. They probably have visualization but not Eon’s. (Interview, winter 2016)

One difference between Eon’s smart home and smart grid technologies was that smart home technologies were more invasive. The same building owner complained about the work required to test the smart home technologies:

We started by installing thermometers that ran on batteries. And the batteries died after four months. And it was 200 of them. It’s not fun. Two AAA batteries. To change them all? We got tired of that after we did it for the fifth time. Then I forced Eon to change thermostats. And we got them at Eon’s expense. But they were poorly designed. (Interview, winter 2016)

By being so invasive, requiring access to every apartment in the building, the smart home technologies lacked the simplicity of the demand response system.

Still, these technologies showed enough potential for the city administration to include them in the HEP. The HEP defines smart homes as visualization and control technologies that ‘will help residents in Hyllie become aware of their own energy consumption and give them tools to decrease it’ (City of Malmö, 2015a, p. 12). According to the HEP, it is the developer’s task to include these technologies in building design. In turn, it is Eon’s task to ‘provide knowledge and technical solutions for the visualization and control of energy use’ (p. 12). Here, Eon’s role is more passive and depends on the interest of developers. Developers might choose to purchase smart home technologies from other companies, if at all.

Despite the lack of interest from developers, smart home technologies remain part of how Eon and the City of Malmö describe the results of the smart city experiments. Eon and Malmö both produced promotional videos where smart home technologies feature prominently alongside smart grids. Eon’s video from 2015 features a family living in Hyllie where one parent, holding a smartphone, explains, ‘Okay look here. With the app we can control all of our energy use’ (Eon Sweden, 2015). The City of Malmö’s video from 2016 illustrates the use of a similar smartphone app, explaining that residents ‘can steer their heating system remotely. They can turn their heat down when they go on vacation for example, and turn it up again in anticipation of their arrival home’ (City of Malmö, 2016). These videos show how smart home technologies are part of the broader
frame of climate-smart cities, and might gain interest if this frame becomes more popular in the future.

The smart home policy assemblage lacks the combination of technology, acceptance from developers, and legitimacy for Eon that gives the smart grid policy assemblage much more potential. In one way, the smart home policy assemblage resembles the energy efficiency policy assemblage: there is a policy in the HEP, but otherwise no obvious organization to perform governance and push for policy implementation. However, if the broader frame of climate-smart cities becomes more important for developers, they might adopt smart home technologies along with smart grids. Furthermore, Eon has an additional opportunity to realize this assemblage. Thanks to its role in the smart grid policy assemblage, Eon already has access to developers, through which it might be able to push smart home technologies as well.

4.4. Renewable energy: a potential role for local government

Of the HEP’s four energy policies, renewable energy is the only one that suggests an active role for the city administration. This policy envisions that ‘a significant proportion of Hyllie’s energy needs is provided by local, renewable production’ (City of Malmö, 2015a, p. 13). In this policy assemblage, the city administration’s role has to do with the design of a neighbourhood’s spatial plan.

In contrast with other parts of the city, Hyllie’s electricity and district heating networks include infrastructure that facilitates micro-production. The electricity network uses ‘new metering and automation technology in the electricity grid, in order to handle a larger amount of locally produced electricity while maintaining power quality and enhanced reliability’ (Swedish Energy Agency, 2016a, p. 4). The district heating network requires buildings to accept supply heat at a variable temperature between 65 and 95 degrees Celsius, which ‘allows local, excess energy to be fed into the district heating network and allows consumers in Hyllie to easily be producers and contribute to Hyllie’s sustainable energy system’ (Swedish Energy Agency, 2016a, p. 9). Excess energy is, for example, waste heat from facilities or excess heat from solar thermal collectors in buildings. This infrastructure allows Eon, as the energy utility, to make efficient use of renewable energy.

The HEP describes a process for integrating renewable energy that involves the city administration, Eon and developers. It gives the city administration and developers the task of considering renewable energy early in the spatial planning and building design processes:

- The City of Malmö, through the City Planning Office, takes solar potential into consideration in comprehensive planning. Solar potential indicates how favourable a surface or structure is for solar energy. Solar potential is influenced by direction, incline, area and shadowing, among other things.
- The developer and the City of Malmö, through the City Planning Office, study, during the spatial planning and building permit processes, the potential for local energy production in buildings, as well as how energy production equipment can be integrated in the building’s and the area’s architecture. (City of Malmö, 2015a, p. 13)

With its authority over spatial planning, the city administration can regulate the size, shape and location of buildings in new neighbourhoods. Eon is also given a task; it should ‘provide
technical guidelines and business models for the export of excess energy to electricity, district heating and district cooling networks’ (City of Malmö, 2015a, p. 13). While micro-production is not always easy to integrate into energy distribution networks, Eon can be supportive thanks to how it designed Hyllie’s energy infrastructure.

The city administration tested how it could facilitate renewable energy in one of the first neighbourhoods that it planned after it published the HEP. The spatial planning process began officially in early 2016. According to the Plan Proposal, a document that describes the principles to guide the spatial planning process, planners would design the neighbourhood according to planning idea called ‘solar blocks’. This idea meant that ‘the area becomes a model area for local production of solar energy’ where ‘buildings are designed for optimized solar potential’ (City of Malmö City Planning Office, 2016, p. 2). The Plan Proposal also describes how the city administration imagined that the spatial plan would benefit developers economically:

- Optimization of the buildings’ solar potential contributes to making solar energy attractive for developers and building owners because they get higher profits and shorter payback periods for solar energy equipment (City of Malmö City Planning Office, 2016, p. 3)

The spatial plan and energy infrastructure are two factors that facilitate the integration of renewable energy into buildings. They both improve conditions so that renewable energy – at least solar energy – is profitable for the developer.

However, the city administration also had other considerations. One such consideration is how the spatial plan influences other aspects of urban life. The Plan Proposal explained that it is ‘a challenge to create optimal solar energy conditions as well as residences and courtyards with good light conditions in an urban context’ (City of Malmö City Planning Office, 2016, p. 2). In addition to these physical considerations, some developers are more interested in solar energy than others. When discussing the solar blocks idea at a meeting of the Climate Contract’s project group, a city planner from the Property Department explained that the city’s housing shortage limited the emphasis the city could place on solar blocks:

She explained that plans for the solar blocks neighbourhood had changed. Since the need to build housing in Malmö was so large, the Property Department would not choose developers according to the solar blocks planning idea. The idea will be part of their discussions with developers but the selection of developers would be made with regular principles, which include sustainability. (Field notes, November 2015)

This decision did not end the test of the solar blocks idea, but it meant that the city might choose developers with little interest in solar energy.

The renewable energy policy assemblage provides the most active role for the city administration. While the choice to install micro-production still falls to the developer, the city administration can improve the conditions for renewable energy. The energy infrastructure in Hyllie provides favourable conditions already; the right spatial plan can improve these conditions even more. This policy assemblage would be even more coherent if the city administration exercised its authority to choose developers with an interest in renewable energy, but it must also consider the city’s housing shortage. Eon’s role in this policy assemblage is passive, but still important. As the energy utility,
It controls access to the grid, and the policy assemblage would be difficult to realize if Eon were to prohibit micro-production of renewable energy.

5. Discussion: smart city experiments and institutional change

The aim of this article has been to provide a better understanding of how smart city experiments reshape the urban governance of building energy use. In particular, the article asks which processes serve to institutionalize the results of smart city experiments. It also asks in what ways these processes contribute to the de-institutionalization of existing governance arrangements. The article addresses these questions by analysing how two smart city experiments influenced the governance of building energy use in Malmö. While the HEP applies specifically to Hyllie, the policy assemblages analyzed in this article are made up of technologies and organizational relationships that extend beyond Hyllie and through the rest of Malmö.

Two of the policy assemblages show how the results of smart city experiments became institutionalized. First, the smart grid policy assemblage emerged around the demand response technology that Eon created in the Smart Grids for Hyllie project. Testing this technology required discussions between Eon and developers. This technology led to the HEP’s suggestion that Eon and the developer should meet early in the building design process. While the HEP only concerns developers in Hyllie, Eon has already spread the technology to other parts of the city. The HEP might help Eon normalize its role in building design processes across the city. Second, the renewable energy policy assemblage emerged around the material configuration of Hyllie’s infrastructure networks. In this assemblage, the infrastructure networks contributed to new relationships between developers and city planners. These two policy assemblages are examples of how new technologies provided the basis for new relations in governance, by the city administration and through Eon.

The analysis also gives examples of how innovations from the smart city experiments struggled to institutionalize. The material configuration of smart home technology required installation in each apartment, which was more invasive than the smart grid technology that only connected to the central building management system. The smart home policy assemblage suffered from what Bulkeley et al. (2016) have called ‘the mundane materialities of the everyday [and] the banal workings of day-to-day infrastructural changes’ (p. 16). However, smart home technologies remain part of how Eon and Malmö communicate about their experiments, which indicates that smart grids and smart homes are part of the same cognitive frame concerning climate-smart cities. If this cognitive frame becomes institutionalized in urban environmental governance, smart home technologies might gain popularity despite their invasiveness. Another example of mundane materialities involves the renewable energy policy assemblage, where the challenges of introducing wind turbines in dense urban environments led a focus on solar energy (see also Parks, forthcoming). But the material configuration of technology was not the only factor that limited institutionalization. The renewable energy policy assemblage failed to change how the city administration chose developers in the solar blocks neighbourhood. Renewable energy ‘conflic[t] ed too much with other important priorities’ (Rutherford, 2014, p. 1466), in this case the city’s housing shortage. These examples show that the institutionalization of experimental results is not given,
even when policy assemblages with the same central actors might successfully institutionalize other results.

Whether the experiments led to the de-institutionalization of existing governance arrangements is less clear. This analysis does not show the elimination of any obviously unsustainable socio-technical configurations. However, the policy assemblage perspective does allow for comparison of the energy efficiency and smart grid policy assemblages. Whereas the energy efficiency policy assemblage grants a mostly passive role for the city administration, the smart grid policy assemblage gives Eon an active role that allows the company to push its new demand response technology. Energy efficiency and smart grids are not mutually exclusive technologies, but developers might have a limited amount of time or interest for matters of building energy use. Developers might find new smart grid technologies more appealing than traditional energy efficiency measures, particularly if they are easier to implement or are more useful in marketing. In this sense, the smart city experiments reconfigured existing arrangements for governing building energy use (see Figure 2). But rather than active de-institutionalization, this process would be better characterized by institutional drift (Streeck & Thelen, 2005, pp. 24–25).

The policy assemblage perspective helps to show how policies that appear at first glance to coexist might instead compete with each other (cf. Hodson et al., 2017, p. 14).

6. Conclusions

This article shows that smart city experiments can reshape the urban governance of building energy use. New technologies reconfigure governance, potentially giving energy utilities a bigger say in the design of buildings. While the smart city experiments in Hyllie might reinforce concerns about increasing corporate influence in urban environmental governance (March & Ribera-Fumaz, 2016; Viitanen & Kingston, 2014), Eon’s role in the building design process is also an example of a smart city governance innovation (Haarstad, 2016a). The increase in corporate involvement has the potential to encourage
more sustainable socio-technical configurations of urban energy systems. Efforts to reduce building energy used struggle against routines that reproduce established energy solutions (Palm & Reindl, 2016). Energy utilities, equipped with urban smart grid technology, might be more successful than local government in encouraging developers to consider energy issues early in the building design process.

That being said, energy efficiency and smart grids have different implications for the energy system as a whole. Smart grids, and perhaps also smart home technologies, might redefine sustainability in the eyes of property developers and energy utilities. If that redefinition occurs at the expense of energy efficiency, it is uncertain whether the overall result will be lower greenhouse gas emissions. But is energy efficiency being left behind? This article shows a city in which smart grids are moving forward. Whether smart grids move forward at the expense of energy efficiency, or in tandem with it, depends very much on whether the local government can maintain developers’ interest in energy efficiency (Smedby & Quitzau, 2016). Smart grid technologies could erode developers’ interest in other aspects of building energy use, in which case energy efficiency could very well be left behind.

Disclosure statement

No potential conflict of interest was reported by the author.

ORCID

Darcy Parks  http://orcid.org/0000-0002-8388-7633

References

Albrecht, M. (2015). Enlightenment in Norway’s oil-shadow? Governance assemblages of a wood-based district heating network in Norway’s inland region. Journal of Environmental Policy & Planning, 17(3), 381–401. doi:10.1080/1523908X.2014.964851

Ballo, I. F. (2015). Imagining energy futures: Sociotechnical imaginaries of the future smart grid in Norway. Energy Research & Social Science, 9, 9–20. doi:10.1016/j.erss.2015.08.015

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. Transactions of the Institute of British Geographers, 38(3), 361–375. doi:10.1111/j.1475-5661.2012.00535.x

Bulkeley, H., & Kern, K. (2006). Local government and the governing of climate change in Germany and the UK. Urban Studies, 43(12), 2237–2259. doi:10.1080/00420980600936491

Bulkeley, H., McGuirk, P. M., & Dowling, R. (2016). Making a smart city for the smart grid? The urban material politics of actualising smart electricity networks. Environment and Planning A, 48, 1709–1726. doi:10.1177/0308518X16648152

City of Malmö. (2009, December 17). Environmental programme for the city of Malmö, 2009–2020. City of Malmö, City Planning Office. (2016, March 3). Spatial plan proposal 5468.

City of Malmö, City of Lund, & Lund University. (2012, December 11). Environmental construction programme for southern Sweden, version 2

City of Malmö City Planning Office. (2016, March 3). Spatial plan proposal 5468.

City of Malmö, Eon, & VA Syd. (2011, February 17). Climate contract for Hyllie.
Eon Sweden. (2015). *The future is here! E.ON is creating smart energy solutions – today.* Retrieved from https://www.youtube.com/watch?v=yx1jVks9B00

European Commission. (2012, July 10). Communication from the commission: Smart cities and communities – European innovation partnership. Retrieved from http://ec.europa.eu/eip/smartcities/links/index_en.htm

European Union. (2003, January 4). Directive 2002/91/EC on the energy performance of buildings. European Union. (2010, June 18). Directive 2010/31/EU on the energy performance of buildings (recast).

Farías, I. (2010). Decentering the object of urban studies. In T. Bender & I. Farías (Eds.), *Urban assemblages: How actor-network theory changes urban studies.* London: Routledge.

Government of Sweden. (2016, September 1). Collaborative groups appointed to develop the government’s innovation policy [Press release]. Retrieved from http://www.regeringen.se/pressmeddelanden/2016/09/samverkansgrupper-utsedda-for-regeringens-strategiska-samverkansprogram/

Haarstad, H. (2016a). Constructing the sustainable city: Examining the role of sustainability in the ‘smart city’ discourse. *Journal of Environmental Policy & Planning,* 0(0), 1–15. doi:10.1080/1523908X.2016.1245610

Haarstad, H. (2016b). Where are urban energy transitions governed? Conceptualizing the complex governance arrangements for low-carbon mobility in Europe. *Cities,* 54, 4–10. doi:10.1016/j.cities.2015.10.013

Harrison, C., & Donnelly, I. A. (2011). A theory of smart cities. *Proceedings of the 55th Annual Meeting of the ISSS – 2011, Hull, UK,* 55(1), Retrieved from http://journals.isss.org/index.php/proceedings55th/article/view/1703

Hodson, M., Geels, F., & McMeekin, A. (2017). Reconfiguring urban sustainability transitions, analysing multiplicity. *Sustainability,* 9(2), 299. doi:10.3390/su9020299

IBM Global Business Services. (2009). *A vision of smarter cities.* IBM Corporation. Retrieved from https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=XB&appname=GBSE_gb_ti_usen&htmlfid=GBE03227USEN&attachment=GBE03227USEN.PDF

IqtiyaniIlham, N., Hasanuzzaman, M., & Hosenuzzaman, M. (2017). European smart grid prospects, policies, and challenges. *Renewable and Sustainable Energy Reviews,* 67, 776–790. doi:10.1016/j.rser.2016.09.014

Klauser, F., Paasche, T., & Söderström, O. (2014). Michel Foucault and the smart city: Power dynamics inherent in contemporary governing through code. *Environment and Planning D: Society and Space,* 0(0), 0–0. doi:10.1068/d13041p

Latour, B. (2005). *Reassembling the social.* Oxford: Oxford University Press.

Laustsen, J. (2008). *Energy efficiency requirements in building codes: Energy efficiency policies for new buildings.* Paris: OECD/IEA.

March, H., & Ribera-Fumaz, R. (2016). Smart contradictions: The politics of making Barcelona a self-sufficient city. *European Urban and Regional Studies,* 23(4), 816–830. doi:10.1177/096976414554488

McLean, A., Bulkeley, H., & Crang, M. (2016). Negotiating the urban smart grid: Socio-technical experimentation in the city of Austin. *Urban Studies,* 53(15), 3246–3263. doi:10.1177/0042098015612984

Ngay-yin Mah, D., van der Vleuten, J. M., Chi-man Ip, J., & Ronald Hills, P. (2012). Governing the transition of socio-technical systems: A case study of the development of smart grids in Korea. *Energy Policy,* 45, 133–141. doi:10.1016/j.enpol.2012.02.005

Palm, J., & Reindl, K. (2016). Understanding energy efficiency in Swedish residential building renovation: A practice theory approach. *Energy Research & Social Science,* 11, 247–255. doi:10.1016/j.erss.2015.11.006

Pan, W., & Ning, Y. (2015). A socio-technical framework of zero-carbon building policies. *Building Research & Information,* 43(1), 94–110. doi:10.1080/09613218.2015.955759

Parks, D. (forthcoming). *Promises and Techno-Politics: Renewable Energy in the Malmö’s Climate-Smart City.*
Prince, R. (2010). Policy transfer as policy assemblage: Making policy for the creative industries in New Zealand. *Environment and Planning A*, 42, 169–186. doi:10.1068/a4224

Quitzau, M.-B., Jensen, J. S., Elle, M., & Hoffmann, B. (2013). Sustainable urban regime adjustments. *Journal of Cleaner Production*, 50, 140–147. doi:10.1016/j.jclepro.2012.11.042

Rohracher, H., & Späth, P. (2014). The interplay of urban energy policy and socio-technical transitions: The eco-cities of Graz and Freiburg in retrospect. *Urban Studies*, 51(7), 1415–1431. doi:10.1177/00420980135000360

Rutherford, J. (2014). The vicissitudes of energy and climate policy in Stockholm: Politics, materiality and transition. *Urban Studies*, 51(7), 1449–1470. doi:10.1177/0042098013500088

Rutherford, J., & Jaglin, S. (2015). Introduction to the special issue – urban energy governance: Local actions, capacities and politics. *Energy Policy*, 78, 173–178. doi:10.1016/j.enpol.2014.11.033

Schick, L., & Gad, C. (2015). Flexible and inflexible energy engagements—a study of the Danish smart grid strategy. *Energy Research & Social Science*, 9, 51–59. doi:10.1016/j.erss.2015.08.013

Schick, L., & Winthereik, B. R. (2013). Innovating relations–or why smart grid is not too complex for the public. *Science & Technology Studies*, 26(3), 82–102.

Smedby, N. (2016a). Assessing local governance experiments for building energy efficiency – the case of Malmö, Sweden. *Environment and Planning C: Government and Policy*, 34(2), 299–319. doi:10.1177/0263774X15614176

Smedby, N. (2016b). *Local environmental governance: Assessing proactive initiatives in building energy efficiency*. Lund: International Institute for Industrial Environmental Economics.

Smedby, N., & Neij, L. (2013). Experiences in urban governance for sustainability: The constructive dialogue in Swedish municipalities. *Journal of Cleaner Production*, 50, 148–158. doi:10.1016/j.jclepro.2012.11.044

Smedby, N., & Quitzau, M.-B. (2016). Municipal governance and sustainability: The role of local governments in promoting transitions. *Environmental Policy and Governance*, 26(5), 323–336. doi:10.1002/eet.1708

Späth, P., & Rohracher, H. (2015). Conflicting strategies towards sustainable heating at an urban junction of heat infrastructure and building standards. *Energy Policy*, 78, 273–280. doi:10.1016/j.enpol.2014.12.019

Streeck, W., & Thelen, K. A. (2005). Introduction. In W. Streeck & K. A. Thelen (Eds.), *Beyond continuity: Institutional change in advanced political economies*. New York: Oxford University Press.

Strengers, Y. (2013). *Smart energy technologies in everyday life: Smart utopia?* New York: Palgrave Macmillan.

Swedish Energy Agency. (2011, November 21). Project decision: Smart grids for a sustainable energy system in Hyllie.

Swedish Energy Agency. (2016a, October 31). Final report: Smart grids for a sustainable energy system in Hyllie.

Swedish Energy Agency. (2016b, October 31). Final report: Smart grids for a sustainable energy system in Hyllie. Attachment 3.

Swedish Energy Agency. (2016c, October 31). Final report: Smart grids for a sustainable energy system in Hyllie. Attachment 4.

Trencher, G., & Karvonen, A. (2017). Stretching “smart”: Advancing health and well-being through the smart city agenda. *Local Environment*, 142(0), 1–18. doi:10.1080/13549839.2017.1360264

Ureta, S. (2014). The Shelter that wasn’t there: On the politics of co-ordinating multiple urban assemblages in Santiago, Chile. *Urban Studies*, 51(2), 231–246. doi:10.1177/0042098013489747

Verbong, G. P. J., Beemsterboer, S., & Sengers, F. (2013). Smart grids or smart users? Involving users in developing a low carbon electricity economy. *Energy Policy*, 52, 117–125. doi:10.1016/j.enpol.2012.05.003

Viitanen, J., & Kingston, R. (2014). Smart cities and green growth: Outsourcing democratic and environmental resilience to the global technology sector. *Environment and Planning A*, 46(4), 803–819. doi:10.1068/a46242

Wallsten, A. (2017). *Assembling the smart grid: On the mobilization of imaginaries, users and materialities in a Swedish demonstration project*. Linköping: Linköping University.