Guest Editorial

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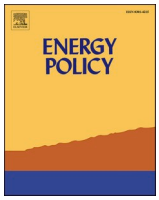

Guest Editorial: Special Issue on "Sustainable urban energy systems – Governance and citizen involvement"

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ABSTRACT

Cities are responsible for over 75% of the total amount of global greenhouse gas emissions. They are also home to the majority of the Earth's population. Ambitious climate mitigation goals can only be realized by transforming fossil based urban energy systems into sustainable, low-carbon ones. This is a multidisciplinary challenge that goes way beyond the technological dimension. In the Special Issue to which this Guest Editorial contributes, a multi-disciplinary perspective is used, exploring governance, institutional, ethical and other aspects, pertaining to citizen involvement in sustainable urban energy systems. The main research questions are, "How can we address key challenges to the analysis and design of sustainable urban energy systems, as regards their governance and institutions, values, social acceptance, and citizen involvement?", and "How can this contribute to shaping a multi-disciplinary academic research agenda?" Based on the main findings from the ten contributions to the Special Issue key challenges to sustainable urban energy system design, planning, and implementation are presented, including suggestions for future research.

1. Introduction

Cities are directly responsible for over 75 percent of total global CO_2 emissions, with the transport and building sectors as the largest contributors (UNEP, 2022). Not only are cities responsible for these emissions, they also are the home for the majority of the Earth's population. By 2023, 56% of the world's population was living in urban centers, and by 2050, 7 out of 10 people are expected to live in cities (UN, 2018). Handling the impact of this development presents a huge challenge for urban development and planning. A second challenge lies ahead regarding the ability to deliver low-carbon energy services to all these people. Moreover, as the impact of climate change will become more virulent, large-sized cities will become more vulnerable to the adverse effects of climate change (Bulkeley, 2013). This not only underlines the necessity to make cities more sustainable in their energy use; it also requires them to become more resilient to extreme weather events and to more structural changes in their climatological and environmental conditions (Ibid.).

In coping with increasing numbers of people living in urban centers and avoiding cities to become the foremost source of anthropogenic greenhouse gas emissions, it is necessary to move away from current fossil based urban energy systems towards sustainable urban energy systems, by reducing the energy consumption and increasing the efficiency of energy use, and by expanding the use of renewable energy sources. To make this happen, changes are required in the governance of the urban energy systems, providing the right incentives to alter all kinds of societal practices on the demand side as well as on the supply side of the energy market, and in the supply chain in between. From being passive agglomerations of energy consumption and environmental pollution, future cities will have to organize their energy provision in a cleaner, smarter, more self-reliant, resilient way, closer to the needs of citizens. Moreover, it is highly important that urban development and planning address the 'greening' of urban systems. Ambitious climate change targets can only be realized by transforming urban systems. By locking in emission levels over the longer term, current and future planning and construction decisions determine a city's ability to pursue a sustainable future (Corfee-Morlot et al., 2009).

There is a need for cities to incorporate fundamental technological but also societal changes in urban energy systems. Technological innovation is an important driver, enabling decentralized and sustainable energy use and provision beyond the traditional confines of electricity, gas, and heat infrastructures. Quite a few cities are taking up this

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challenge, ranging from metropoles like London, Amsterdam, and Paris, and medium-sized cities like Freiburg, Graz, Milton Keynes, Delft and Breda, to small municipalities like Lochem in the Netherlands and Saerbeck in Germany (Broto and Bulkeley, 2013; Hoppe et al., 2015; Späth, 2013). It can be observed that, increasingly, such processes are not only imposed top-down, but that residents play an active role in bottom-up initiatives, for example in energy communities (Seyfang and Haxeltine, 2012). Citizens are not only influential in making changes to their lifestyle. They also take part in the (self-) governance of energy systems and in the provision of energy, by actively participating in grassroots initiatives for renewable energy generation. This involves a variety of innovations in the social aspects of a low carbon energy system, like civic empowerment and the articulation of social goals pertaining to the general wellbeing of communities (Hoppe and de Vries, 2019). At the same time, such innovations challenge the institutional setting of the prevailing centralized energy systems. For a successful transition towards sustainable urban energy systems, technological and social innovations should deal with key underlying societal values and co-evolve with the wider institutional and governance context (Koirala et al., 2016).

In this Special Issue (SI) a multi-disciplinary perspective is used, exploring the technological, governance, ethical, behavioural, governance and policy aspects of urban energy systems. This is done to identify key challenges and academic research questions, in a domain that is traditionally scattered among different (mono-) disciplinary approaches. This was the point of depart of the Conference on "Sustainable Urban Energy Systems - Technological prospects, citizen involvement and governance arrangements", that was organized on 8–9 November 2018 at Delft University of Technology, in Delft, The Netherlands. The main research questions that emerged then and there were "How can we address the key challenges to analyse and design sustainable urban energy systems as regards their governance and institutions, values, social acceptance, and citizen involvement?", and "How can this contribute to shaping a multi-disciplinary academic research agenda?"

This SI aims to show that the complex transition towards Sustainable Urban Energy Systems (SUES) demands more than technological innovation. Indeed, technological innovations have to be embedded not only in appliances, in homes, and in the infrastructure systems, but also in institutions, in broadest sense. This requires new user practices, business models and different modes of regulation, addressing newly shaped economic, public and social values. It also demands new ways of collaboration and public/private decision-making, whilst mobilizing societal actors and empowering citizens to actively participate in planning processes.

This Guest Editorial Note is structured as follows. In Section 2, the concept of sustainable urban energy systems is introduced and defined. Subsequently, it is connected with three topical dimensions: firstly, institutional factors and governance; secondly, values and social acceptance, and thirdly, citizen involvement (e.g., citizen participation, co-creation, co-production and community energy). Next, in Section 3, the key lessons from the articles contributing the SI are highlighted; referring to their disciplinary background, research design and methods, geographical scope, and level of analysis. In Section 4 key challenges are discerned according to the classification just presented. The article ends with an overview of the key challenges identified and suggestions for future research.

2. Defining sustainable urban energy systems

Before addressing the different aspects of SUES one first needs to clarify what urban energy systems actually mean. In following (Jaccard, 2006) (Keirstead et al., 2012) define energy systems in their review article as, "the combined processes of acquiring and using energy in a given society or economy" (p.6) before defining urban energy systems. They name three aspects that are key to urban energy systems, i.e. (i) viewing energy systems as combined processes, from resource extraction to end-use; (ii) balancing energy supply and demand in urban areas where energy is not anymore supplied from energy sources outside the area, and where 'users' are no longer only passively consuming energy, as there are new opportunities for in-city generation; and (iii) by acknowledging that urban energy systems are socio-technical systems not only comprising of technical components like pipes, cables, transformers and the like, but also of social aspects pertaining to end-consumers, customer preferences, institutions, regulation, social structures and social practices. In sum, (Keirstead et al., 2012) define urban energy systems as, "systems that represent the combined processes of acquiring and using energy to satisfy the energy service demands of a given urban area" (2012: p. 3849). Although we acknowledge this definition, we would like to stress the importance of institutions and social components of urban energy systems which appear not mentioned explicitly in the afore mentioned definition. We consider this of great importance because the workings of energy systems cannot be understood properly (1) in the absence of institutions - as "rules of the game" (Ostrom, 2009) – and when neglecting (2) the role of values and (3) key social components, in connection to the relevant physical and technical elements (Correljé et al., 2022). So, when designing and operating energy systems equal attention is required to technological components on the hand and institutional and social ones on the other (Scholten and Künneke, 2016).

When addressing 'sustainable' urban energy systems scholars highlight energy related issues like energy conservation, the use of renewable energy sources and increased energy efficiency levels. For instance, (Yamaguchi et al., 2007) view a transition to sustainable energy systems first and foremost from the perspective of energy saving measures when modelling future sustainable urban energy systems. By doing this they focus on three levels: i.e. (a) the neighbourhood - city level, addressing energy generation and distribution planning, for instance the introduction of district heating and cooling systems and electricity supply networks by using distributed generators; (b) the building level, seeking improvement in the performance of building insulation, optimization of the operation of building systems, and introduction of cogeneration, etc.; and (c) the equipment level, seeking improvement in efficiency of energy-consuming appliances like lighting, office-equipment and heat source machines. When combining this interpretation of 'sustainable' urban energy system with the definition of urban energy system by Keirstead (Keirstead et al., 2012), "sustainable urban energy systems" can be defined as, "Low carbon, energy efficient systems using renewable energy sources that represent the combined processes of acquiring and using energy to satisfy the energy service demands of a given urban area, taking into account both the neighbourhood, building and equipment level."

When stressing the importance of institutions and social components - including social structures, practices and behaviour – in sustainable urban energy systems we suggest to adjust its definition into: "Low carbon, energy efficient systems using renewable energy sources that represent the combined processes of acquiring, distributing and using energy to satisfy the energy service demands of a given urban area, whilst taking into account the neighbourhood, building and equipment level, as well as institutions, values and social components." Note that we also included "distribution" to the "combined processes" mentioned in the definition, in addition to acquiring and using energy.

3. Characteristics of the articles contributing to this Special Issue

Ten articles were published in the SI. They show a great deal of variation in terms of their disciplinary background, the level of analysis, research design, technology coverage, and countries in which research was conducted. With regard to their disciplinary background the articles cover: ecological economy, ethics of technology, innovation studies, transition studies, sociology, governance/policy sciences, environmental management, social psychology, social geography, and planning

studies. With regards to their level of analysis the articles cover the household/building level, the neighbourhood level, the municipal/local level, country level and even the EU level. In terms of research design all studies were of empirical-analytical nature, and include both qualitative, quantitative, and mixed methods used. Quantitative approaches used include Agent-Based Modelling (ABM), surveys, and framing (content/media) analysis. Qualitative approaches include case studies (single, multi, cross-case), regulatory framework assessment, and consultation workshops. Finally, several articles presented classification studies of medium to large-N datasets. A variety of urban energy technologies are covered in the articles including: community/decentralized energy storage, Smart Grid (including Virtual Power Plant, community battery, local energy market technology and services (e.g. P2P, 'Gridflex'); several distributed generation technologies including wind and solar power, Net Zero Energy Buildings (NZEBs) and other green buildings concepts in both the domestic and utility sectors, home heating options like heat pumps and district heating. Moreover, the technologies researched cover both individual and collective options. The articles in this SI mostly covered a wide range of EU countries (i.e., the UK, Netherlands, Germany, Belgium, France, Italy, Croatia, Spain, Sweden, Portugal, Finland, Denmark, Poland). Moreover, one article also covered countries outside Europe, namely India and Singapore (Jain et al., 2020). Within the countries mentioned a great number of pilot projects were researched.

4. Contributions to this Special Issue

4.1. Institutional factors and governance

As stated, a transition towards a sustainable urban energy system cannot be accomplished relying on technology only. There are critical social, political and institutional factors that should be taken into account when striving to establish sustainable urban energy systems (Hoppe and van Bueren, 2015). Barriers that impede such processes might have to do with social acceptance by local communities as well as with more general socio-political resistances (Wüstenhagen et al., 2007). The former particularly applies in areas where the construction of near-by energy infrastructure is bound to meet resistance (Wolsink, 1996). This is, obviously, related to the disruptive and decentral nature of these technologies. The latter is often rooted in social and behavioural concepts like attitudes and values of the people involved, either as residents or as end consumers or prosumers. Moreover, such attitudes are often shaped by formal and informal institutional factors, involving (inter)national organizational structures and decision-making processes, business strategies and public policies, traditions and modes of delivery of energy services, or the feeling of particular social or cultural groupings being treated unfairly (Wolsink, 2007).

In their article (Jain et al., 2020) address governance and policy required to support the transition to low energy consuming buildings, in particular 'near or net zero energy buildings' (NZEBs). Whereas policy makers have paid a lot of attention to this issue in developed countries, attention to this approach to constructing buildings is also required in developing countries. Ways to do this pertain to the introduction of policies and environmental regulations to push the demand for low energy buildings, targeting the introduction of new sustainable technologies and their uptake, requiring energy efficiency in building design and the integration of renewable energy technology, so that the potential for energy savings are not missed. Jain et al. (2020) assess the governance of urban energy innovations for low energy green buildings in Delhi and Singapore, with the objective to provide greater understanding of governance arrangements to spur the adoption of these in the building sector.

Technological innovation does not stand alone. If it is to succeed it requires both institutional and social innovation. This also applies to sustainable urban energy system innovation. Community energy storage (CES), for example, offers innovative possibilities for balancing the intermittent supply of renewable energy and the varying demand for power. Technological devices like battery packs allow for short-term storage of locally produced energy, like solar power or wind. CES therewith provide the technological conditions for creating institutional arrangements that make a variety of (new) services available and offer the possibility of combining individual needs with collective storage services. (Gährs and Knoefel, 2020) analyse the political and regulatory framework for the use of storage in community energy systems in Germany. They assess future market development, policy and legal arrangements, funding, social acceptance and participation, and business models. In addition a set of potentially relevant future economic policy instruments related with CES (like grid fees, concession levies, electricity taxes, EEG levy, and VAT) is assessed ex ante, addressing implications for different stakeholders in the electricity system.

(Vringer et al., 2020) address the importance of local public bodies in governing urban energy transitions. The improvement of local governing capacity is of great importance to accelerate local energy transition. They hypothesize that governing capacity is positively related to policy output. Results from a survey with a response of 163 municipalities in the Netherlands, however, show that governing capacity, its preconditions (like having sufficient and qualified staff and budget available) and policy output to support the implementation of urban energy policy) differ largely among Dutch municipalities. Surprisingly however, no direct relationship was found between policy output and governing capacity - i.e. the capacity of municipalities to formulate and implement effective policies, with capacity referring to three components: (1) decision-making, (2) implementation, and (3) accountability (Boogers et al., 2008). Nevertheless, the study does establish statistical relationships between preconditions of governing capacity and policy output.

4.2. Values and social acceptance

Dealing with citizen involvement in urban energy systems means not only coping with complex factors causing 'nuisance' in the technological functioning of today's energy systems, but also having to acknowledge the social, cultural, ethical and political dimensions. This underlines the importance of paying attention to societal values in the transition to sustainable urban energy systems. Such values come forward in the desire of communities to contribute to energy democracy, in achieving energy justice, securing affordability of energy services and inclusive prosperity, fostering responsible innovation, ascertaining democratic legitimacy, while minimizing the environmental impact of future and current urban systems. Getting hold of such issues that have to do with the value dimension is important because the feasibility of transforming urban energy systems will depend on it. Therefore it is important to engage in value laden deliberative participation, which might also enable constructive conflict (See: (Correljé et al., 2022; Pesch et al., 2017).

The importance of values is made explicit in the notion of *energy justice,* which refers to the "equitable access to energy, the fair distribution of costs and benefits, and the right to participate in choosing whether and how energy systems will change" (Miller et al., 2013) p. 143). In their contribution to this SI (Milchram et al., 2020) explore the implications of the introduction of smart grids with respect to energy justice. Analyzing two empirical cases, they investigate how energy justice can be related to different technical and institutional elements in the design of smart grids. This approach contributes to the understanding of justice implications of different regulatory arrangements of smart grid systems. Results underscore the importance of fairness in data governance, participatory design, user control and autonomy, technology inclusiveness, and the design for expansion and replication. The authors suggest that more efforts are required in testing future smart grid experiments to facilitate the implementation of 'just' electricity sector regulation.

Closely related to energy justice is social acceptance. In their

contribution to this SI (de Wildt et al., 2021) developed an approach to assess, ex ante, the social acceptance of sustainable heating systems in city districts. The approach uses an agent-based model (ABM) to anticipate social acceptance, by identifying value conflicts embedded in various sustainable heating systems in specific social settings, like a community-driven heating initiative in The Hague, the Netherlands. Based on the results the authors formulate scenarios of value change to understand the severity of resulting social acceptance issues and their potential impact thereof.

Consumer and prosumer perceptions, behaviour and practices are important for the design of successful business models for energy storage. In their contribution to this SI, (Bögel et al., 2021) present a study of workshops with consumers at an early stage of the development of energy storage projects, in order to understand their needs (e.g., flexibility, affordability) as well as their preferences in relation to different business models. The study examines the role of autarky (independence from the centralised energy system), autonomy (control over energy management) and relatedness (degree of sharing required) in relation to storage options. They also address *the role assigned to consumers in business models*. Such roles range from the (current) mostly passive use of energy, through to an *active prosumer* rule, where consumer-citizens are engaged in energy production, consumption and distribution. Results from the study – based on two case studies: one in Sweden and one in Portugal - suggest that consumer-citizens perceive an increase in autarky and autonomy as key benefits of decentralized energy systems. This is highly motivating for their support of energy storage options. However, the study also revealed that consumer-citizens wish to handle the new technology with close to no effort.

4.3. Citizen involvement

Citizen involvement entails different ways in which citizens participate and engage in processes directly or indirectly related to urban energy systems. This can happen to varying degrees. Typically, households are only involved late in decision processes when key decisions have already been made by property owners, project developers, distributed grid operators, municipalities, or housing associations). They are basically only consulted but do not have a say in (meta) decision making. Commitment might increase when households (and other roles citizens can have) are involved earlier in planning and decision making processes, and are given an equal role to other actors in decision making arenas. Instead of being merely consulted, they actually participate in decision making about planning, investment and operation of key elements of urban energy systems, like choosing between (renewable) energy generation alternatives, management and operation of (smart) electricity grids or heat grids (Itten et al., 2021; Sillak et al., 2021). As citizens have become increasingly aware, involved, and are able to mobilize community energy initiatives - notably in the form of renewable energy cooperatives – they are also capable of participating in planning and decision making processes in more organized and professional ways (Coenen and Hoppe, 2022).

Renewable energy cooperatives and other grassroots community energy initiatives increasingly participate in public decision making (with local authorities, but nowadays also with national government), and co-create governance arrangements, and thereby pathways that contribute to making urban energy systems more sustainable. Next to co-creation, these grassroots organizations are also involved with the implementation of (co-produced) government policy, and in some cases even in management and operation of urban energy infrastructures and energy generation plants. This allows them to operate on arm's length of government, and by doing so making sure that community values are cherished and community goals are met (Hannon and Bolton, 2015; Warbroek and Hoppe, 2017). In sum, citizen and community involvement in decision making regarding urban energy systems can have different forms, and involves both participation via co-creation (formulating policy) and participation via co-production (implementing policy). Moreover, grassroots community energy organizations allow citizens and communities to participate in more formal and powerful ways.

Community energy is a growing phenomenon across Europe that is attracting the attention of both policy makers and researchers for the role it may play in accelerating the energy transition. However, the extant literature dealing with the participation of civil society actors in renewable energy production has two important limitations. First, it consists of studies that have their focus on a limited number of countries and, in particular, on a UK context (Van der Schoor and Scholtens, 2019). Second, little attention has been devoted to the contextual factors that make this approach successful and to the question of what elements of such favourable contexts can be transferred to other countries. Therefore, in their contribution to this SI (Ruggiero et al., 2021) explore the wider societal forces, cultural rules and regulative elements that determine the success and diffusion of citizen-driven renewable energy initiatives. They do this *using a neo-institutional theoretical approach*, analysing ten case studies from the Baltic Sea Region. Results from the study show that community energy projects require a sufficient degree of institutional support. Local and national governments are recommended by the authors to address four issues in order to strengthen the role of community energy in the transformation of urban energy systems: 1) by harmonising policies; 2) by creating a culture for transitions; 3) by developing visions for community energy; and 4) by promoting policy learning from experiments.

The rise of community energy in recent years taps into another important issue regarding citizen involvement in sustainable urban energy systems, namely the importance of social innovation. Social innovation involves innovations that are social in their means and contribute to civic empowerment and social goals pertaining to the general well-being of communities. This may relate to issues like social incentives to stimulate behavioral change (e.g., programs and workshops organized by community energy initiatives targeting household energy consumption), new social configurations (e.g., using social entrepreneurs or intermediaries to build social networks), new organizational forms (e.g., renewable energy cooperatives), new forms of governance to stimulate transitions to low carbon economy (either at the local or regional scale; e.g., citizen self-governance or co-creation to co-design low carbon policy), or novel policies and regulations to empower social groups to engage in low carbon energy activities (Hewitt et al., 2019). Social innovation often co-evolves with techno-economic innovation, and the combination might be particularly apt to spark citizen action. Examples are renewable energy cooperatives using ICT platforms and smart metering to incentivize their members to engage in energy saving behaviors, or to invest in renewable energy technology (Koirala et al., 2016). In addition, serious energy games (often ICT based) offer virtual spaces in which citizens (but also other stakeholders) can practice and learn on how to design urban energy systems of the future, and how to engage in strategic decision making (Bekebrede et al., 2018).

To fulfil the European Union's goal of providing "Clean Energy for All Europeans", a transformative shift of the energy market from centralised systems based on fossil fuels to decentralized small-scale systems based on renewable energy sources (RES) is needed. Citizens have been placed at the core of the energy policy of the Energy Union. In their contribution to this SI, (Horstink et al., 2021) offer a preview into results of a European-wide research project (PROSEU) that addresses the role of citizens who actively participate in the market, in particular those that produce and consume energy from renewable sources, referred to as 'RES prosumers'. They present an exploratory categorisation of the different collective social actors, referred to as 'collective RES prosumers', aiming to clarify their participation in the energy landscape. They find six categories with different engagement and needs, which are related to the EU's framing of collective energy actors. These are: energy cooperatives, energy communities; organisational prosumers; RES prosumer facilities; RES prosumer influencers.

In their contribution to this SI, (Wittmayer et al., 2021) address

social innovation in terms of changing social relations, involving new ways of doing, organising, knowing and framing, which is transformative to the extent that it challenges, alters and/or replaces dominant institutions in the social context (Avelino et al., 2019; Haxeltine et al., 2017). An important element of such institutional change concerns the processes through which innovations 'mainstream', 'grow' and/or 'gain impact'. These processes are, depending on their theoretical origin, referred to as *mainstreaming*, diffusion, scaling, embedding, translating etc. This paper aims to contribute to the understanding of such processes by applying a multi-actor perspective to unpack how 'mainstreaming' of social innovation manifests across different institutional contexts. Taking the empirical case of energy prosumers as illustration, this paper specifies processes of 'mainstreaming' of social innovation across different institutional logics, including: formalisation and bureaucratisation (state logic), commercialisation and marketization (market logic), as well as normalisation and 'communitisation' (e.g., community logic). As is argued, each of these processes carries a number of tensions and paradoxes regarding resistances against such innovation, versus their transformative impact.

To support the development of social innovation, room for experimentation is needed. Cities can be coined as seedbeds for innovations, but only if room is given to organize series of experimentation with techno-economic and social innovation, also focusing on citizen involvement, empowerment, and improving the general wellbeing of local communities (and not only increasing techno-economic performance of energy systems) (Geels, 2013). Whereas community energy initiatives practice citizen science to counter claims by incumbent energy systems actors, living labs can be set up to test technical innovations in real-time and in conjunction with social innovations that co-evolve with them (i.e., by involving a community energy initiative and creating a new actor configuration encountering new user experiences and social practices) (Nevens et al., 2013). There is an important role for government (i.e., local authorities, but also higher tiers of government) to support the establishment of venues where local experimentation can take place. Local governments can deploy modes of governance by enabling or governance by provision to make this happen, and stimulate community involvement and social innovation (Bulkeley and Kern, 2006). Both are necessary to make the transition to sustainable urban energy systems possible.

With regard to citizen involvement in energy transitions community energy initiatives are often seen as agents of change (Hewitt et al., 2019; Smith et al., 2016). However, their capability to act is curtailed by their institutional and actor environment. Here, it not only matters what capacity and resources community energy have at their dispense, but also how they are viewed by others. In their contribution to this SI, (Lagendijk et al., 2021) argue that energy transition stands to benefit from a stronger advocacy of community energy initiatives, notably through a better strategic and spatial framing. They employed a framing analysis of the representation of ten Dutch community energy cases in the period 1989–2017 in the public opinion. Results show that community energy initiatives generally meet a positive framing, emphasizing economic, environmental and community benefits. However, this appears primarily related to the instrumental need for community energy initiatives to prove community acceptance, rather than exposing their strategic roles in promoting the energy transition. As compared to rural settings there is relatively more attention for energy community initiatives' transformative role in urban centers.

5. Challenges to researching sustainable urban energy systems

The articles contributing to the SI revealed insights into a number of challenges as regards the creation of academic knowledge supportive in the design, planning and implementation of sustainable urban energy systems. We classify these challenges threefold, related to the three dimensions of: i) institutions and governance; ii) values and ethics; and iii) citizen involvement.

5.1. Institutional and governance challenges

With regard to novel technology to be implemented in sustainable urban energy systems the articles by (Jain et al., 2020) and (Gährs and Knoefel, 2020) and provide insights in challenges encountered to the introduction of new technology. (Jain et al., 2020) analysed the uptake of NZEBs and green buildings from an innovation and governance perspective and addressed the importance of policies and environmental regulations to push the supply of low energy buildings, targeting the introduction of new sustainable technologies, energy efficiency in building design and the integration of renewable energy technology. The authors call for a deeper understanding of diverse governance arrangements. (Gährs and Knoefel, 2020) found that in Germany one of the biggest obstacles faced by community energy storage, other than a complex regulatory framework, is the lack of a clear legal definition of such storages in national as well as in EU law. Moreover, there is a need for further standardisation, not only regarding technical aspects such as communication interfaces or fire prevention, but also in the area of customer protection such as warranty terms. (Vringer et al., 2020) stressed the importance of local government and municipalities as agents of change. However, they seriously doubt whether municipalities have sufficient governing capacity to fulfil their role effectively, and succeed in formulating and implementing new policies to incentivize and facilitate transformative change in greening urban energy systems.

5.2. Challenges with regard to values and social acceptance

Two of the contributions to the SI address challenges encountered in urban energy systems when introducing smart technology. (Milchram et al., 2020) raise the question how design choices in smart grid projects impact energy justice? They argue that design choices are value-laden, with value conflicts occurring in local smart grid projects. This raises many normative, ethical questions on how to cope with these conflicts. (Bögel et al., 2021) address the introduction of community energy storage. They are doubtful whether this technology can live up to expectations, in particular with regard to consumer-citizen issues that are most relevant to urban-scale storage. They studied consumer roles and the related prosumer versus consumer-debate concerning energy futures, which range from the current mostly passive use of energy by consumers to the active role that prosumers can play in energy production, consumption, and distribution. Smart grid technology, including CES, will potentially change the relation between production and consumption. Here, there is a need to better understand prospective domestic consumer-citizens, more specifically regarding perceptions of autonomy (control over energy management) as part of envisaged living experiences and motivations for engagement. (de Wildt et al., 2021) studied social acceptance of heating options by households. Although more sustainable heating systems are required in city districts to reduce greenhouse gas emissions, these systems may lack social acceptance as they often require significant adjustments to homes and may lead to a noticeable loss of in-home thermal comfort. Fostering social acceptance is often difficult due to the long-term planning horizon for energy systems. It is therefore unclear which design requirements and policy guidelines need to be specified ex ante. They suggest the further development of an approach to support social acceptance by identifying value conflicts embedded in sustainable heating systems in specific social settings.

5.3. Challenges to citizen involvement

(Ruggiero et al., 2021) studied community energy projects in the Baltic Sea region and factors that influenced their performance and survival. They found that institutions as well as visions, for example, plans for future energy generation, are important contextual features for urban community energy projects. However, many community energy initiatives find it hard to overcome unfavourable contextual conditions.

In order to stem the tide it is important for community energy initiatives to build trust, appeal to their community's sense of identity, and engage in networking, and promotion of demonstration projects. How to engage in these activities is however very challenging. Both (Wittmayer et al., 2021) and (Horstink et al., 2021) studied collective 'prosumership'. (Wittmayer et al., 2021) hold that renewable energy 'prosumerism' comes with promises and expectations of contributing to sustainable and just energy systems. However, in its process of becoming mainstream, numerous challenges and doubts arise whether it will live up to these. (Horstink et al., 2021) add that, although there is a new EU regulatory framework that recognises civic-inspired prosumer initiatives, little is known about the full range and diversity of collective actors in renewable energy self-consumption as well as how they engage with the changing energy system. The authors find it challenging that there is a lack of fine-tuned policies to support different actors, more particularly in the challenging journey regarding the transposition of the European Union's Clean Energy Package (CEP). Finally, (Lagendijk et al., 2021) address the importance of framing of the community energy movement and argue that energy transition still stands to benefit from a stronger advocacy of energy community's contribution, notably through a better strategic and spatially sensitive framing.

6. Conclusions and policy implications

This Guest Editorial started claim that the complex transition towards sustainable urban energy systems demands more than mere technological innovation. The ten articles contributing to the SI have verified this. They have done this in several ways. Table 1 presents an overview of challenges to developing, planning and realising sustainable urban energy systems, classified into three dimensions: a) governance and institutions; b) values and social acceptance; and c) citizen involvement. Based on the insights taken from the articles contributing to the SI several suggestions for future research are presented, using the afore mentioned classification into three dimensions.

6.1. Suggestions for future research regarding institutions and governance

(Gährs and Knoefel, 2020) argue that there is a need for developing best-practice examples and for monitoring the use of SUES technology like community energy storage. In addition, research projects should focus on examining new services and business models, to facilitate the necessary changes to the regulatory framework. (Jain et al., 2020) suggest future researchers to elaborate the analytical framework developed in their articles, potentially also in the form as a policy tool to support cities in managing urban energy system innovations. Based on the article by (Vringer et al., 2020) it is advised that future research addresses the evaluation of *governing capacity* as an empirically relevant variable. Currently, measurements of governing capacities of individual municipalities and other governmental organizations are based on less transparent methods. The authors call for developing an alternative approach to measure governing capacity and its components more directly.

6.2. Suggestions for future research regarding values and social acceptance

In line with (Milchram et al., 2020) future research is suggested exploring the feasibility to govern smart grids as commons in the sense of Elinor Ostrom's 'Governing the Commons', (Ostrom, 2009) and further examine the relationship between trust and perceptions of justice. Future research should focus more on justice as recognition, which remains under-theorized (Bulkeley et al., 2014). This should also address misrecognition of vulnerable groups which is associated to procedural and distributive injustices. Future research might also explore the feasibility and effects of governance as commons and collective ownership in smart grid systems, and how to build trust in a smart grid configuration. In line with (Bögel et al., 2021) it is suggested to extend research into the effects of different storage options, e.g. short-term storage and seasonal storage and/or different levels of autarky, and on possibilities for consumer-prosumer engagement. Based on the article by (de Wildt et al., 2021) it is suggested that the value-ABM research approach should be further tested for other cases, that it is complemented with participatory decision-making methods, and that the model is extended to simulate the decision-making of households in relation to social acceptance of urban sustainable energy system technology (i.e. sustainable heating options).

Table 1
Challenges encountered when desiring to establish sustainable urban energy systems (SUES).

Dimension	Challenge
Governance and institutions	Need for policies and environmental regulations to push supply SUES technology
	Absence of a regulatory framework
	Absence of a proper legal definition of SUES technology
	Need for more standardisation, not only covering technical aspects but also as to protect consumers.
	Poor (local) government capacity
	Unfavourable conditions (i.e., resources) to enabling (local) government capacity.
Values and social acceptance	Lack of insight into how design choices impact energy justice
	Addressing value conflicts in SUES projects
	Expectations newly introduced technology encounters
	New technology may have severe impact on supply chains and the relation between energy producers and consumers
	Perceived autonomy
	Social acceptance in light of high transaction costs
	Social acceptance in light of value trade-offs
	Predicting and coping with social acceptance in planning activities
	Long time horizon of urban energy projects and infrastructure
	Specification of design requirement and policy guidelines
Citizen involvement	Unfavourable contextual settings: social and institutional
	Engaging in social, networking and promotion activities
	Novel social (prosumer) organisational structures living up to expectations (in their mainstreaming process)
	Grassroots prosumer collectives lacking knowledge and knowhow on how to engage in transformative action
	Lack of fine-tuned policy to support actors
	Need for better framing and stronger advocacy of community energy initiatives

6.3. Suggestions for future research regarding citizen involvement

In line with (Ruggiero et al., 2021) it is suggested that future studies focus on how SUES visioning with community energy project takes place and how having these visions in place contributes to the institutionalisation of community energy practices in urban areas. In addition it is suggested that further research seeks to better understand the cultural determinants of community energy. In line with (Wittmayer et al., 2021) future research is suggested into how hybrid institutional arrangements may reconcile the formal-informal logics (i.e. gaining recognition) and public-private logics (i.e., delineating access).This should move academic discussions and policy debates beyond idealistic discussions of ethical principles and abstract discussions about power distribution and address hybrid institutional arrangements and their capacity to safeguard particular transformative ideals and normative commitments. The article by (Horstink et al., 2021) on prosumer categorisation makes clear that there is a need for future research to further test, refine, and validate the proposed actor categories. Future researchers are encouraged to comment and contribute or elaborate upon the tentative framework presented by the authors. Finally, in line with (Lagendijk et al., 2021) it is suggested that further research is conducted into specific perspectives, attitudes and framing actions of local citizens, the media and other stakeholders affecting community energy initiatives, their social and institutional acceptance, and other related complexities.

CRediT authorship contribution statement

Aad Correljé: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. **Thomas Hoppe:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Rolf Künneke:** Conceptualization, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

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References

Avelino, F., Wittmayer, J.M., Pel, B., Weaver, P., Dumitru, A., Haxeltine, A., Kemp, R., Jørgensen, M.S., Bauler, T., Ruijsink, S., 2019. Transformative social innovation and (dis) empowerment. Technol. Forecast. Soc. Change 145, 195–206. https://doi.org/10.1016/j.techfore.2017.05.002.

Bekebrede, G., Van Bueren, E., Wenzler, I., 2018. Towards a joint local energy transition process in urban districts: the go2zero simulation game. Sustainability 10 (8), 2602. https://doi.org/10.3390/su10082602.

Bögel, P.M., Upham, P., Shahrokni, H., Kordas, O., 2021. What is needed for citizen-centered urban energy transitions: insights on attitudes towards decentralized energy storage, 149. https://doi.org/10.1016/j.enpol.2020.112032.

Boogers, M.J.G.J.A., Schaap, L., Karsten, N., van den Munckhof, E.D., 2008. Decentralisatie als opgave: Een evaluatie van het decentralisatiebeleid van de Rijksoverheid (1993-2008). Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. https://pure.uvt.nl/ws/portalfiles/portal/1063634/decentralisatie.pdf.

Broto, V.C., Bulkeley, H., 2013. A survey of urban climate change experiments in 100 cities. Global Environ. Change 23 (1), 92–102. https://doi.org/10.1016/j.gloenvcha.2012.07.005.

Bulkeley, H., 2013. Cities and Climate Change. Routledge. https://doi.org/10.4324/9780203077207.

Bulkeley, H., Edwards, G.A., Fuller, S., 2014. Contesting climate justice in the city: examining politics and practice in urban climate change experiments. Global Environ. Change 25, 31–40. https://doi.org/10.1016/j.gloenvcha.2014.01.009.

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

Coenen, F.H., Hoppe, T., 2022. Renewable Energy Communities and the Low Carbon Energy Transition in Europe. Springer Nature. https://doi.org/10.1007/978-3-030-84440-0.

Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M.G., Cochran, I., Robert, A., Teasdale, P.-J., 2009. Cities, climate change and Multilevel governance. OECD Environment Working Papers, No. 14. OECD Publishing, Paris. https://doi.org/10.1787/220062444715.

Correljé, A., Pesch, U., Cuppen, E., 2022. Understanding value change in the energy transition: exploring the perspective of original institutional economics. Sci. Eng. Ethics 28 (6). https://doi.org/10.1007/s11948-022-00403-3.

de Wildt, T.E., Boijmans, A.R., Chappin, E.J., Herder, P.M., 2021. An ex ante assessment of value conflicts and social acceptance of sustainable heating systems: An agent-based modelling approach. Energy Pol. 153, 112265 https://doi.org/10.1016/j.enpol.2021.112265.

Gährs, S., Knoefel, J., 2020. Stakeholder demands and regulatory framework for community energy storage with a focus on Germany. Energy Pol. 144, 111678 https://doi.org/10.1016/j.enpol.2020.111678.

Geels, F., 2013. The role of cities in technological transitions;: Aanalytical clarifications and historical examples. In: Bulkeley H, C.-B.V., Hodson, M., Marvin, S. (Eds.), Cities and Low Carbon Transitions. Routledge, pp. 13–28. https://doi.org/10.4324/9780203839249.

Hannon, M.J., Bolton, R., 2015. UK Local Authority engagement with the Energy Service Company (ESCo) model: key characteristics, benefits, limitations and considerations. Energy Pol. 78, 198–212. https://doi.org/10.1016/j.enpol.2014.11.016.

Haxeltine, A., Pel, B., Dumitru, A., Avelino, F., Kemp, R., Bauler, T., Kunze, I., Dorland, J., Wittmayer, J., Jørgensen, M.S., 2017. Towards a Transformative Social Innovation theory: a relational framework and 12 propositions. TRANSIT working paper (16). http://hdl.handle.net/2013/ULB-DIPOT:oai:dipot.ulb.ac.be:2013/265954.

Hewitt, R.J., Bradley, N., Baggio Compagnucci, A., Barlagne, C., Ceglarz, A., Cremades, R., McKeen, M., Otto, I.M., Slee, B., 2019. Social innovation in community energy in Europe: a review of the evidence. Front. Energy Res. 7, 31. https://doi.org/10.3389/fenrg.2019.00031.

Hoppe, T., de Vries, G., 2019. Social innovation and the energy transition. Sustainability 11 (1), 141. https://doi.org/10.3390/su11010141.

Hoppe, T., Graf, A., Warbroek, B., Lammers, I., Lepping, I., 2015. Local governments supporting local energy initiatives; Lessons from the best practices of Saerbeck (Germany) and Lochem (The Netherlands). Sustainability 7 (2), 1900–1931. https://doi.org/10.3390/su7021900.

Hoppe, T., van Bueren, E.M., 2015. Guest editorial: governing the climate change mitigation and energy transition challenges in cities. Energy, Sustainability and Society 5 (19). https://doi.org/10.1186/s13705-015-0047-7.

Horstink, L., Wittmayer, J.M., Ng, K., 2021. Pluralising the European energy landscape: collective renewable energy prosumers and the EU's clean energy vision. Energy Pol. 153, 112262 https://doi.org/10.1016/j.enpol.2021.112262.

Itten, A., Sherry-Brennan, F., Hoppe, T., Sundaram, A., Devine-Wright, P., 2021. Co-creation as a social process for unlocking sustainable heating transitions in Europe. Energy Res. Social Sci. 74, 101956 https://doi.org/10.1016/j.erss.2021.101956.

Jaccard, M., 2006. Sustainable Fossil Fuels: the Unusual Suspect in the Quest for Clean and Enduring Energy. Cambridge University Press. https://doi.org/10.1017/CBO9780511754104.

Jain, M., Siva, V., Hoppe, T., Bressers, H., 2020. Assessing governance of low energy green building innovation in the building sector: insights from Singapore and Delhi. Energy Pol. 145, 111752 https://doi.org/10.1016/j.enpol.2020.111752.

Keirstead, J., Jennings, M., Sivakumar, A., 2012. A review of urban energy system models: approaches, challenges and opportunities. Renew. Sustain. Energy Rev. 16 (6), 3847–3866. https://doi.org/10.1016/j.rser.2012.02.047.

Koirala, B.P., Koliou, E., Friege, J., Hakvoort, R.A., Herder, P.M., 2016. Energetic communities for community energy: a review of key issues and trends shaping integrated community energy systems. Renew. Sustain. Energy Rev. 56, 722–744. https://doi.org/10.1016/j.rser.2015.11.080.

Lagendijk, A., Kooij, H.-J., Veenman, S., Oteman, M., 2021. Noisy monsters or beacons of transition: the framing and social (un) acceptance of Dutch community renewable energy initiatives. Energy Pol. 159, 112580 https://doi.org/10.1016/j.enpol.2021.112580.

Milchram, C., Künneke, R., Doorn, N., van de Kaa, G., Hillerbrand, R., 2020. Designing for justice in electricity systems: a comparison of smart grid experiments in The Netherlands. Energy Pol. 147, 111720 https://doi.org/10.1016/j.enpol.2020.111720.

Miller, C.A., Iles, A., Jones, C.F., 2013. The social dimensions of energy transitions. Sci. Cult. 22 (2), 135–148. https://doi.org/10.1080/09505431.2013.786989.

Nevens, F., Frantzeskaki, N., Gorissen, L., Loorbach, D., 2013. Urban Transition Labs: co-creating transformative action for sustainable cities. J. Clean. Prod. 50, 111–122. https://doi.org/10.1016/j.jclepro.2012.12.001.

Ostrom, E., 2009. Understanding Institutional Diversity. Princeton University Press. https://doi.org/10.1515/9781400831739.
Pesch, U., Correljé, A., Cuppen, E., Taebi, B., 2017. Energy justice and controversies: formal and informal assessment in energy projects. Energy Pol. 109, 825–834. https://doi.org/10.1016/j.enpol.2017.06.040.
Ruggiero, S., Busch, H., Hansen, T., Isakovic, A., 2021. Context and agency in urban community energy initiatives: an analysis of six case studies from the Baltic Sea Region. Energy Pol. 148, 111956 https://doi.org/10.1016/j.enpol.2020.111956.
Scholten, D., Künneke, R., 2016. Towards the comprehensive design of energy infrastructures. Sustainability 8 (12), 1291. https://doi.org/10.3390/su8121291.
Seyfang, G., Haxeltine, A., 2012. Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. Environ. Plann. C Govern. Pol. 30 (3), 381–400. https://doi.org/10.1068/c10222.
Sillak, S., Borch, K., Sperling, K., 2021. Assessing co-creation in strategic planning for urban energy transitions. Energy Res. Social Sci. 74, 101952 https://doi.org/10.1016/j.erss.2021.101952.
Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., Seyfang, G., 2016. Making the most of community energies: three perspectives on grassroots innovation. Environ. Plann. 48 (2), 407–432. https://doi.org/10.1177/0308518X15597908.
Späth, P.R.H., 2013. The 'eco-cities' Freiburg and Graz: the social dynamics of pioneering urban energy and climate governance. In: Bulkeley H, C.-B.V., Hodson, M., Marvin, S. (Eds.), Cities and Low Carbon Transitions. Routledge, pp. 88–106. https://doi.org/10.4324/9780203839249.
UN, 2018. 68% of the World Population Projected to Live in Urban Areas by 2050, Says UN. United Nations. Retrieved 4 May 2022 from. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.
UNEP, 2022. Cities and Climate Change. United Nations Environment Programme. Retrieved 4 May 2022 from. https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change.
Van der Schoor, T., Scholtens, B., 2019. Scientific Approaches to Community Energy: a Literature Review, vol. 6. Centre for Energy Economics Research, University of Groningen. https://research.hanze.nl/ws/portalfiles/portal/26503394/VanderSchoor_2019_Scientific_Approaches_of_community_energy_CEER_policy_paper_6.pdf, 978-94-034-1656-4 (pdf).
Vringer, K., de Vries, R., Visser, H., 2020. Measuring governing capacity for the energy transition of Dutch municipalities. Energy Pol. 149, 112002 https://doi.org/10.1016/j.enpol.2020.112002.
Warbroek, B., Hoppe, T., 2017. Modes of governing and policy of local and regional governments supporting local low-carbon energy initiatives; exploring the cases of the Dutch regions of Overijssel and Fryslân. Sustainability 9 (1), 75. https://doi.org/10.3390/su9010075.
Wittmayer, J.M., Avelino, F., Pel, B., Campos, I., 2021. Contributing to sustainable and just energy systems? The mainstreaming of renewable energy prosumerism within and across institutional logics. Energy Pol. 149, 112053 https://doi.org/10.1016/j.enpol.2020.112053.
Wolsink, M., 1996. Dutch wind power policy: Stagnating implementation of renewables. Energy Pol. 24 (12), 1079–1088. https://doi.org/10.1016/S0301-4215(97)80002-5.
Wolsink, M., 2007. Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Pol. 35 (5), 2692–2704. https://doi.org/10.1016/j.enpol.2006.12.002.
Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: an introduction to the concept. Energy Pol. 35 (5), 2683–2691. https://doi.org/10.1016/j.enpol.2006.12.001.
Yamaguchi, Y., Shimoda, Y., Mizuno, M., 2007. Transition to a sustainable urban energy system from a long-term perspective: case study in a Japanese business district. Energy Build. 39 (1), 1–12. https://doi.org/10.1016/j.enbuild.2006.03.031.