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Spatial Negotiation and Energy Transition Management: the University Campus Zurich Case.

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Abstract

In the implementation of Energy Transition Strategies within urban (re)development projects, processes of spatial negotiation between functional needs (for buildings and transportation infrastructure) and energy solutions able to meet the energy performative targets have been observed. In a large number of urban transformation cases, spatial planning and design decisions are independent trajectories to which the energy optimization adapts, based on the idea that technological measures for reducing the energy consumption and for clean energy production can be adapted or integrated in a second stage at the building scale. Furthermore, competitive dynamics for the use of space, in particular in interventions of redevelopment within dense urban environments, contribute to exacerbate the conflict between the idea/principles for energy transitions and its spatial configuration.

The paper investigates the practice of energy transition in a Swiss case where the ambitious National Energy Strategies confront these obstacles in managing the implementation phase. The decision makers involved in the project of the Hochschulquartier (HQ), the new University Campus in Zurich, have been interviewed to understand how energy and spatial decision are taken and coordinated at the micro and macro level, and to understand the main constrains. The results show that the practice of spatial-energy integrated decisions needs new forms of coordination, decision structure and procedure, as well as a new role for designers.

1. Introduction

Fossil fuel dependency and the growing energy demand, together with climate change, are the most significant environmental challenges of the last decades. Urban areas, which take a large share of the energy consumption, result as the producers of 70% [1, 2] of the global greenhouse gas emissions and the 'battleground' to realize the Paris goals of demand reduction, reuse of waste sources and production by renewables. Furthermore, addressing a systemic and sustainable change in energy use and supply within cities, increases the level of complexity and uncertainty [3]. This derives from the type of actors and their interests, as well as the community vision and the decisions process [4].

Although, studies on cities are growing in number, thus informing policies and create principles for an effective energy transition, many bottlenecks are derived from the lack of understanding of the local context and the adaptation of models in the implementation process [5].

Similarly to the distinction between urban sustainability transition and domain-based sustainability transition [6], different traits can be identified between urban energy transition and its theoretical domain. For a long time only macro-factors such as population change, economic growth and technological advancement [7] have been considered influential in environmental and energy transition theory. And even when it has been recognized that "changes in drivers have time- and space-related effects" [8], many factors and connected dynamics have been overlooked in the definition of strategies. For example, the explanation of the link between niche and regime, according to Frantzeskaki et al. [6] appears insufficient to understand urban transitions because of the multiple meaning of spatial configuration and the hierarchical values attributed by actors to their needs and objectives.

Cultural values, ideas, stakeholders' objectives, strategies and application of technologies have the power to produce an infinite number of dynamic interconnections between the change in socio-technical systems, spatial and performative qualities. In addition, the diversity of urban territories and conditions for application of energy policies leads to simultaneous challenges and opportunities for the implementation of energy strategies. Therefore, the complexity of urban contexts seems to require new forms of transition management and operationalization [9] able to integrate the environmental, the cultural, the spatial and the political dimensions of a sustainable transition.

In order to frame new practices of transition, a deep understanding of the key conditions which consent a paradigm change is necessary. The present study will therefore use an analytical framework articulated around five pillars to evaluate the components of energy transition practice in a case study of an Urban Europe research project, called SPACERGY. One of the goals of SPACERGY is to develop guidelines for a successful energy transition for the development and realization of urban projects by creating decision support tools in a Living lab approach of co-creation with practice. In the complex main case of the Hochschulquartier (HQ) in Zurich, where the process of design already has started, the main aim was to analyze and understand the pitfall of the process and bottlenecks in realizing an energy efficient district. Its main aim is to meet the targets of of the Swiss '2000 Watt Society' program [10].

First of all, the paper will give insight in the specific context of the case; policies and the energy approach in the Zurich context. Secondly, a framework composed of five key factors has been used to analyze the conditions in which the transition of the HQ is taking place. These factors are: boundaries & actors, vision, process & management, energy related aspects and energy measures, have been investigated by using available data and results of a number of surveys with the most relevant stakeholders. Finally, conclusions and recommendations are drawn, highlighting critical aspects that require attention and/or significant improvements to achieve an effective (paradigm) change.

2. The Hochschulquartier case and its energy context

The analysis of an energy transition practice was conducted within the SPACERGY project for three different case studies, of which the case study in Switzerland is the main. The case of the Zurich 'Hochschulquartier' was selected as it is representative for complex district projects that aim for high energy efficiency in a context of spatial limitations, since this in fact concerns a redevelopment project of an existing area. Moreover, it is representative for densification patterns of urban transformations, which is interesting for many other cities in Europe and beyond. The project was also chosen due to good available data and possibilities to involve stakeholders in the process.

The project of 'Hochschulquartier' for a new university campus consists of a transformation of a dense and central area of Zurich which already hosts the three main educational institutions of Zurich: ETH, the University of Zurich, and the University Hospital Zurich. The area is currently being redeveloped and densified to create additional floor space for the universities, hospital and complementary services. The spatial interventions are being planned based on an a first Masterplan designed in 2014 [11]. It still results to be very difficult, however, to meet the limits imposed by the '2000 Watt Society' targets to which the city has been committed since 2008 [12].

In order to understand the type of energy transition and priorities faced in this project it is necessary to position it in its energy context by looking at the complex Swiss multi-scale dimension of energy policies and strategies at the federal and urban level. The trajectories traced by the Federal Energy Strategies and the city's Energy Policy have been acknowledged in various occasions as ambitious and challenging. The reason can be found in the type of supply as well as the geographical and democratic nature of the country.

At the national level, the energy transition strategy of Switzerland follows different objectives compared to other European countries. After the Fukushima disaster in 2011, the population expressed through a referendum the will of phasing-out the nuclear power from the supply sources. The energy strategies, that the Swiss government has developed, therefore took this challenging priority within the change of the energy mix. Additionally, the Energy Strategy 2050 aims to contribute in reducing the environmental impact of energy production and consumption by focusing on four pillars: energy efficiency, renewable energies, replacement and new construction of large power stations for electricity production, and foreign energy policy [13].

Although the time frame to achieve the nuclear power phase out and replacement with other primary sources appears long enough the Swiss transition presents several challenges. Firstly, the use of renewable technologies finds important obstacles in the geography of Swiss territory and requires significant infrastructural investments. Topography and climate make it quite difficult to place large photovoltaic and wind power stations, while the hydropower generation with the existing power plants has reached almost the maximum production capacity. Secondly, regarding the improvement of energy efficiency, the 'Building Programme' (launched by the Federal Government to reduce the energy consumption of the building sector) has to confront growing uncertainty in future type of demand. This is a result of external pressures, such as the global temperature rise, that is expected to intensify the energy consumption for space cooling and consequently electricity demand in particular in dense urban areas. Similarly, also the midterm aims of the Federal Energy Strategy appear very ambitious targeting a reduction of consumption pro capita by 43% within 2035. This corresponds to the 13% reduction on 2000 watt per capita established as energy policy in many cities, including Zurich.

At the city level, the objectives of Zurich energy policy aim to secure sustainable supply that conserves resources and reduces primary energy consumption and related emissions. These reflect Federal and Cantonal climate protection laws and the 2000-Watt goal. Furthermore, a powerful instrument called 'Energy Masterplan' has been developed for the application of the 2000-Watt Society approach. This has two fundamental roles. First of all to strategically connect long term objectives to the annual Action Plans and the secondly to define the quantitative targets to reduce the consumption per capita of two kilowatt hours per hour by identified five areas of actions and implementation tasks. However, the coordination between spatial planning and energy planning remains an important issue. Although regarding settlement development the Energy Masterplan states that spatial planning and energy planning are coordinated, in practice there are examples in which the coordination appears to be very complex. This is largely the case in the HQ development plans.

3. Analysis of five key elements for energy transition management of the HQ

In order to understand the possible pitfalls and bottlenecks in achieving the energy urban energy targets, the analysis of the HQ development process within the SPACERGY project has been structured around five key elements: boundaries & actors, energy vision, process & management, energy related aspects and energy-spatial measures. These five key issues are used to describe the multiple dimensions of a transition process to explore the role of relation between actors, their influence on visions and how energy solutions are debated and selected.

Qualitative methods using available spatial data and a number of surveys with most relevant stakeholders, are employed for the study. The participants for the interviews directly involved in the project, are representatives of the Office of Planning and Architecture of the Canton of Zurich, of the real estate and energy departments of the three institutions, and of the Quartierverein Fluntern.

3.1 Boundaries and actors

The transformation of the HQ entails the integration of the needs of different stakeholders : ETH, USZ and UZH, the Canton and City of Zurich and four neighborhood associations (Quartierverein).

The number and type of actors recognized, represent the first element of complexity for the energy and the spatial transition of the district. First of all, the three involved educational institutions have different natures and cultures, since ETH is a Federal institution, while the UZH is Cantonal, while the USZ is also Cantonal, however set to become independent. Secondly, as shown in Fig.1 the HQ area falls within the boundary of four neighbourhoods, Oberstrass, Fluntern and Zurich 1 rechts der Limmat, and Hottingen. This has created a situation in which different administrative authorities have to negotiate their planning aims and actions at different hierarchical levels as well as with the city representatives. Coordination and collaboration between all actors appears to be a fundamental achievement since for many years the three institutions have operated in an independent way until the Canton assumed the project management role in 2014.

Fig.1. Location of the HQ and the four neighborhoods

3.2 Energy vision

A second element of analysis regards the early construction of a common vision with the involvement of the city, the three owners (universities and hospital) and the inhabitants of the four neighborhoods. The sharing of a vision not only concerns the application of energy concepts at the district level, but also a number of aspects related in the early planning phase, such us the quality and identity of the outside space, the functional program, the level of permeability to mobility flows. Despite the long process and the recognition of its relevance, participatory activities were not present along the decision processes, because of the fact that a clear framework was lacking, while the undefined roles in organizing and leading the coordination of activities further complicated this. All the participants in the interviews consider shared moments important and necessary to involve all actors, including the inhabitants, to build awareness of the decisions taken by the different parties. The benefits highlighted were that discussions could enlarge the spectrum of the topics to address, bringing forward new ideas and more sustainable solutions. Given the high degree of complexity due to the number of actors involved together with the public ownership, many of the interviewees agreed that as a consequence the process becomes slower and longer, and therefore more expensive and time-consuming. However, it was stressed that the long term values of these activities could facilitate the decision making process by helping the definition of common goals and visions that would create less opposition in the implementation phase.

In particular regarding the energy vision, preliminary studies [12] produced jointly by the three institutions in 2016 have made a first attempt to merge the single projects developed by the three institutions. However, in this initial stage it only investigated the energy supply system and the supply related infrastructure, by describing possible scenarios of energy demand and strategies for energy supply in the future, without considering the more complex spatial dimension of the energy transition. Thus, the three institutions didn't produce joint energy concepts for the entire district, while the inhabitants of the neighborhoods resulted to be excluded from the debate around the energy future of the area.

3.3 Process & management

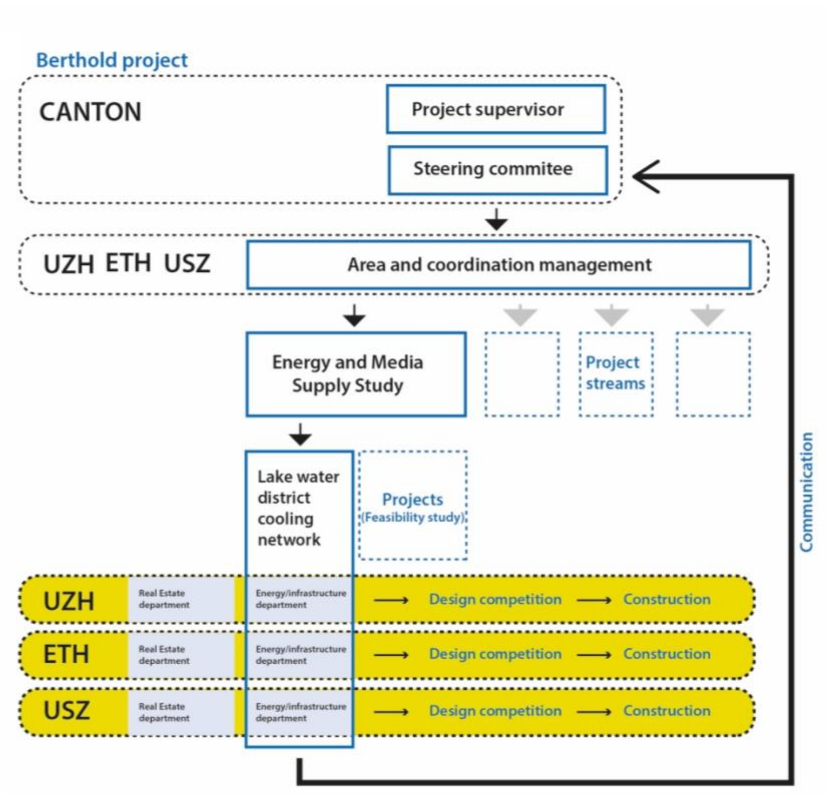
The third part of the analysis regards the process of decision making and its management, and in particular the coordination of and between energy related and spatial decisions. Decisions regarding energy and spatial components within the process of the HQ can be subdivided in three levels. The first level concerns the overall framework managed by the Berthold project team (macro level); the second level of coordination regards the decisions that are made by the three institutions and their internal departments (micro level). The third level includes the role of the inhabitants of the area and their requests.

At the macro level the resulting process is organized in a hierarchical structure as shown in Fig.2 where at the top there is "Projektaufsicht" (project supervision) followed by the "area and coordination management", which initializes the several project streams (like the Energy and Media Supply Study) and services the basic financing so the feasibility study can be started; next, separate teams with representatives of all stakeholders develop specific smaller (sub)projects. The Berthold project steering committee

(Projektsteuerungsgremium) has the main role for the coordination of all the parties in the area including the Canton and City of Zurich. Meanwhile at the micro level, each institution has experts on energy and spatial fields who are coordinated internally. The third level which is represented by the process of involvement of the representatives of the inhabitants appears as a practice of mediation and creation of awareness on the decisions taken and focuses only on spatial aspects, neglecting energy and infrastructure issues.

This main problem related to (lack of) coordinating decisions between the energy and spatial sectors at the macro level is a result of the complexity of the location and the lack of space for the (spatial) needs (amplifications) of the three institutions. A consequence is that the spatial constraints become the main drivers, whereas the energy aspects have to follow. Moreover, that the overall coordination tends to become a political mediation practice that supersedes the importance of a common principle of integrated sustainable development.

Fig.2. Decision process structure



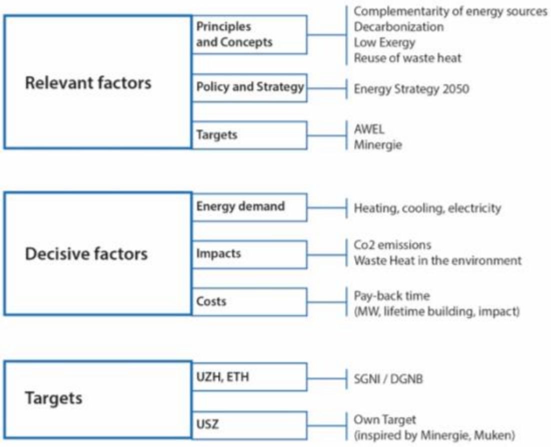
In the analysis of the process at the macro and micro level, a common pattern is observed since energy concepts, guidelines and studies regarding energy supply and energy performance follow the spatial decisions. Principles regarding integrated spatial-energy solutions related decisions are underestimated and very often missing at the macro and micro levels. In addition, the framework for the decision process on energy infrastructure hasn't included the involvement of inhabitants, thus preventing application of possible benefits that come from integrated decisions, such as the use of waste heat from the institutions for the residential heating during the night.

At the micro level, the coordination between the real estate and energy departments within the individual institutions, seems to find internal management challenges. Main issues brought up during the interviews related to the lacking of standard operation procedures for the coordination of different offices regarding spatial development projects, the instability of the departments structures and the need for new experts, as well as the difficulty in involving energy experts in an early stage when energy performative concepts can be developed together with planning principles within an integrated, or synergetic approach.

3.4 Energy related aspects

The forth factor analysed focuses on the energy aspects that have been taken in account along the planning and design process. The people interviewed were asked to list factors they considered important in order to improve the energy performance, factors that drive energy decisions and the targets used. As shown in Fig.3 large variety of aspects has been identified. The parameters that have been used vary in importance according to the phase in which the energy performance is taken into consideration.

Fig.3. List of energy related aspects



In the early stages the relevant energy factors are the expression of abstract concepts that predominantly have to do with the spheres of energy principles and policy related and strategic goals. In a second stage, when taking decisions, the factors become measurable indicators for the energy performance and their impacts. Here the decisions are made based on the amount of energy needed for heating, cooling and electricity, and on the impacts in terms of CO2 (equiv.) production, as well as the costs for the implementation of energy systems and measures to support them. The third group of indicators comes from the general goal to achieve an energy label at the building scale. The target catalogues available seem to be unable to cover the complexity of the intervention in the HQ because of the types of uses allocated in a number of complex (existing) building configurations. This constrains results in two ways: first of all, a selection of subset of the available indicators is used for design competitions in the form of guiding parameters, and a secondly concerning the transformation of the standards to create new target values.

As a result, coherent key factors for the district are missing. The diversity of the parameters taken into account, highlights a general discrepancy between the energy factors generally considered relevant to improve the performance of the district, and the ones used to take decisions, both diverse from the assessment indicators used for standard labelling.

3.5 Energy measures

This final section evaluates the actual energy solutions for energy supply and production for the HQ, starting from the most relevant changes in type of supply and infrastructure, and the different approaches employed by the three owners of the area. The institutions are now in a phase of collaborative work to find out possible synergies of and within the supply systems. The main challenges are the change of supply of heat for space conditioning and domestic hot water, at the moment provided by the existing waste incinerator plant and Walche heat pump, and the provisions of cooling. Despite the consideration and investigation of the feasibility of a district cooling system using water from Lake Zurich, there are basically no measures aiming to decrease the need for cooling. The individual energy measures selected (Fig.4) are very similar regarding the use and reuse: low temperature systems for heating and higher temperature systems for cooling, improvement of the efficiency of the buildings and reuse of waste heat from the cooling clusters (server rooms, etc.) wherever possible. Regarding the local production with renewables, electricity production with photovoltaics has been prioritised by the three institutions. Aspects regarding the energy efficiency of the urban structure however, have been completely overlooked: in the analytical studies of the masterplan and concepts of low energy urban design related improvements are completely absent up till now. The main reported reason is the fact that the energy transition is not a priority for the universities compared to the allocation of the functional program in a complex situation were the space availability is under pressure and the main driver of change.

Fig.4. Energy measures

	Use	Reuse	Production
ETH	• Cooling grid to connect all ETH cooling plants in a loop • Outdated energy clusters need renovation • Lower supply temperature for heating • Improve efficiency of the buildings with better insulation and windows when possible	• Reuse of waste heat from cooling plants	• Small electricity production from PV plants • Stop using heat from the incineration plant within the next 15 to 20 years.
UZH	• Lower electricity demand through LED lighting • Lower input temperature for the heating systems • Introduce setback temperatures in classrooms • Lower the heating demand with better insulated buildings (both for new buildings and retrofits)	• Waste heat recovery in the buildings	• Use of the maximum spatial capacity for electricity production with PV panels
USZ	• Geothermal storage for waste heat flows • Low heating temperature (max 45 degrees) • Higher cooling temperature (min 10 degrees) • Reduce electricity demand by demanding more efficient systems from manufacturers •Reduce process heat demand by moving processes out of the area	• Minimize waste heat flows through heat recovery	• Financially-feasible combination of centralized and decentralized energy production • Reduce the use of district heating as far as possible • PV being considered

4. Conclusions

The presented study has used an analytic framework articulated around five key elements to evaluate the components of energy transition practice in the Swiss case of the Hochschulquartier Zurich, with the aim to understand the potential pitfalls of the process and bottlenecks in realizing an energy efficient district. The previous sections have described the multiple dimensions of the transition process, by exploring the role and relations between actors, their influence on visions and how energy solutions are debated and selected.

The nature of the area, the overlying of several administrative boundaries and the type of actors, produce a first level of complexity for its energy and spatial transition, as it has the potential of exacerbate disagreement and need of negotiation. The strong political dimension, that is typical for every systemic process in urban environments, influences strongly the mentioned complexity and therefore was one of the causes of the difficulties in the project to establish fundamental principles and common concepts to direct decisions in the future transition phases. Dynamics of disagreements, negotiation and conflicts, which naturally tend to emerge in the management of a structural change, very often depend on the alignment of the actors' visions and the limitations encountered along the project.

The second bottleneck identified in the HQ was the lack of a clear common energy vision in the initial stages of the projects. The energy vision seems to be missing from the very beginning since energy strategies were individually identified by each institution and in addition, each of them were neglecting the spatial dimension of energy infrastructures for production, storage and low carbon building design.

A management dimension and a time dimension arise in the stated need for the construction of a shared vision. Absence of a coordination and risk related avoidance of time-consuming forms of active participation, in which all stakeholders could discuss about the future of the area are the main obstacles found in this case. Besides of that, the definition of a common vision in an initial stage of co-creation would have reduced potential opposition of inhabitants in the long term. Finally, the lacking common visions resulted in a cascade effect along the entire process, since coherent key energy factors and measures for district supply and productions result almost absent.

In the analysis of the process and its management, a number of restrictions came up regarding the coordination of spatial and energy transition related decisions. Prioritization of functional program, separated decision making structures and the need for adaptation of the coordination procedures between energy and real estate departments of the institutions are the core obstacles to achieve harmonization of spatial and energy related decisions. In other words, the perception of space scarcity to allocate the functional program and the structural lack of coordination between the experts in the two domains drives the process towards the empowerment of the spatial constraints that have to be removed. The consequence is that energy aspects result subordinated together with the idea of an integrated practice for sustainable development and that this reduces the opportunities to apply basic concepts of low energy urban design in the definition of the masterplan.

In conclusion, the practice of transition in complex urban cases seems to require new forms of transition management and operationalization. The construction of an integrated energy-spatial vision able to merge the need and the aspiration of all the actors, followed by a re-adaptation of the decisive structure, proceeding and tools to facilitate the coordination of the two aspects, are recognized as the crucial elements for a successful energy transition. Further integration of the spatial, cultural, environmental and management related dimensions could guide to an effective (paradigm) change.

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