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Strategies for a Sustainable Energy Transition

A Case Study of the Housing Sector in Graz, Austria

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Abstract: In the challenging context of sustainable energy transition, the housing sector plays an important role. Its energy efficiency has to be increased, and heating should be supplied by renewable energy sources. Furthermore, we will need additional housing which moreover will have to satisfy more diverse needs. The location of buildings is directly responsible for the resulting mobility. Thus, spatial planning as a strategic instrument, as well as legislation and subsidies will be analyzed. The goal of this thesis is to develop new more efficient strategies on how to adapt these instruments. Methodologically, the Multi-Level-Perspective (MLP) will be used to analyze this complex system. Moreover, research on legislation, subsidies and niche innovations will be conducted. Results will be reconfirmed and optimized together with experts. To focus research on an interesting example, Graz will serve as case study. Many current processes where transformation is necessary will be analyzed, e.g., insulation practices or subsidy schemes. Additionally, a brief overview of showcase niche innovations, facilitating a transition process, will be presented. Finally, expected results and implications following from this research will be discussed.

Background and Challenges

In order to mitigate climate change, the energy sector, responsible for two thirds of all greenhouse-gas emissions, needs to change. Strategies aim for

increasing energy efficiency, energy saving and a switch to renewable energy sources. The housing sector plays an important role in the quest of achieving a sustainable energy transition. Additionally, this process is influenced by developments such as urbanization, social disparities, migration and an ageing society. Consequently, we will need more housing, which also will have to satisfy new, more diverse needs. This points to the importance of a spatial planning process which considers urban sprawl and its energy impact, and the impact of the housing location on resident mobility. The location of a building is directly connected to the resulting mobility which is more important in an overall energy balance than any energy measure of the building itself.

Spatial planning, legislation or subsidies are strategic instruments to enable a transition, but so far they are rather part of the problem. The challenge is that currently these instruments are well-intentioned but ineffective. In practice, changes are mainly incremental, technology-centered and result in short term gains, sustaining the current growth-based system. From the perspective of a scientific community critical of growth, this housing system, under the constraints of limited resources, is incompatible with a necessary paradigm of strong sustainability.

The goal of this thesis is to develop new, more effective instruments and strategies that would also facilitate a learning-based transition process towards a sustainable future system.

Methods

Transition theory recently established itself as a prominent tool for investigating socio-technical sustainability transitions (Markard et. al. 2012). Sociotechnical systems, e.g. the housing sector, are complex networks of actors and institutions. In contrast to purely technical transitions, sociotechnical transitions also encompass change in user practices and institutions, and thus lead to a fundamental shift of the system. Sustainability innovations pave the way for different sociotechnical pathways towards sustainability. In Markard et. al. (2012) four different transition approaches are identified: transition man-

agement, strategic niche management, multi-level perspective and technological innovation systems. Transition Management (TM) was introduced by Loorbach (2010) and describes a new governance approach for sustainable development. The presented framework analyzes the role of four different types of governance activities in sociotechnical transition processes. Strategic Niche Management (SNM) is described in detail in Schot and Geels (2008). It deals with the creation of protected spaces that allow experimentation with niche innovations. The authors also linked SNM to the MLP by arguing that SNM alone will not lead to system change. The Multi-Level Perspective (MLP) was introduced by Geels (2002). In this very broad framework, a so called 'patchwork of socio-technical regimes' (the current system) is influenced by niche innovations and an 'exogenous landscape'. Niches are proposed as sources of radical change and are leading to incremental or substantial regime change. If pressure from the 'exogenous landscape' opens a window of opportunity in the patchwork of regimes, niche innovations have the potential to establish themselves as alternative paths within the system. In contrast, the current regime will try to resist fundamental changes (Geels 2014). Therefore, attention should be focused on how to destabilize current regimes. Finally, the Technological Innovation Systems (TIS) approach has its roots in Carlsson and Stankiewicz (1991), where the authors analyze the interplay of technology development, and institutional and organizational changes. The term TIS was introduced in Bergek et. al. (2008) and Markard and Truffer (2008). The latter paper identifies similarities and overlaps of the TIS and the MLP approaches.

As a very broad framework, the MLP suits very well, and will be used for analyzing the complex system of the housing sector as a whole. Legislation and subsidies are interpreted as landscape pressures, whereas regional best practice examples are part of the niche innovations. Research will be conducted on all these elements with a specific focus on the case study of the housing sector in Graz. The analytical results will be the basis for the development of new strategies and options for policy makers and stakeholders. They will be optimized and adapted in iterative, reflexive and participative processes with experts.

Processes Where Transformation is Necessary

The case of Graz

Graz, as a medium sized European city, will serve as case study. The city is expected to grow within the city limits by more than 13% over the next 10 years, which means a total of ca. 37,000 additional inhabitants and the need for new housing – even without considering the growth due to suburbanization processes. Additionally, the historic center of Graz is an UNESCO World Heritage Site which limits the growth and redensification options in the downtown, as well as energy efficiency measures. The interesting question for Graz is: how to control these processes by legislation and planning and second, which niche innovations and best practice examples have the potential to shape a sustainable future system.

The housing sector

The housing sector is responsible for 24% of the total final energy consumption in Austria (Statistik Austria 2015). Most of this energy is used for heating and warm water. With a huge, rather inefficient, building stock, there is a lot of potential for savings. Politics as well as the private sector have already reacted, but the standard solutions are far from sustainable. In particular, for most energetic refurbishments – and also for new buildings – EPS (expanded polystyrene) panels are used. On the one hand, their energy performance is very good, they are very cheap and they are easy to apply. Thus they seem like a perfect choice; however, the average expected live time of such insulation is only around 30 years (Bundesamt für Bauwesen und Raumordnung 2001, p 90). Moreover, toxic chemicals are applied as flame retardants (Umweltbundesamt 2014). Although new chemicals are now replacing the current ones, it is unclear if the new ones are any better. This means that we will have a huge hazardous waste issue within just two decades. Alternative ecological building materials are available, but usually not considered due to short sighted economic decisions. Whereas new buildings could do completely without an extra insulation layer if, e.g., 50cm bricks would be used, refurbishments are a bit more complex. Still, also here sustainable solutions are available. For example, in the STELA project (Institut für Gebäudelehre

2015), dwelling blocks from the 1970s are thermally refurbished by attaching a special kind of sunroom to the façade, all around the building. This is not a trivial, nor a cheap solution, but brings additional benefits such as, the extension of the living space and thus a redensification or also flexibility in the adaption of floor plans to new needs. Presumably, such a solution will also last longer than a refurbishment with EPS panels and thus be even cheaper in the long run. For historic buildings, even more individual solutions have to be found, as it is often not possible to change the appearance of the façades.

For space heating, a switch to renewable energy is essential. Still it is common practice to replace old oil burners with new more efficient oil burners. Considering that a new heating system is usually in operation for at least 20 to 30 years, the simple replacement with a new oil burner prolongs the dependence on fossil fuels significantly. Alternatively, community heating, heat pumps and wood fired heating systems should be enforced. Another important topic is the ventilation of energy efficient, air tight buildings. Frequent ventilation is necessary to maintain good air quality. At the same time, there should not be too much ventilation because of the energy losses. The technical solution is automated venting systems which have to be very carefully planned and frequently maintained in order to be able to provide good air quality. On the other hand, the users could do the ventilation manually. This ability of control over the windows is usually also desired by most residents. However, users tend to be very inefficient, thus, a change in behavior would be necessary.

Spatial Planning

Spatial developments indicate a strong urbanization process, but at the same time also a consistently strong tendency towards urban sprawl. Urbanization is a positive process as it tends to increase the density in central places, which leads to more efficient infrastructure. Suburbanization, on the other hand, leads to inefficient and expensive infrastructure. Vast amounts of land are used and a lot of energy has to be spent on mobility. Thus we would need strong regulations that prohibit such unsustainable developments, and on the other hand, promote denser structures. However, density should not be regarded only quantitatively. Qualitative aspects of density should also be con-

sidered. Moreover, for new developments, brown fields should be preferred over green fields. Even more important is the reuse of existing structures, e.g., the conversion of unused industry or office buildings into living space.

Legislation and Subsidies

Austria's legislation forms the statutory framework for all these developments. One principal problem is that every state has its own additional legislation, scattering legislative and executive powers over three layers of administration, i.e., national, state and municipal levels. This might be a reason why changes usually take a long time.

Styria's spatial planning law still makes new developments of remote locations possible, although all stakeholders jointly agreed in the national strategy 'ÖREK' (ÖROK 2011), that there should be a clear commitment towards centralization and against urban sprawl. It would be very important that such non-binding agreements become obligatory, in order to be enforced as planned.

Austria's legislation demands high standards for new buildings, however, even more important are refurbishments of the existing building stock. Incentives encourage house owners to invest into energy saving measures. Nonetheless Austria grants subsidies for EPS insulations rather than focusing on more sustainable alternatives. Another example is subsidies for the renewal of oil burners. On the one hand, they come from the state which could be easily stopped immediately; on the other hand the fossil industry is trying to maintain their customer stock by granting additional subsidies (Heizen mit Öl GmbH 2015). Such practices could be simply prohibited. Denmark is an example where the installation of new oil heating (and natural gas) is prohibited completely in new buildings. In existing buildings a renewal is prohibited if district heating is available (Danish Energy Agency 2012, p15).

Niche Innovations and Best Practice Examples

According to the MLP, changes in the landscape can put pressure on the current patchwork of regimes. This could be achieved by adapting legislation

and the subsidy system. If this breaks up the stability of the system, suitable niche innovations might be able to prevail. Therefore research on niche innovations and best practice examples was conducted. Some potentially suitable approaches will be presented in the following.

Spatial Planning

From the spatial planning perspective, one notable niche might be the so called 'Mobility Pass for Residential Real Estate' (Schrenk et. al. 2012), which is a certificate for buildings describing its impact on mobility. This could be a useful tool to raise awareness among people. Further, it could form a basis for higher fees on infrastructure or public transport support, especially for newly constructed buildings in remote locations.

New buildings

Considering new buildings, a notable movement is co-housing projects. In such projects, a community of interested people jointly designs and constructs a building, where each party owns an individual flat. These flats usually do not have a kitchen or generous living spaces, but instead these areas are part of the common areas. Users can socially interact in these spaces instead of just brief meetings in the staircase in regular apartment buildings. This promotes a community feeling that also promotes the idea of sharing and commons, and thus a more sustainable live style. These buildings are also spatially more efficient when areas are shared. Additionally, residents identify much more with the building and the group if they were involved in the design process as well. Such co-housing projects can be found in many places. Currently there is also one example in Graz called 'Kumpanei' (CumPane Verein für integrative Lebensgestaltung 2015). For new developments, such co-housing projects should be promoted. It would make sense to investigate how far existing buildings would be suitable to be reused for co-housing.

Existing buildings

Regarding the existing building stock it is hard to figure out one sustainable off-the-shelf solution for most existing buildings. The aforementioned STELA project (Institut für Gebäudelehre 2015) focuses on one big category, i.e., 70s

apartment buildings. It tries to solve the issues of improving thermal insulation, increasing quality of life, making floor plans adaptable, incorporating renewable energy in form of combined solar thermal and photo voltaic panels and e-mobility all in one. Additionally, the residents still living in the selected trial buildings are included in the process through participatory methods. This practical research project is still under development, but it already shows now how many issues could be solved or improved by perceiving the necessity of a thermal refurbishment as an opportunity, rather than a burden.

Behavioral change

Finally, a transition process cannot work without participating users. The necessary behavioral change can be achieved through education and participation. The transition movement tries to support and facilitate this process. Local movements are connected through the Transition Network (Transition Network 2015). There is also a transition group present in Graz (Verein Transition Graz 2015). These bottom-up movements might be the most important niches, as they experiment how possible future systems could be shaped.

Expected Results

In a short- and mid-term perspective, it is expected that efficient and goal-specific subsidies, parallel to changes in legislation, will bring immediate benefits. They will put pressure on the system, facilitating a transition process. The enforcement of stricter spatial planning rules will yield positive long-term effects. Furthermore, a change in the behavior of people towards more sustainability is crucial, but eventually a long-term issue. For example, in high efficiency buildings a change in ventilation behavior is necessary, but often does not happen, making calculated gains obsolete (Tappler et. al. 2014). Moreover, it would be beneficial if people would orient their preferences more towards denser forms of living, rather than the ideal of the detached house in the suburbs. This needs a long-term change of mindset and means that we have to make the city more attractive. Support can be provided through participatory processes, education, and training as crucial ingredients for a successful tran-

sition process. In short, there is more need for smart citizens (not in a smartphone sense), than for just (technology centered) smart cities.

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