Policy Brief:
Systeeminen muutos ja innovaatiot
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Accelerating the path towards renewable energy and eco-efficient housing in Finland

What kinds of issues shape the paths to renewable energy solutions?

Green Growth strategies need to adopt a broader perspective on change processes than conventional growth strategies, because deep changes are needed for instance in energy production and consumption behaviour as well as in natural resource use. Different levels of change need to be realised in a coherent manner. This Policy Brief draws on the Multi-Level Perspective (MLP) and Technological Innovation System (TIS) frameworks.

The MLP distinguishes three main levels of niches, regimes and landscape that need to co-evolve in order to realize a system transition. Landscape level forms an exogenous macro-level environment, e.g. international agreements on sustainable development. Regime refers to the existing structures and actions of the system, e.g. existing industries, institutions and practices. Niches form the level at which radical or incremental novelties emerge that deviate from the existing regime, e.g. the development of solar energy in Finland. The results show that a successful change needs actors and actions influencing all three levels of society into the same direction.

Name of the project:
Accelerating Transition Towards Sustainable Energy System within System-level Innovation Framework (SUSER)

The MLP framework is combined with the TIS framework to find out policy recommendations. In the TIS framework seven key functions are identified, which will ensure the success of the system. These functions are (1) entrepreneurial activities, (2) knowledge development, (3) knowledge diffusion, (4) guidance of the search, (5) market formation, (6) resource mobilization and (7) creation of legitimacy. As a policy recommendation, we claim that by analysing the absence or existence of needed functions in the innovation system, we are able to identify the drivers and barriers of the new innovations, and find real ways for instance to accelerate the transitions towards renewable energy in the society.

This analysis is illustrated by looking at the case of stakeholder mapping from the written material of the Finnish Eco-Viikki housing area planning and construction process and placing these mapped stakeholders into the MLP and TIS frameworks in order to find the weak functions. The results of the case-study show that in the Eco-Viikki case, the case itself was a Niche level example. The Landscape level pressure, in turn, was a starting point for the whole Eco-Viikki process. The problems however culminated in the weaknesses in knowledge development and diffusion as well as in resource mobilization (Regime level). Hence, in this case, policy interventions were especially needed in the educational parts of the system in order to amend the knowledge development and diffusion, and gain competent resources for the regime change towards renewable energy.

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Tekesin Ohjelmatoiminnan strateginen tuki -yksikkö rahoittaa innovaatioympäristöä palvelevaa tutkimusta teemakohtaisilla hauilla.

Introduction

Three levels of analysis are abstracted in the Multi-Level Perspective (MLP) model: landscape, regime and niche. Niches can be interpreted as innovation systems 'in the making' with functions that can be supported by policy tools.

A core idea of future-oriented planning is that we can shape the future together and that a change is possible because of our ability to affect this future creation process. A key feature of technology, however, is path dependency, i.e. the constraining influence of past developments and future directions of the technological development of the technological, organizational and infrastructural inter-dependencies. This means that most innovations build on past discoveries and are adapted to pre-existing conditions for successful diffusion. For example, houses and housing areas are designed based on previous design processes and experiences. Path dependency makes system transitions difficult to achieve as the prevailing system acts as a barrier to the creation of a new system. The transition of path-dependent systems is a complex multidimensional societal change process dealing with the co-evolution of technological, industrial, policy and social changes.

Such path dependencies can be described systematically by the so-called Multi-Level Perspective (MLP), which distinguishes three levels of change: landscape, regime and niche (Geels and Schot 2007). Landscape forms an exogenous macro-level environment. Examples of landscape-level drivers are international agreements on sustainable development and EU legislation as well as domestic developments in society at large. These drivers influence developments at niche and regime level. Regime refers to the existing structures and actions of the system, e.g. existing industries, institutions and practices. Niches form the level at which radical or incremental novelties emerge that deviate from the existing regime, e.g. the development of solar energy in Finland. A niche usually starts with an individual experiment such as a specific city region like Eco-Viikki, but it may also consist of several experiments that are related to each other. A system transition is possible if there is landscape-level pressure on the regime and, at the same time, new solutions from the niche level. A socio-technical change is a result of the interaction and synergy of all the different levels. This interaction often includes controversy and conflicts of interest.

A system transition is possible if the policy supports the functions of the innovation system at the niche level and if there are landscape level pressures creating a window of opportunity for the niche to grow and to change the regime level.

Niches can be seen as emerging innovation systems. These emerging innovation systems can grow over time and become more powerful. If they gain enough power, they may be able to overthrow (part of) the regime, especially if there is pressure from the landscape. Strong and well-developed innovation systems are necessary for regime shifts and, thus, system innovations or even transitions to be realized. By analysing emerging innovation systems it is possible to identify systemic problems or market and system failures that hamper their development. Identifying these systemic problems helps in the development of relevant policy interventions.

The MLP is particularly useful for describing the overarching emergence of a niche and its evolution towards – potentially – a regime change. However, it is not sufficient from a policy perspective, for which it is vital to:

1. understand the underlying mechanisms and dynamics
2. identify the deficits (or 'failures') that may justify policy intervention
3. specify intervention strategies to drive the transformative process forward

The Technological Innovation Systems framework (TIS, Hekkert et al. 2007) is particularly useful in this regard in order to link the MLP to the formation of targeted policy strategies. While TIS focuses on the early phase of establishing and stabilizing a specific technological niche, it points to the requirements for diffusion and thus for change at regime level.

The TIS framework lists seven key functions that need to be in place to ensure that an innovation system can be established. These functions are (1) entrepreneurial activities, (2) knowledge development, (3) knowledge diffusion, (4) guidance of the search, (5) market formation, (6) resource mobilization and (7) creation of legitimacy (Hekkert et al. 2007). This list can be further broadened to include production and consumption aspects, if relevant (Weber and Rohracher 2012).

Materials and results: Eco-Viikki as a pilot case

Landscape developments allowed key actors to push forward with ecological solutions in the planning of Eco-Viikki. However, there was insufficient practical expertise and a lack of trained staff for the new solutions.

In order to illustrate the dynamics of system innovation, we have analysed the planning and building of the Eco-Viikki city region in Helsinki. The analysis is based on the material written during and after the planning and building process (see the further reading list). Eco-Viikki was the first ecological housing area to be built in Finland. The planning started in spring 1995. In Eco-Viikki, ecological solutions such as solar heating and power were used. In addition to testing environmentally friendly technologies, the process also pioneered a new type of urban planning as well as new criteria for sustainable housing. The planning of Eco-Viikki emphasized networking by different actors (architects, engineers, ecology experts and building developers), resident participation and sustainability.

According to monitoring studies (see the further reading list), Eco-Viikki is more environmentally friendly than conventional housing areas, although it did not achieve all its goals. For example, the buildings in Eco-Viikki use 25% less heating energy than conventional buildings, but the goal was set at 33%. Electricity and water consumption is also below average. Eco-Viikki has been successful in testing many ecological solutions, including solar energy, and in creating ecological criteria for eco-efficient building as well as a model for collaborative urban planning. However, the effects on the dominant practices of the Finnish building sector remained limited.

The change process in Eco-Viikki included many actors and stakeholders. They can be divided into four groups (Figure 1):

- societal actors and government (e.g. ministries, city of Helsinki)
- developers and researchers (e.g. University of Helsinki, Organisation of architects SAFA, eco-city consultants)
- funders and entrepreneurs (e.g. TEKES, Sitra, building companies)
- NGOs

These actors can be identified as enablers or promoters of change, preventers of change and actors with no clear orientation towards change (see the further reading list, Eco-Viikki material).

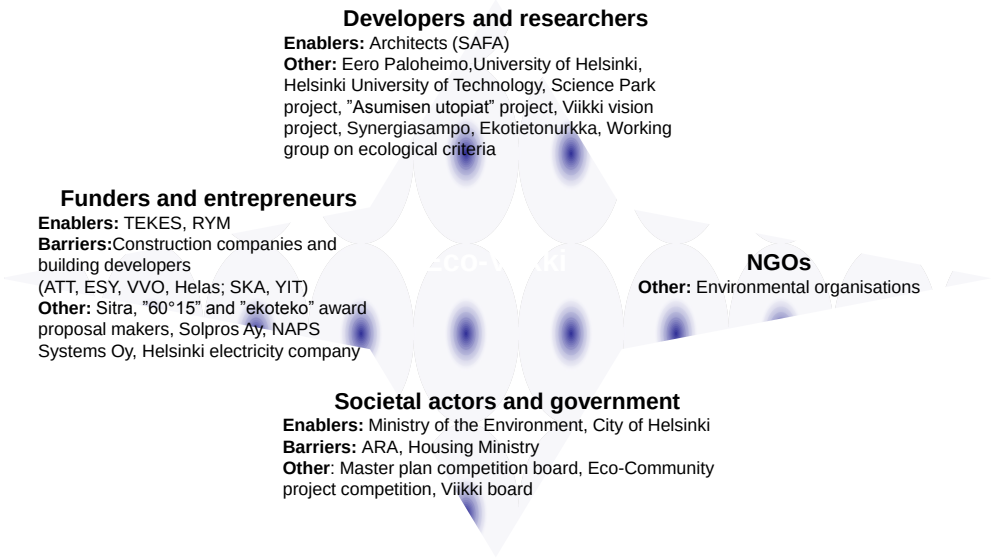

Figure 1. Actors of the Eco-Viikki process (the actor model is modified from Kivisaari et al. 2013)

In addition to the different stakeholders we identified three main landscape level drivers: sustainable development, climate change and the prevailing strong economic growth at that time in Finland. There were international agreements regarding sustainable development and climate change, such as the Brundtland Commission in 1987 and the Rio Conference in 1991, which also influenced Finnish construction and environmental legislation. Helsinki City signed the Agenda 21 agreement in 1995. This agreement emphasized sustainable development rising from local bottom-up action. These drivers put pressure on the regime and were drivers in the Eco-Viikki process.

Before analysing the niche-level innovation system in more detail, we briefly describe the regime-level barriers that were identified. The cognitive barriers were construction, and designing and building companies that used their old routines and habits to design and build the Eco-Viikki housing area. Normative institution as a barrier was seen in the old practices supported by the Housing Minister. However, the regime offered an opportunity to change the regulative institution, namely new legislation that supported the new regime and changed in response to the landscape-level pressure of sustainable development.

To analyse the Eco-Viikki as an emerging innovation system we used the seven key processes (Hekkert et al. 2007) in order to evaluate whether the eco-housing TIS functions well based on the experiences gained from the Eco-Viikki case (Table 1):

Table 1. Eco-Viikki and seven functions of TIS

Function	**Description of the function performance in Eco-Viikki**	**Assessment of the function performance (weak, average, strong)**
1. Entrepreneurial activities: Are there sufficient active entrepreneurs (architects, construction firms, etc)?	In Eco-viikki there were active eco-city consultants, solar energy companies and construction firms. Solar energy solutions were used in Eco-Viikki because of the initiative by solar energy equipment suppliers and consultants.	strong
2. Knowledge development: Is there sufficient knowledge available on how to design, plan, construct and maintain eco-efficient neighbourhoods?	In the process, a set of criteria for the ecological performance of the houses was developed. However, Eco-Viikki was designed based on old practices, which did not take into account the special needs for, e.g., solar panels. In addition, the maintenance staff were not part of the planning process, and expertise related to the maintenance of solar heat systems was not developed.	weak
3. Knowledge diffusion: Is the knowledge sufficiently shared in the innovation system?	According to the Environment Minister, the ultimate idea of the whole Eco-Viikki process was to convince the public, and especially the architects, that eco-efficiency is possible and desirable in the construction industry. The target was not met, because the idea of eco-efficiency was left out in the implementation phase. The Eco-Viikki process did not change the habits of the construction industry.	weak

4. Guidance for the search: Is there sufficient shared vision on a future for eco-villages in Finland? Did the vision regarding eco-villages change over time? (e.g. were new topics like water management, social/cultural aspects added/removed from the vision?)	The change from the idea of an eco-village to a modern eco-region or eco-efficient neighbourhood happened during the Viikki process. Inhabitants had and have a different idea of the region to that of the consultants; They see it as '"a normal place to live" not an "Eco-village".	average
5. Market formation: Is there a problem finding sufficient financial capital for eco-efficient neighbourhoods?	The Eco-Viikki case had funding from the TEKES RYM programme and the EU THERMIE programme. Eco-Viikki was meant to be a pilot example and a start to enhancing the abilities for Finnish exports in this area.	average
6. Resource mobilization: Is there a problem of a sufficient, well-trained labour force for eco-efficient housing area?	There was a lack of relevantly trained maintenance staff for the renewable energy systems.	weak
7. Creation of legitimacy: Are there sufficient lobby activities to increase the legitimacy of eco villages and change existing institutional structures?	The Environment Minister, the city of Helsinki, SAFA and other supporters acted as lobbyists in the process.	strong

The weakest performance in the Eco-Viikki case was by the knowledge development and knowledge diffusion functions. At the regime level, existing habits and old structures of construction and energy clusters created barriers to the development. The problems of knowledge diffusion and resource mobilization were related to these old structures and habits. The design of the new buildings and the whole residential area was done based on old models, and the needs for new solar energy technology were not considered. As a result, the solar panels were difficult to maintain because of their placement in locations that could not be accessed easily. The existing district heating system also decreased the perceived benefit of the solar heating solutions.

According to our interpretation, the Housing Minister seemed to be a part of the building industry lock-in at regime level because the Housing Minister did not promote the Eco-Viikki process and was sceptical about it. However, the Environment Minister managed to take advantage of the landscape level drivers of sustainable development and shape the development of Eco-Viikki in a more innovative eco-city direction. This opened up possibilities for entrepreneurial activities (e.g. solar energy actors), the creation of a shared vision, market formation and legitimacy creation. Despite the strong regime-level push towards old solutions, the agile niche-level actors, like the entrepreneurs, made the application of new innovations possible in Eco-Viikki. Active solar energy consultants and component suppliers pushed solar energy solutions onto the agenda, and TEKES and EU funding made this niche-level experimentation financially possible.

The biggest barrier to the success of the use of renewable energy after the Eco-Viikki process was the maintenance of the solar heating systems: optimum efficiency of the solar heating systems was not achieved because the maintenance staff were not willing and capable of maintaining and operating the complex solar heating systems. HPAC (Heating, Plumbing and Air-Conditioning) staff was not taken into consideration in the planning process of the area, even though they were the key actors in operating the systems optimally. As a result, the construction companies interpreted this as solar heating systems not being an effective option and that it would not be wise to continue the development of these kinds of systems.

Challenges for innovation policy

Transition management research intends to clarify not only the systemic problems but also the content and challenges for policy to induce systemic change and the societal embedding of new innovations.

The challenges for innovation policy can be seen in the fulfilment of the demands of the seven functions of TIS described above (Hekkert et al. 2007). In the Eco-Viikki case it seems that the biggest challenges were the functions of knowledge development and diffusion, and resource mobilization in TIS (see Table 1). The Eco-Viikki study showed that in order to make the transition to renewable energy solutions it is not enough to obtain public subsidies, risk financing (regime-level legitimacy) and support from legislation and international agreements, including permission conventions (landscape-level legitimacy). Knowledge development and diffusion, and resource mobilization are also needed. The HPAC (Heating, Plumbing, Air-conditioning) staff in Eco-Viikki were not capable of operating the solar heating systems optimally because of a lack of knowledge. As earlier research about Finland's renewable energy business potential on global markets has indicated (Kohl et al. 2012), changes should also cover educational and communicational aspects in addition to economical and regulatory potential. The Finnish education system is currently not systematically educating renewable energy actors; the renewable energy education system is fragmented. A shared vision would provide the ability to develop renewable energy services as a whole including technology, implementation and maintenance as well as the potential integration of different and separate technological systems. However, in order to achieve a shared vision, there must be an ability to understand it. This understanding requires an appropriate educational background.

This specific example shows that a comprehensive perspective must be adopted to identify the main barriers to and enablers of innovation and change. From a policy perspective, however, this is not sufficient to justify policy intervention. According to the proponents of the TIS concept, there is a limited set of functions (and related systemic problems), which – if not properly fulfilled – can be used to make the case for policy action.[1] In the Eco-Viikki case, the problems culminated in the weaknesses in knowledge development and resource mobilization. Hence, in this case, policy interventions were needed in the educational parts of the system.

Policy recommendations

If a regime change is going to happen, all the levels (landscape, regime and niche) and the actors operating at the different levels have to go in the same direction. It is impossible to change the system with only financial incentives or other economic instruments

If a regime change is going to happen, all the levels (landscape, regime and niche) and the actors operating at the different levels have to go in the same direction. It is impossible to change the system with only financial incentives or other economic instruments, e.g. feed-in tariffs, because that would not increase the knowledge of stakeholders. Hence, a societal system change is needed: a techno-economic solution is not enough on its own. By analysing the TIS and its functions, we found the weak points of the system and recommended policy interventions to affect these weak points. This is the way paradigm changes could make it possible, for instance, to accelerate green growth in our society. However, while this may be the way forward to specify systemic intervention strategies, it would also be necessary to assess the effectiveness and synergies, as well as the efficiency of different intervention instruments before concrete transformative policy actions were put into practice.

In the future in the SUSER project, we will continue by studying two more eco-efficient city area cases in the Tampere region (Vuores, building started 2010, and Härmälänranta, building starts 2013) and find out if there is a development continuum between these cases, similarities and differences (SUSER Policy Brief IV). Before this, the SUSER project will combine participatory foresight and a transition management approach, including the assessment of the transition arena and language of TIS (see Table 1), in the Vuores case (SUSER Policy Brief II). In addition, the SUSER project will generate insight into the transition policy actions of energy-efficient building in the Netherlands, Austria and Finland (SUSER Policy Brief III).

Further reading

Eco-Viikki material

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