European Forum for Studies of Policies for Research and Innovation

2013 EU-SPRI FORUM CONFERENCE
MANAGEMENT OF INNOVATION POLICIES

Proceedings of the 2013 EU-SPRI Forum Conference
Madrid 10-12 April 2013
ISBN 978-84-695-7408-9 ORAL PRESENTATION

Title

Firing on all Engines
Motors of Innovation in the Emerging TIS for Energy Efficient Buildings

Authors

Roar Samuelsen, Senior researcher, NIBR Norwegian Institute for Urban and Regional Research, Gaustadalleen 21, 0349 Oslo, Norway.
E-mail: roar.samuelsen@nibr.no

Ove Langeland, Senior researcher, NIBR Norwegian Institute for Urban and Regional Research, Gaustadalleen 21, 0349 Osl. Norway.
E-mail: ove.langeland@nibr.no

Keywords
Technological innovation system, motors of innovation.

UAM-Accenture Chair

Institute of innovation and knowledge management

1. The motivation

This paper focuses on the emergence of a technological innovation system (TIS) related to energy efficiency in the built environment in Norway. More specifically, we deal with the characteristics of this system in terms of its structural and functional features. In recent years the energy performance of all types of buildings has received increased interest from owners and builders, from the construction and energy industries and from actors in the policy system and the research sector. According to IEA (2008) "Energy use in the building sector accounts for about 40% of world's final energy use and 33% of direct and indirect greenhouse gas emissions". This fact together with the issue of climate change and the growing energy resource shortage drive research towards continuous improvement of energy efficiency measures. Thus, this has become one of the main issues on the agenda of transitions to a more sustainable and decarbonised future.

Technologically, the achievement of a more energy efficient built environment is the joint effort of actors from the construction and property sector and the energy sector. Continuously, new concepts like passive houses, active houses, power houses and zero energy/emission buildings (ZEB) are introduced, pushing the levels of energy use downwards. Internationally, as well as in Norway, a range of innovative projects are conducted at the level of single buildings, blocks or whole communities.

Of particular interest is that these innovative efforts and practical implementations are jointly pursued by sectors that are generally described as being conservative, system optimising and having low rates of innovation. The construction sector, for instance, is characterised by project-based and fragmented activities and hidden innovation patterns. Innovation is characterized as hidden because it takes place through sector-wide partnerships and project-level interactions with clients, between construction companies, consultants and clients and not primarily in R&D labs (Abbott et al. 2007). If innovation is largely hidden, so are the innovation systems wherein this activity takes place. Our ambition is to identify both the structural elements and functional dynamics of the TIS that emerge in this field in a Norwegian context.

The research question we ask is *what characterizes the TIS emerging around energy efficient buildings and built environments in Norway in terms of structural and functional dimensions and motors of innovation?*

Our aim is twofold: i) to outline an analytic framework that enables us to address the research question, ii) analyse the emerging system in terms of structural elements, functional dynamics, systemic problems and motors of innovation.

2. The approach – technological innovation systems

The conceptual framework is based on the innovation system approach. The main perspective is the functional approach to technological innovation systems (TIS) (Bergek et al. 2008, Hekkert et al. 2007, Wieczorek and Hekkert 2012). The TIS concept was developed to explain the nature and rate of technological change. A TIS can be defined as 'a dynamic network of agents interacting in a specific economic/ industrial area under a particular institutional infrastructure or set of infrastructures and

involved in the generation, diffusion, and utilization of technology' (Carlsson and Stankiewicz, 1991). This approach may be applied to at least three levels of analysis: i) to a technology in the sense of a knowledge field; ii) to a product or an artefact; or iii) to a set of related products and artefacts aimed at satisfying a particular [societal] function. Central to the TIS approach is the analysis and evaluation of the development of a particular technological field in terms of the *structures* and the *functions* (i.e. processes, activities, events) that support or hamper the generation, diffusion, and utilization of technology. With respect to the latter, the approach has been especially fruitful in explaining why and how sustainable technologies have developed and diffused into society, or have failed to do so.

Structural elements of the TIS

The "Carlsson-approach" to TIS definition, focusing on actors, networks and institutions has recently been expanded on by Wieczorek and Hekkert (2012). They propose four types of system elements: actors, institutions, interactions and infrastructures. The main difference from the "Carlsson-approach" is that i) the system element *networks* are seen as a type of *actor,* alongside individual actors; ii) *interactions* between actors are included as a system element, highlighting relationships; and iii) *infrastructure* is included as a system element. The concept of institutions is similar to the "Carlsson-approach", including both formal/hard and informal/soft institutions. Using this framework, we map and outline the central systems elements of the energy efficiency TIS in Norway.

The functional dynamics of the TIS

Several studies of functions have taken place the past decade (e.g. Bergek et al. 2008a, Hekkert et al. 2007). In this way the innovation system is defined by specifying activities or processes within the system and not primarily by its elements, i.e. organisations/actors. Referring to activities or processes, we are aware that this represents two competing definitions of functions currently applied by TIS scholars, as accounted for by Bergek (2012). Without going into this issue any further, we follow Bergek's (2012) proposal to define functions as *chronologies of things - events/occurrences - that happen/appear in innovation systems*, in order to emphasise that causal mechanisms or logical sequences of events are not a necessary part of the functions. Using this framework, we map and outline the important things that happen/appear in the energy efficiency TIS in Norway.

Systemic problems in the TIS

In order to analyse the relationship between system elements and functional dynamics, we have asked a set of diagnostic questions concerning the development and state of each of the function. We base this analysis on studying each function through the perspective of the four structural elements. Using this framework, we have identified which structural elements influences on the functions, in particular what causes the weakness or absence of the functions, and thus represent systemic problems. Following the insights from Klein-Woolthuis et al. (2005), we consider systemic problems as factors that negatively influence the direction and speed of innovation processes and hinder the development and functioning of the TIS. We are abel to diagnose the systemic problems by looking at each of the structural elements

in two ways: whether it is because of its presence/absence or because of its properties. In order to contribute to a positive influence on the direction and speed of the innovation processes and promote the development and functioning of the TIS we endeavour to identify the type of systemic problems in question. This is a precondition for a selection of strategies and tools that would target them and thus influence the overall functioning of the innovation system (Wieczorek and Hekkert 2012)

The motors of innovation in the TIS

In order to develop a synthesis of the research on central parts of the building and energy sectors we use Suurs (2009) typology of four motors of sustainable innovation; i) the Science and Technology Push Motor; ii) the Entrepreneurial Motor; iii) the System Building Motor; and iv) the Market Motor. For each motor we indicate what are typical structural drivers and barriers and what are typical structural impacts as observed across the complex field of energy efficiency in the built environment. Suurs (2009) further development of his synthesis into the Succession Model of Innovation is useful in analysing the emergence of the TIS in focus. With this model we are able to relate the various motors of innovation to each other and to consider them as (sub)stages within the formative stage of the TIS. It will be argued that each motor of innovation, by its impact on TIS structures, causes the TIS in question to develop into a more complete (and more complex) structural configuration which, in turn, is prone to bring about a more advanced motor of innovation.

This approach enables us to identify what could be seen as successive generations of concepts for energy efficient buildings like passive houses, active houses and power houses (net energy producing houses). In Norway, the concept of passive houses is currently driven by the System Building Motor but the Market Motor needs to be up and running by 2015 due to the implementation of new building codes. The concept of power houses is currently driven by the Science and Technology Push Motor with the first powerhouse in Norway awaiting to be built in 2013, thereby starting up the Entrepreneurial Motor to become the main driver for a period. This imply that several – or all – motors of innovation are running at the same time within the building and energy sectors as they develop increasingly more energy efficient building concepts.

3. The expected results

The expected results of the project that this paper reports from will be

i theoretically, to contribute to the further development and refinement of the TIS approach as research tool for studying sustainability transitions;
ii empirically, to contribute knowledge pertaining to a better understanding of innovation processes in the emerging TIS for energy efficiency in the built environment in Norway;
iii practically, to provide knowledge relevant for targeted intervention in order to stimulate the functional dynamics of the emerging innovation system.