Low Carbon Innovation Policies:

From National Competitiveness to Global Leverage

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1 Introduction

Diffusion of low carbon technologies requires radical shift in innovation policies. Current national innovation strategies and policies are not sufficient in rapid diffusion of climate technologies as they are fundamentally designed around national competitiveness priorities, not to produce global public goods (see Tomlinson et al. 2008).

The dominant focus of innovation policies in developed countries has been on science and technology support. While being historically successful and important from national capability development and competitiveness perspectives, these policies often fail to bring along wider market transformations. In order to fill the existing low-carbon innovation gaps, higher priority should be given to practice-oriented innovation policies which include developing country actors and capacity building. 'Shortening the distances' between different actors is a prerequisite for the new generation of user-driven, open low carbon innovation systems.

Mainstream innovation was earlier argued to originate in science and technology; and especially in science-based technology. However, recent studies have demonstrated that only a minor part of innovations stems from science and the vast majority have a very practical origin (e.g. CIS 2004, Harmaakorpi and Mutanen 2008). Besides scientists and technology experts, customers and employees acquire new roles in the future innovation practices.

This paper will explore how user-driven innovation policies could better serve low carbon innovation in a global scale. Special attention is given to the role of collaborative research and development activities between developed and developing countries, and how these collaborative strategies could be supported by new climate policies. The key argument is that developing countries require support to build effective innovation systems instead of just utilizing narrow technology transfer approaches like the Clean Development Mechanism of Kyoto Protocol.

2 Changing Character of Innovation

The patterns of innovation are undergoing a major change. Earlier different innovation models, whether they are linear or nonlinear, have been mostly closed in their nature. The more recent models have begun to stress the need to open up the rather sheltered innovation processes. It is no longer possible for one company alone to innovate effectively in a world characterised by complexity and an increasing variety of customer demands. The open innovation paradigm highlights the more open exchange of knowledge and sees the benefits of external economies of knowledge in open and communicative innovation processes. (Pihkala and Harmaakorpi 2008)

One definition for open innovation is "Use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively"(Chesbrough 2006). The open philosophy in the innovation creates challenges in innovation networks. Granovetter (1973) defines the concepts of strong ties and weak ties in social networks. Strong ties are characterised by common norms and high network density. These strong ties are easier for closed innovation, since they normally include a relatively high amount of trust, common aims and the same kind of language to communicate. However, the weak ties are reported to be more fruitful for innovation, because more novel information flows to the individuals through weak ties than through strong ties (Granovetter, 2005).

Burt (2004) has developed the argument further by arguing that innovations are most likely found in the structural holes between the dense network structures. In order to be able to utilise the innovation potential in these structural holes, information should often be transferred between different partners, as well as partners of completely different horizontal knowledge interest, or interdisciplinary (Pihkala and Harmaakorpi 2008). The partners on the opposite sides of the structural hole have information of different quality and for their own purposes. A highly important factor in spanning the structural holes and overcoming the information asymmetries is the absorptive capacity of its actors, its networks and the entire system (see e.g. Zahra & George, 2001).

Global innovation also means open innovation. The leaders of many big companies argue that open innovation no longer gives any special competitive advantage, it is a necessity. The Schumpeterian creative destruction of today can be outlined by closed and open innovation: companies, industries and nations relying on closed innovation models come under destruction and those relying on open innovation models are creative and thus successful in the future. In spite of this, surprisingly many companies and nations practice quite closed innovation models and policies. However, ideas may be hard to find without new input from different fields of knowledge. There is certainly a need to break boundaries and achieve intellectual cross-fertilisation between innovative partners so as to keep innovation continuous and sustainable. (Harmaakorpi 2009)

3 Low Carbon Innovations Systems

Interactive and cumulative learning processes mean that the institutional set-up will affect innovation process. This is especially relevant for the analysis of innovation system. It has recently become increasingly common to study innovations within various kinds of innovation systems. Examples of such institutions are universities, R&D laboratories, schools, patent systems, labour market organisations, banking systems, various governmental agencies etc. In addition, there are other kinds of institutions in the sense of norms, habits, practices, and routines that may be very important influences upon innovations and innovation systems. (Edquist & Johnson 1997, 165-166.)

The current environmental innovation policy regimes are largely based on the linear model of innovation (Foxon & Pearson 2008, 150). The two common models based on the linear model of innovation are the technology push, on the other hand, and market pull, on the other (OECD 2008, 13). Technology policy considerations are increasingly considered in climate policy analysis, since the importance of technology in future greenhouse gas emissions as well as feasibility and costs of emission reduction efforts are undisputable. However, there is an ongoing debate around the two different approaches to innovation described above. The policies on technology-push emphasizes the role of policies that stimulate research and development, especially those aimed at lowering the costs of meeting long-term objectives with technology that today is very far from economic in existing markets. The policies might include public-funded R&D or R&D tax credits. (Halsnæs et al. 2007, 156)

Consequently, a question arises: if technologies that are cost effective and help minimize climate-forcing emissions, why are the technologies diffusing more rapidly? (Unruh & Carillo-Hermosilla 2006). One main explanation is path dependence, or “lock-in” to existing technologies. Path dependence is a strong feature of innovation systems. This means that certain technologies are closely linked with their social and economic environment. In consequence, technological alternatives must compete not only with components of an existing technology, but with the overall system in which it is embedded. Technological paradigms persist because they are a complex of scientific knowledge, engineering practises, process technologies, infrastructure, product characteristics, skills and procedures which make up totality of technology and which are exceptionally difficult to change in their entirety. (Smith 2000)

The demand-pull emphasizes the use of instruments to enhance the demand for lower emission technologies, and so increasing private incentives to improve these technologies and including any learn-by-doing effects. Demand-pull instruments might include emission taxes or more direct approaches, such as renewable portfolio standards, adoption subsidies or direct public-sector investments. The technology development differs from the traditional linear model of innovation so that it emphasises the roles of different actors, the importance of feedbacks, both positive and negative between the different parts of the system. (Halsnæs et al. 2007; Foxon 2003)

Lock-ins do not only exist in firms, but industries and the whole socio-economic system may not be able to switch away from the existing technologies. The elements of a technological paradigm interlock with each other and a change in a techno-economic paradigm must involve a complex and integrated process of change in all activities, including science, engineering practices physical infrastructure, social organization plant design and so on. (Smith 2000)

3.1 Policy Failures in National Innovation Systems

There has been a considerable amount of research on national innovation systems and their success. Although there is already significant public and private investment in low carbon innovation in high income countries, this is often done with a view to creating national competitive advantage. Competition is a crucial factor in driving innovation but it does not fully capture all of the global public good aspects of low carbon technologies. Low carbon knowledge and innovation have the classic elements of a global public good as, at a fundamental level, the benefits of low carbon innovation are nonexcludable and non-rivalrous in consumption across national borders. That is to say that the use of new low carbon knowledge and innovation by one country does not prevent others benefiting from it, and when one country decarbonises all will gain from reduced global emissions. This means that in the absence of additional multilateral action, private markets will under-invest in low carbon innovations relative to the global social optimum. (Tomlinson et al. 2008)

Therefore, we might observe significant policy failures in national R&D programmes. Currently multilateral institutions do not sufficiently address cross-border issues to induce networks of innovation. Action is required to create a new balance of risk and reward to drive innovation forward. Therefore additional effort is required by the global community to create an innovation system that takes risks to develop new, disruptive technologies that are appropriate for both developed and developing country economies; that encourages innovation in supporting networks (business models and institutions) alongside new technology; and that allows for rapid diffusion of new ideas and technologies after they are developed. (Tomlinson et al. 2008)

We can use Finnish innovation system as an example. The Finnish innovation system consists of producers and users of new information and knowledge and know-how. At the core of the innovation system are education, research and product development, and knowledge intensive business and industry. The producers of new technology include universities and polytechnics, research institutes and business enterprises. The users are mostly enterprises, private citizens, decision makers and authorities responsible for societal and economic development. The role of scientific information in societal and economic development has been constantly growing, which increase the significance of cooperation and networking both between the public and the private sectors. A key task for science, technology and innovation policies is to ensure a balanced development of the innovation system and strengthening cooperation within it. Alongside this, increasingly important are also cooperation relationships with other sectors, such as economic, industrial, labour, environmental and regional policies or social welfare and health care services. (Seppälä 2006)

During the recent years, Finland’s technology policy has focused on the creation and application of new knowledge and skills, on the integration of well-being and sustainable development and the capacity for continuous renewal. Finland has striven to create a favourable environment for innovation and business activities. Economic and societal development in Finland has been based on developing and diffusing high technology both domestically and internationally. In consequence, Finland has ranked as one of the leading European countries for innovation as measured in terms of growth, competitiveness, technological sophistication and infrastructure. (Ebersberger 2005)

The mental trap here is that national innovation systems might perceived to be open from the participants' perspective because of collaborative elements included, but simultaneously they usually are quite closed from the global perspective. Hence, the main barrier for the efficient diffusion of low carbon innovations in Finland, and probably in other developed countries, is not the lack of funds, but rather the mobilisation of the funds, rethinking of structures from global perspective, and the willingness to take risks in investing in new technologies and ways of acting.

It could be stated that climate policies based solely on research and development are not efficient for the goal of significantly reducing carbon emissions. The problem is that this approach does not set limits for the use of carbon- intensive fuels. The emissions are effectively reduced only if the investments for R&D are so great that the price of clean technology is below the price of coal intensive fuels, even if there is no value for the emissions. Another challenge is the allocation of the funding for R&D. For example an efficient allocation of the public funding for R&D is challenging since the knowledge has spread to both public and private sector. The challenge is to allocate the funding to projects that have the greatest potential for the public good. (Urpelainen 2008).

4 Improving Low-Carbon Innovation Capacity in Developing Countries

Researchers have asserted that developing countries have an opportunity to avoid carbon lock in because they have not yet built out their national energy infrastructures. Their late comer status theoretically allows these countries to "leapfrog" straight to superior climate technologies and infrastructures. (Unruh & Carillo-Hermosilla 2006). In order to achieve this ideal, developing countries' ability to engage and use adaptive and disruptive innovation alongside incremental improvements is crucial. Developing countries' (particularly the lowermiddle and lower income countries) lack of innovative capacity may severely limit their ability to engage in effective decarbonisation and adaptation. Similarly, lack of market incentives has led to the creation of 'orphan' areas of research, especially in relation to adaptation technologies. Developing countries require support to build effective innovation systems rather than a narrow focus on technology transfer. (Tomlinson et al. 2008)

Enhancing the capacity of developing countries to innovate will bring significant benefits to other countries by providing new markets for firms and investors and increasing the overall rate of global innovation. Major developing countries already have the ambition to build towards a knowledge-base economy. Brazil, China, India, South Africa and Malaysia – among others - have significant domestic capacity to innovate. Simlarly, commercialization of new technologies at scale will be possible only by early deployment in major developing economies. (Tomlinson et al. 2008)

4.1. Finnish-Malaysian R&D Cooperation

To illustrate some of the emerging collaborative mechanisms, an example from the Finnish-Malaysian R&D cooperation in the field of sustanaible palm oil production is presented. The global demand for palm oil is growing, thus, prompting an increase in production in the major producing countries Malaysia and Indonesia. Such increasing demand for palm oil is due to palm oil's relatively cheap price and versatile advantage both in edible and non-edible applications. The increasing demand for palm oil is also ascribed to the increasing demand for biofuel as an alternative source of energy particularly in Europe having a mandated biofuel utilisation target.

The production of palm oil is not without problems or challenges. The whole industry is partly blamed as a culprit for loss of forest cover and forested areas (deforestation), loss of biodiversity, endangering wild animals and species, soil, air and water pollution, chemical contamination, as well as for land disputes and social problems in Malaysia (also in Indonesia). At the milling factories, the problems of waste and pollution particularly of the palm oil mill effluents are also of growing concern. (Panapanaan et al. 2009)

We can identify a need for investment in adaptive biofuel research which will suit developing countries' needs. In the biofuel sector, because of the possibility of having different feedstocks, developing country needs would be different than those of developed countries Barton (2008). The IEA World Energy Outlook (2007) suggests that transport will contribute "roughly a fifth of the increase in global emissions to 2030 in all of its three scenarios, consolidating its position as the second-largest sector for CO2 emissions worldwide. Most of the increase in transport emissions comes from developing countries, where car ownership and freight transport are expected to grow rapidly".

The growth and modernisation of palm oil industry in Malaysia is not without the influence of various research and development efforts of different scientific organisations. The contribution of research to support the development of capacities, technologies and innovations is very much evident by the roles being played by both public and private research institutions. (Panapanaan 2009)

A recent development has been that a major university in Malaysia, Universiti Malaya (UM), and a leading Finnish university in the field of energy technology, Lappeenranta University of Technology (LUT), have established a significant level of cooperation in palm oil – related research. LUT benefit is that through UM, it is possible to obtain first-hand information on the local conditions when assessing the sustainability and carbon balance of palm oil based fuels. For UM, the upside comes from the better understanding of market perspective and technological advances brought by LUT. This development can be seen as the emergence of new international innovation system around one source of renewable energy.

It is evident that there will be other areas and sectors where the differing needs of developed and developing countries might require additional R&D and demonstration capacity to fill this gap (Tomlinson et al. 2008).

5 Proposal for Joint Action

Based on the analysis above, the following extension of current Clean Development Mechanism is proposed:

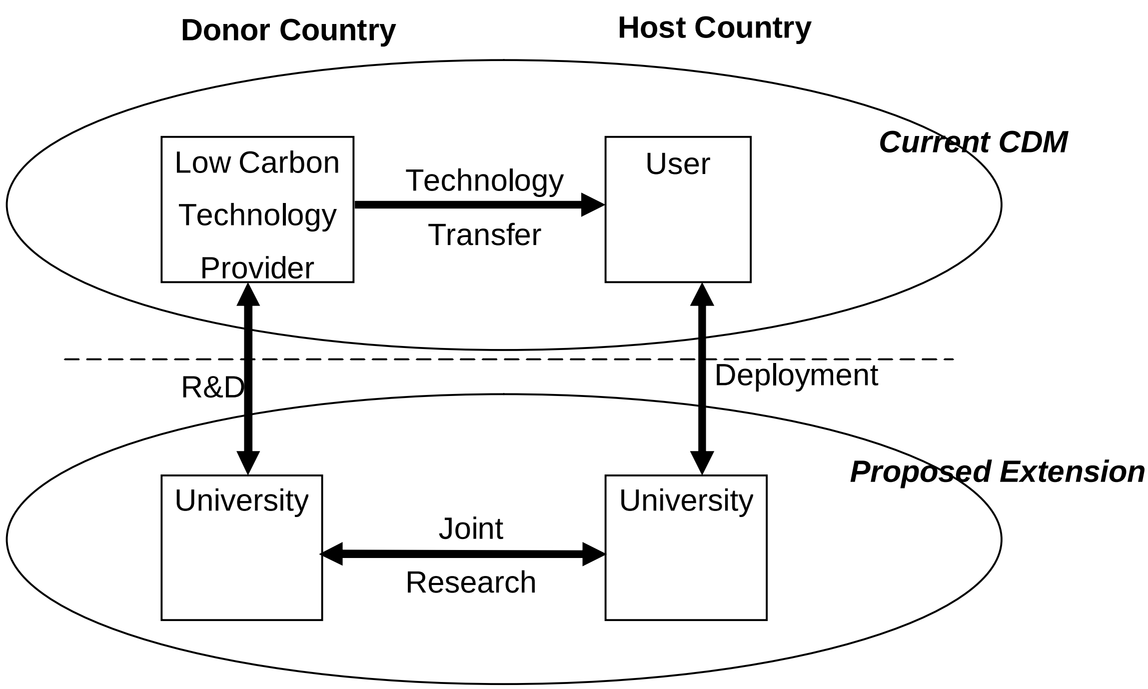

Figure 1. From Technology Transfer to Innovation Systems.

In order to make the proposed extension applicable, funding for research cooperation between developed and developing country should be counted against international obligations of the developed country. For example, this funding could be part of the country's contributions to the global climate fund, were such obligations to be established.

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