Fostering public research funding for green innovation

How does science results in green innovation?

Research often provides the seed that ultimately leads to innovation, in particular where innovation is technological. Such research can come from many areas and goes beyond narrow categories of environmental science (Igami and Saka, 2007). For example, a mapping of scientific fields that influence innovation in green technologies, as measured by patenting, shows that areas such as chemistry and material sciences are more important for green technologies than research on energy and the environment. In most of these areas, the United States, Japan and Germany account for most of the links to green patents (OECD, 2010).

Scientific breakthroughs could open new avenues for energy production or help increase the efficiency of energy use. They could also provide new ways of capturing and using GHG emissions, or of adapting to global environmental challenges such as climate change. In deciding where to invest, government should in principle focus on those areas where the social returns of investment are potentially the highest and where it is unlikely that the private sector will invest on its own. This is typically in areas where the risks of investment are too high, the lead times too long, and the appropriability of outcomes low. This implies that governments will need to take the lead in investments in basic research that can help overcome fundamental challenges and specific roadblocks to innovation, or that enhance the knowledge base for followon investments in green innovation by the private sector.

Some of this investment may need to be channelled to specific areas, e.g. through more focused efforts in areas where research is aimed at resolving known challenges. But some will also need to be generic or blue sky, as ideas and new knowledge may emerge from many directions. As shown above, greater investment in energy R&D or environmental R&D may be needed, but the evidence shows that green innovations over the past decade have relied on a very wide range of research, reflecting the growing multidisciplinarity of scientific research.

Using public research funding as a catalyst to exploit new technology pathways

Science is an essential aspect of greener innovation, but very little attention has been given to the appropriate research funding model and the selection criteria to foster green technology. Indeed, it is difficult to identify specific disciplines as the sources of the scientific knowledge that will make major scientific contributions to green innovation and thus to green growth. A mapping of scientific fields reveals that “clean” energy technologies draw on a diversity of scientific knowledge bases which have a broader focus than research on energy and the environment, such as materials science, chemistry and physics (OECD, 2011a).

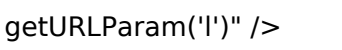
The coming together of different fields of science and technology through collaboration among research groups and the integration of approaches originally viewed as distinct can also facilitate radical innovations as it opens up new avenues for technology development. Scientific breakthroughs are typically achieved by small interdisciplinary and multidisciplinary groups. For example, Heinze et al. (2009) find that there is less exploration when research groups are large and hierarchically organised. Therefore to advance the frontiers of knowledge will require better interaction across disciplines and appropriate funding systems that encourage such interdisciplinary research at the level of institutions (universities, research centres), departments, and single research units.

Funding systems have generally favoured scientific specialisation, but governments are increasingly adapting their research-financing mechanisms in order to facilitate funding of interdisciplinary research relating to green innovation, e.g. by making greater use of competitively awarded project

funding.

At the operational level, national research priorities for green innovation can be also expressed via the missions of research institutions or through more flexible structures such as centres of excellence. But there are limits and risks associated with a top-down approach to steering and managing university research. A too top-heavy approach is unlikely to provide a cumulative and diverse stream of green innovation because it reduces researchers' freedom and the experimentation that could lead to important but unexpected breakthroughs. At the same time, setting priorities only from the bottom-up can lead to research that is fragmented and lacks a critical mass. Ensuring a broader stakeholder involvement in priority setting can guard against the risk that public research crowds out private research in emerging technologies.

Figure 1. PCT patents filed by PRIs in environment related technologies, % of all PCT patent applications



Turning science into green business

As PRIs and universities have become more entrepreneurial, there has been an increase in technology-based economic development initiatives, by improving institutional environments and capacities at national and university level, by the promotion of collaborative industry-science linkages (ISL) to hasten the transfer process, and by efforts to nurture university spin-offs.

There are large differences across countries in the degree to which the public research system (PRIs, higher education, hospitals) contributes to green patenting. In Portugal and Singapore, for example, the research system accounted for over 20% of all green patents between 2004 and 2009. Research commercialisation and knowledge transfer are considerably broader than patenting, however. Knowledge transfer channels such as industry-science linkages or publications have been found to be more important (Cohen et al., 2002; Foray and Lissoni, 2010).

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Links
[1] http://dx.doi.org/10.1787/sti_scoreboard-2011-en
[2] http://dx.doi.org/10.1787/9789264119925-en
[3] http://dx.doi.org/10.1787/sti_outlook-2012-5-en