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Demand-Side Innovation Policies

26-27 October 2010

Delegates will find attached the final report of the Joint TIP-CIIE Project on Demand-Side Innovation Policies. It is submitted to the CIIE and CSTP for declassification. Delegates should note that an accompanying annex document including the case studies of demand-side innovation policies is available under the reference DSTI/IND/STP(2010)1/REV1/ANN.

Contacts: Fabienne Cerri, E-mail: fabienne.cerri@oecd.org, Heekwon Jung, E-mail: heekwon.jung@oecd.org and Mario Cervantes, E-mail: mario.cervantes@oecd.org

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EXECUTIVE SUMMARY AND POLICY CONCLUSIONS

The *OECD Project on Demand-Side Innovation Policies* was launched in 2008 under the auspices of the Working Party on Innovation and Technology Policy (TIP) and the Committee on Industry, Innovation and Entrepreneurship as an input to the *OECD Innovation Strategy*[1]. This final report provides insights into the rationale and scope for public policies to foster demand for innovation and draws on country experience and case studies to illustrate the risks and opportunities for demand-side innovation policies.

Historically, OECD governments have tended to rely on macroeconomic policies (e.g. monetary and fiscal policy) and framework conditions (e.g. competition, tax or entrepreneurship policies) to support market demand and avoid distortion. Demand for innovation in this context emerged from the removal of barriers to firm entry, allowing potential entrepreneurs to enter the market with new or improved goods and services (based on innovation) and meet unmet or latent demand. As such, much of the role of government on the demand side of innovation has focused on getting "prices right" in order to foster markets for innovation.

In recent years, however, OECD countries from Finland to Austria and emerging economies like China and Brazil have used more targeted demand-side innovation policies such as public procurement, regulation, standards, consumer policies and user-led innovation initiatives, as well as "lead market" initiatives to address market and systems failures in areas where social needs are pressing.

This interest in demand-side innovation policy has emerged in the context of a greater awareness of the importance of feed-back linkages between supply and demand in the innovation process. As discussed in Chapter 1, demand-side innovation policies are part of an evolution from a linear model of innovation policy usually focused on R&D, to a more broad-based approach that considers the full scope of the innovation cycle. This focus on the demand-side also reflects a general perception that traditional supply-side policies – despite refinements in their design over recent decades – have not been sufficient to bring innovation performance and productivity to desired levels.

Furthermore, current pressures on fiscal budgets in OECD countries have generated interest in using demand-side innovation policies to boost innovation performance while at the same time increasing productivity of public sending – through innovation - in areas where there are strong social demands like health, security, population ageing and the environment.

However, with few exceptions, experience in OECD member countries shows that the use of such policies remains limited to areas where societal needs are not met by market mechanisms alone (e.g. health, environment) or where private and public markets intersect (e.g. energy supply, transport). In these areas, OECD countries are employing such policies with varying degrees of expertise and success to

[1] To implement the project, a Steering Group on Demand-Side Innovation Policies was created in the TIP, which also involved CIIE Delegates. Under the initial leadership of Canada and then Australia, the project brought together 12 participating countries. In the first phase of the project a scoping paper was prepared and then discussed at the Joint CSTP-CIIE Workshop on Demand-Led Innovation (14-15 September 2009). Country case studies were carried out in parallel and discussed at the recent TIP Expert Meeting on 27-28 May 2010.

reduce market risk and fragmentation and "pull" innovation in ways that should avoid harming competition.

The evidence to date suggests that the likely success of demand-side policies depends on a number of strategic factors. Firstly, because government is one of several actors that influences demand, it is important to consider whether the action undertaken is efficient from a market (and budgetary) point of view and whether it improves social welfare. Thus, demand-side policies should be targeted to clearly articulated policy objectives and their impacts should be carefully evaluated. In addition, complementarities between demand and supply-side measures are essential. Due to the sector specificity of innovation dynamics, the most promising level for policy making is perhaps the sectoral level. The scale of demand-side policies should be assessed carefully as it is easier to match demand and supply-side policies in a specific sector than across the economy as a whole. The timing and duration of government intervention also need to be considered: different policy measures supporting the demand and/or the supply-side are needed along the different phases of the innovation cycle.

Secondly, adopting demand-side innovation policies has several implications for the public sector. The combination of different policy measures (whether sectoral, supply or demand oriented) to support demand for innovation makes good governance and policy co-ordination within the public sector essential. The systemic nature of demand-side policies also implies that alignment needs to be achieved not only across different levels of government, but also with industry and other influential stakeholders. It is therefore necessary to establish shared visions and roadmaps between the public sector and firms to successfully implement demand-side policy instruments. A demand-side innovation policy assumes a more pivotal role for public administrations (e.g. through procurement, regulation, setting and certifying standards). This requires investments in skills and competencies of human resources in public administration, as well as organisational and cultural change. It also raises the question of how the public sector can be incentivised to participate in this innovative effort (e.g. in the promotion of innovation-friendly public procurement).

Public procurement is at the centre of recent demand-side innovation policy initiatives. Because of their large purchasing power governments can pull demand for innovation and can also create a signalling effect as a lead user influencing the diffusion of innovations more broadly. However, using public procurement as a policy instrument to promote innovation is challenging. The traditional focus on value-for-money as well as the problem of fragmentation of public demand (often between different levels of government) can limit potential scale effects for innovative procurement. Furthermore, many agencies with responsibilities for public procurement operate separately from line ministries or government agencies with a remit to foster innovation. This dispersion and the lack of data gathering on this issue makes the proportion of procurement dedicated to innovative products or services very difficult to assess. In addition, public procurement can distort competition also in excluding foreign firms from domestic markets.

The use of regulation to foster innovation has so far not been among the key objectives of regulators. The setting of key regulations to allow for instance the emergence of new technologies is challenging as they can have far-reaching economic consequences. Also, the effects and the timing of regulations are difficult to determine *ex ante*. Regardless of the impetus for regulation (i.e. competition, environmental, consumer protection, etc) achieving innovation as an outcome will require alignment of the goals of agencies that implement the regulations. It will also involve co-ordination between the regulators and the different stakeholders.

As regards, standards, the public sector's role is mainly one of facilitator or co-ordinator, meaning that standardisation is not always easy to use as a policy instrument. The setting of standards is mainly the responsibility of industry bodies and procedures in standards bodies can be slow and bureaucratic and can be influenced by large players. This also raises the issue of timing: if standardisation occurs too early it

could shut out better technologies, but if it occurs too late, the costs of transition to the new standard could prevent diffusion. Another limit on the role of governments in standards-setting is that for many technologies, standards are set openly at the international level. Therefore, efforts to impose nationally-based standards through public procurement, for example, are risky and costly due to technology lock-in and the fact that it is difficult to determine *ex ante* the dominant standard given rapid technological change and global market dynamics.

As consumers and users become catalysts for innovation, in creating demand and facilitating the diffusion of innovation, consumer policy is of growing importance. Consumer policy regimes and consumer education play a role in promoting innovation in key innovative markets and can help ensure that confident consumers make informed choices. Consumer policy is thus an important policy instrument that can be used to counter inertia and scepticism towards new goods and services, and help improve the flow of information between users and developers.

The different case studies reviewed in this project [see DSTI/IND/STP(2010)/REV1/ANN] reflect considerable interest in demand-side policies in a number of OECD countries. They also show that demand-side innovation policy measures, with the exception of SME procurement of innovation, are often still at a pilot stage. The lack of evaluation still makes evidence-based policy making in this area challenging. Therefore, better data evidence and adequate evaluation metrics and methodologies are important to identify successful demand-side measures and to scale them up to larger scale initiatives.

The general principles and recommendations for demand-side innovation policies stemming from this policy report and from the evidence provided by the case studies are the following:

- Government should assess the rationale and opportunity for policy intervention.
- Policies to foster demand for innovation need to consider market and sectoral issues
- Scale, timing and duration of policies to foster demand need to be determined carefully and address the risks of protectionism, large player dominance and technological lock-in.
- Demand-side policies need to be matched and combined with adequate supply-side policies and measures. This will require mechanisms to enhance government co-ordination and stakeholder involvement.
- There exists a large potential to boost demand for innovation by increasing the innovation capacity of the public sector to meet social and even global challenges.
- Adequate incentives and regulatory frameworks can help foster innovative public procurement in line with good governance, transparency and accountability.
- Mobilising public administrations in favour of innovation – through supply-side or demand-side measures − requires establishing strong incentives, administrative reform, and upgrading competencies of human resources.
- Consumer policy and education ought to be used as a means to enhance user involvement in innovation creation and diffusion.

1. DYNAMICS OF DEMAND AND INNOVATION

1. One of the key findings of the OECD Innovation Strategy is that despite the increasing variety of actors in the innovation process, firms remain the pre-eminent means for translating good ideas into jobs and wealth. A clear implication from this is that the policy environment in which firms operate, on both the supply and demand-sides, is fundamental to innovation.

2. Governments have long fostered innovation in firms by focusing on supply-side factors such as the formation of human capital and public investment in R&D, while the role of demand and markets in inducing innovation was taken as a given. The question of demand is now receiving increasing attention. This is not to say demand was not important in the past – the feed-back linkages between supply and demand in the innovation process have always been critical. Rather, the interaction between the two is much more rapid than in the past in light of advances in ICT and increased participation of users in the innovation process in some industries. Moreover, there is growing understanding of the crucial role of demand for innovation. This chapter reviews the role for demand in the innovation process, describing the dynamics between demand and innovation.

1.1 Matching supply and demand forces

3. The theoretical framework underpinning the innovation process and policies over the past century has been influenced by technology-push and demand-pull innovation theories. Supply-push theories stipulate that innovation is the essential force behind social and economic changes (Schumpeter, 1934) and that economic growth and productivity are driven by the knowledge output of a society. Accordingly, public policy should have as its main objective boosting knowledge production and supply in order to accelerate knowledge spill-overs and externalities (Jones and Williams, 1998). An increased supply of funds, laboratories, researchers, discoveries and patents would thus translate into more innovations, sales, growth and jobs. Examples of technology or supply-push based public policies are government sponsored R&D, tax credits for companies to invest in R&D, enhanced capacities for knowledge exchange and support for education and training.

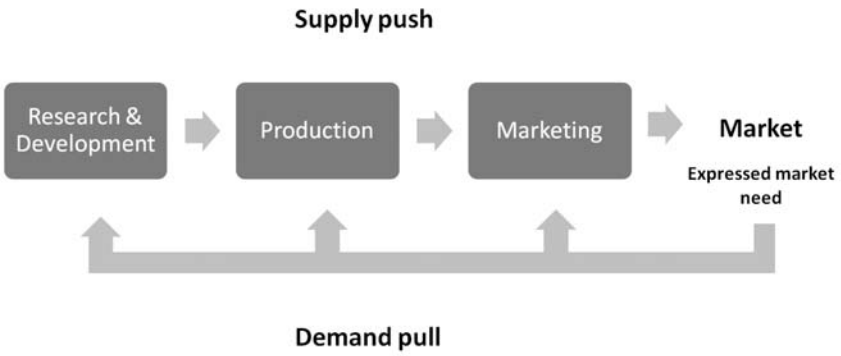
4. Demand-pull theories on the other hand suggest that the ability to produce innovations is often widespread and flexible, but what is often needed is market opportunity (*i.e.* demand). Rather than working on the beginning of the innovation chain, these theories focus on its end: the market place. Demand would thus be the force that directs resources and capabilities for innovation in a certain direction, meeting societal or market needs (Schmookler, 1966; Rosenberg, 1969). As a consequence, a demand-side policy approach focuses on boosting demand and on encouraging suppliers to meet expressed user needs. It also aims to reduce barriers to innovation and stimulate the emergence or the redesign of markets. Examples of demand-side innovation policies include: tax credits and rebates for consumers of new technologies, technology-oriented government procurement, technology mandates, as well as innovation-specific regulations and standards.

5. While both frameworks provide insights into how innovations arise, both have their shortcomings; technology-push theories have failed to account for the importance of markets for innovation, while demand-pull theories have ignored the importance of supply conditions for innovation (Nemet, 2009). In fact, both technology-push and demand-pull forces act as a catalyst for the successful introduction and diffusion of innovations. This recognition of the essential interaction between demand-pull and supply-push is reflected in the broader academic literature. For example, Mowery and Rosenberg (1979) conclude that neither supply nor demand factors are sufficient for innovation. Both must exist

simultaneously. And Freeman (1974) surveyed a set of 40 innovations, showing that successful cases were able to link technical and market opportunities.

6. This implies that demand-side policies need to complement supply-side measures (and not replace them) as innovation is the product of the creative interaction between supply and demand (Figure 1). A range of studies have argued that a major task for a systemic innovation policy is the organisation of information flows between users, consumers and others affected by innovations in order to articulate and communicate preferences and demand to the market (Von Hippel 1976, Mowery and Rosenberg, 1979 and Smits 2002).

Figure 1. Matching supply-push with demand-pull forces



Source: OECD based on Martin, 1994.

1.2 The role of prices in affecting demand

7. Prices are a key element in the introduction and diffusion of innovations as they allow supply and demand to meet[2]. Markets where competition between firms is high will tend to lower prices, which will in turn increase access for consumers to innovative products or services. However, if prices are too low, both innovation and competition will be limited: firms will not invest in developing new products or services if they can not appropriate some of the rents from innovation. In addition, if low profits are expected for new entrants, this deters entry onto the market.

8. For goods with network effects a critical mass of users is necessary to make the good attractive, as the benefit for users grows with scale (*e.g.* the use of videophones or software such as electronic messaging services). In these cases, price and access are of central importance for the diffusion of innovations: low prices and competitive access to the network are needed to achieve a necessary critical number of users.

9. Governments can influence prices through competition policy, regulation or standards. In the software sector for example, governments promote open source software standards to stimulate competition and to facilitate the potential entry of new companies. In the case of mobile telephones, or broadband, governments set standards (GSM and ADSL in Europe for example) and delivered licenses to a

[2] Price and utility are the two factors influencing and constructing demand. Information-based measures such as labeling can help consumers make informed choices about product or service quality and impact the perception of utility. This could for example be the case for environment-friendly products.

set number of suppliers in order to keep prices sufficiently low to make products and services available to a critical mass of users.

10. In the case of pharmaceuticals, governments use pricing schemes to ensure the affordable access to medicine. Research has shown that pricing in the pharmaceutical sector has ambiguous effects: price cap regulation has been found to have a negative impacts on sales revenue and innovation (Troyer and Krasnikov, 2006) and delay the launching of new drugs (Danzon and Epstein, 2008), it however has also had positive effects, for instance in terms of access to vaccination in developing countries (Mahony, 2005).

1.3 Sector specific innovation dynamics

11. The dynamics of innovation and market structure differ greatly across sectors[3]. Different sectors will exhibit different forms of innovation value chains. They will draw on specific knowledge bases, lock-in specific technologies, depend on certain inputs from allied suppliers, and serve a (potential or existing) demand.

12. Some sectors are dominated by knowledge-driven industries (*i.e.* technology-push) such as pharmaceuticals, energy, and materials. Others are dominated by industries that are platforms and standards based such as automotive, machinery tools, and computer operating systems. Malerba (2005) illustrates the significance of sector-specific structures:

- in sectors with a quite homogeneous demand, co-evolution (between technology demand, and firms) leads to the emergence of a dominant design and industrial concentration (e.g. chemicals, pharmaceuticals);

- in sectors with either a heterogeneous demand, or competing technologies with lock-ins, or network externalities and standards, specialised products and a more fragmented market structure is likely to emerge (e.g. ICT, software).

13. For some industries, particularly technology-push industries such as pharmaceuticals and chemicals, the supply of novel or radical innovations to meet (existing or potential) demand can be very crucial. These science-based industries (Pavitt, 1984), typically run large in-house R&D programmes, or sponsor R&D activities in universities or at small firms (Malerba, 2005).

14. For others, particularly platform or standards based industries, such as computer operating systems, automobiles, machine tools, or telecommunications, responding to changing demand through incremental innovations is more frequent and, arguably, more desired. For this group of industries incremental innovation around dominant designs and locked-in systems, with a greater focus on integrating new innovations into existing products and services, are more important than producing revolutionary innovations to replace existing standards along which competition and innovation have evolved (Utterback and Suarez, 1993; Malerba, 2005).

15. From a policy perspective, industrial and sector dynamics can have implications for demand-side innovation policies. Nemet (2009), for instance, argue that demand-oriented innovation policy can be more effective in stimulating incremental innovation than radical disruptive innovation. Also, Malerba's and Pavitt's differentiation of innovation patterns across different industries calls for governments to adopt different policy approaches towards different sectors.

[3] A sector is here defined as a set of activities which are unified by some related product groups for a given or emerging demand and which share some basic knowledge (Malerba, 2005).

1.4 Diffusion of innovations along the value chain

16. A demand-side innovation policy needs to concern itself with the entire innovation cycle, from the start of the innovation chain to its end in the market place. Innovation is more than a single event of invention, discovery or change. It is an activity conducted through numerous actors linked through value chains, knowledge networks and innovation systems. The value chains extend from suppliers of resources to firms, to buyers of products and services from firms. Value is created within these chains; at each step of the process, different participants (*e.g.* innovators, suppliers, complementary innovators or customers) seek to maximize the value that can be extracted from trading within the chain.

Absorptive capacity of suppliers

17. As innovation triggers change and adjustments among players across the chain, the absorptive capacity along the value chain is essential. For instance, when the change following to the introduction of an innovation is radical and disruptive, supply restrictions can emerge. Supply can for example be unable to provide the necessary components of a new product or service. Further down the value chain, an innovation may render obsolete existing complementary accessories, supportive products or services which in turn can lead to resistance from complementary innovators (*e.g.* replacement of the typewriter and ink-ribbon manufacturers).

18. Restrictions in supply-chains (e.g. lack of appropriate skills or knowledge, physical capacity or financial capital, desire to keep relationships with suppliers of complementary technologies, delivery systems or distribution networks) can delay and sometimes compromise the successful introduction of an innovation to the market, regardless of the volume of end-user demand. Thus efforts to stimulate innovation through demand incentives need to consider that supply restrictions may call for appropriate supply-side measures.

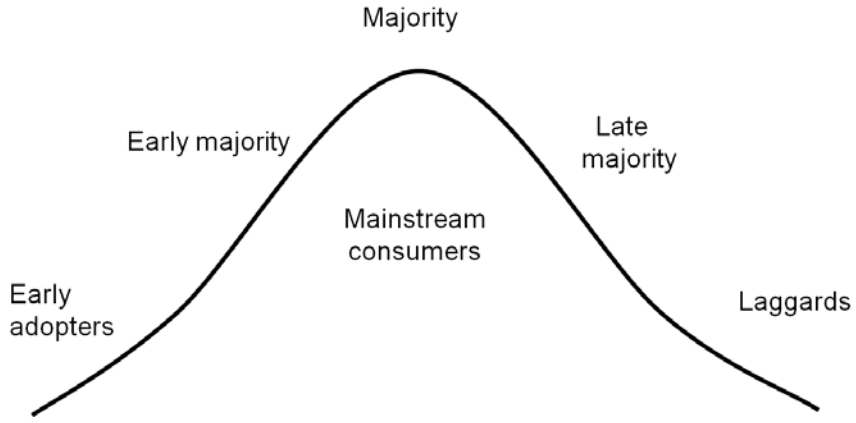
Take-up rate by users

19. Challenges on the demand-side are linked to the diffusion of innovations and their take-up by consumers. While diffusion is generally less of an issue for incremental innovation, it is more so for radical innovations (Christensen, 1995). In fact, the successful introduction of a radical innovation into the market entails that it is commercially viable, but also socially accepted (e.g. the resistance of public opinion in some countries as regards the introduction of GMO technology in food crops).

20. Innovations spread through a market in phases (Rogers, 1962 and 2003). Early adopters select the innovation first, followed by the majority until a technology or innovation has reached its saturation point (Box 1). More often than not, the real challenge for an innovation is its take up by mainstream consumers. The majority of users will usually join in when innovations in an industry become more incremental and tend to embody a smaller degree of inventiveness, but also when price competition between suppliers starts and prices fall.

Box 1. The process of innovation diffusion - the case of digital cameras

The first digital cameras emerged in the 1980s with early models being produced by Sony and Kodak. Diffusion started among professional photographers (early adopters) and products were constantly improved during the 1990s. Early 2000 Nikon and Canon started producing digital cameras targeting mass users (early majority). Between 2002 and 2006 digital cameras spread among mainstream consumers replacing traditional silver film cameras and accessories (majority and late majority): they represented 70% of turnover from sales in 2002.



Source: OECD based on Rogers, 1962.

The role of early users

21. While later mainstream users will often wait until products and services have been on the market for some time, early users take the risk of testing an innovation that may not be fully optimised or functional in return for the possibility of solving a problem they face more quickly (*e.g.* the use of high-tech lightweight material for mountain bikes only occurred many years after the introduction of the first models). This user population often has higher costs to bear as they assume the learning costs of later users (Edler, 2007).

22. Early users have a central role in two respects: *i)* they reassure users' possible concerns as regards the perceived risk in adopting a new technology; *ii)* they provide the producer with early revenue and feedback which allows improvements in the nascent innovation. In fact, due to reluctance from customers who have doubts about the viability of the firm or the innovation, a frequent cause of failure amongst innovative start-up firms is an inability to get a foothold in the market, even if the product, process or service is technically superior to its rivals (Georghiou, 2007). Malerba et al (2007), present a number of cases where the effect of demand and lead users in pulling radical innovation has been key to the emergence of a new technology (Box 2).

Box 2. Effects of demand on technological innovation and market structure

Scholars of technological change have long stressed demand effects on innovation and market structure, considering size and structure of demand as important factors influencing the magnitude and orientation of inventive efforts (Von Hippel, 1988). Scholars concerned with the factors influencing industry structure have also paid attention to the structure of demand, as well as the sensitivity of customers to advertising in determining whether or not the industry becomes concentrated (Sutton, 1991 and 1998).

Malerba et al (2007) argue that the successful introduction of a radically new technology in an industry where a dominant design and few dominant firms have emerged using older technology relies on the existence of fringe markets which the old technology does not serve well, or on experimental users and sometimes on both. New firms need to find a market that keeps them alive for long enough to develop the new technology to a point where it is competitive on the main market. Niche markets or experimental users provide that space. The authors present a number of cases where the effect of demand and lead users in pulling radical innovation has been key to the emergence of the new technology:

- *Computer technology*. The advances in computer performance over the last 40 years have been largely driven by a succession of major advances in component technologies. In no case has the firm that had market and technological leadership under one regime of components been the leader in developing and marketing computers employing the next generation of components. In each case, new firms were key players in the transformation of the technologies and the industry. And in each case, the new firms got their start by selling to experimental users, or to users whose needs were inadequately met by computers based on the older component technology.

- *Transistors* were first introduced as a potential substitute for vacuum tubes, but in most uses they were inferior. However, in the Unites States the Department of Defense recognised the potential advantages of transistors in several of the weapons systems it was contemplating. The Department of Defense thus provided a special market for transistors, and companies selling almost exclusively to that specialised market were able to survive and advance transistor technology to a point where it could compete effectively with vacuum tubes in a wide range of civilian uses. By the mid-1970s, transistors had virtually eliminated vacuum tubes.

- *Aircraft jet engines*. The American Department of Defense provided a (large) niche market that induced the development of aircraft jet engines. Without that specialised market, it is likely that jet engine technology would have developed much more slowly. As it happened, supported initially by defense demand, jet engine technology rapidly advanced and relatively quickly replaced piston engines on the civilian aircraft market.

- *The Internet*. As is well known, the early work which started progress toward the development of Internet was funded by the American Department of Defense because of its own special needs. Those needs called for something like a packet switched network, as an alternative to a circuit switched network. As that technology developed, a new group of experimental users joined the market, principally academic researchers who used ARPANET to connect research laboratories. As a result of further development, the Internet became a technology capable of attracting a large number of users.

Source: Malerba *et al.*,2007.

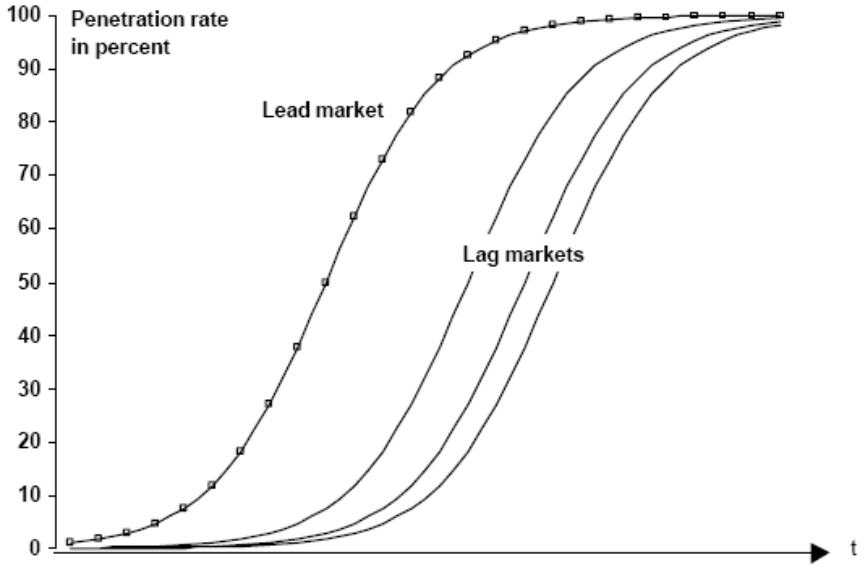
23. Finally, the competencies and capacities of users (organisations or individuals) are essential for the diffusion of innovations. Surveys of innovation-intensive companies have shown that the pre-conditions for customers purchasing products are linked to favourable attitudes to risk-taking, new technologies and the skills to use those products (Georghiou, 2007). This is why governments are increasingly paying attention to users' competencies and their role in the innovation process.

24. In some industries, such as video games, software or music production, users have become so knowledgeable that there is now a tradition of user innovation and indeed an expectation among producers, that users will be able to participate in the innovation process (Von Hippel, 2005). In this case, users become drivers of innovations as they know how to find solutions to their needs. Users' co-invention is for example particularly important in explaining technological change in information technologies (Malerba, 2005). This interaction, blurring boundaries between supply and demand, leads to a learning process that benefits both sides (*e.g.* like many other firms, LEGO has turned from a pure manufacturing company of toys for children into a more open and networked cooperative organisation involving its users). It is through these interactions that more innovation occurs and more growth follows (Lundvall and Johnson, 1994). In some sectors as in software (open source software) communities of practices are the source of constant incremental innovation and change.

1.5 The emergence of a lead market

25. Once an innovation or technology has taken hold of a market, it can be characterised as operating in a "lead market". A lead market can be thought of a "new" market with potential to expand geographically (and otherwise) [4] and create above-average rents for firms. Lead users play an important role in "pulling" innovation: a lead market often originates in areas where customers are demanding and willing to pay for the innovation. Under certain circumstances public sector actors are well placed to play the role of lead users, mobilising common needs to turn them into a common demand (see section 2.1 below). The development of lead markets follows an S pattern as users in other markets (including in other countries) adopt the innovation (Figure 2).

Figure 2. The international diffusion pattern of an innovation design



Source: M. Beise / Research Policy 33 (2004) 997–1018.

[4] The term "lead market" can be defined as: regional markets with specific attributes that increase the probability that a locally preferred innovation design becomes internationally successful as well (Beise and Cleff, 2004).

26. A key characteristic of a lead market is that the uptake results not by the sole technological superiority of an innovation, but by the ability of market players including competitors, consumers, and government regulations, to influence its adoption (*e.g.* via the price mechanism) and the adoption in other markets, including those outside a country's border. Initially countries will present different innovation designs for a given problem based on national conditions and the regulatory context. Depending on the countries lead or leverage imposed say via a standard, a country may be able to impose its technology or innovation on the global market. The transfer from one market to another however implies generic market requirements (*e.g.* the French Minitel is an example where over-specific development precluded the export success of the technology). The development of lead markets can help innovating firms achieve the critical mass and competitiveness to bring prices down and encourage further diffusion and adoption of the innovation.

27. The promotion of lead markets has received increased attention from OECD countries in recent years. If a country or region is able to impose its technology or innovation on the global market (for instance via a standard), its firms might capture above average rents for a period of time. In Europe for example, the convergence over a technical standard for interoperability of mobile phone networks, the GSM, has allowed firms to invest in a winning technology and Europe's mobile-phone industry to thrive.

2. DEMAND-SIDE POLICIES AND INSTRUMENTS

28. Recent trends in innovation policy give growing emphasis to demand-side policies[5] and instruments. A number of OECD countries, from the United Kingdom to Finland and Japan, as well as the European Commission, have made explicit policy statements on the need to give greater importance to demand-side innovation policies. Japan, for example, has recently re-oriented its innovation strategy towards a series of demand-oriented national goals such as the transition to a low-carbon economy and tackling the challenges of an aging society. Finland has adopted a general plan for demand-side innovation - *The Finnish Policy Framework and Action Plan for Demand and Use-driven Innovation Policy (2010*). And the United Kingdom's plan, *Innovation Nation (2008),* introduced demand-side initiatives affecting public procurement and regulation. Nonetheless, the role of demand-side policies still remains relatively marginal in the full portfolio of government policies on innovation in OECD countries.

29. This chapter considers the motivation, rationale and scope of demand-side policies and instruments and provides examples of national approaches. The forms of demand-side policy instruments reviewed include innovation-friendly public procurement, technology-oriented regulations and standards as well as consumer-oriented schemes.

2.1 Demand-side policies

Evidence and trends

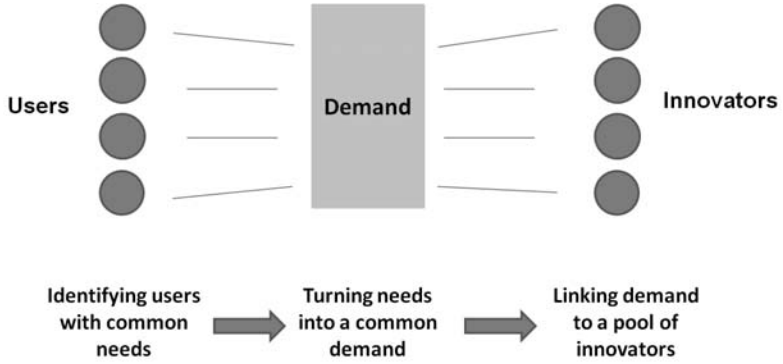
30. While there is no single definition of a demand-side innovation policy, it is often understood as a set of public measures to increase the demand for innovations, to improve the conditions for the uptake of innovations or to improve the articulation of demand in order to spur innovations and allow their diffusion (Edler, 2007). They often aim at addressing barriers affecting the market introduction and diffusion of innovations. For example, demand-side policies respond to situations when markets for innovative products may be insufficiently developed (e.g. certain renewable energy technologies), but where a technology or product has a high potential benefit and/or where public sources of demand afford opportunities to stimulate innovation to meet societal needs. This can also imply meeting these needs by creating an articulated market demand (Figure 3). Some barriers on the demand-side affecting the market introduction and diffusion of innovations include (Edler, 2007):

- Lack of interaction between producers and users (producers don't know the user preferences, users don't know the innovations are available or can exist);
- High switching cost to new technologies, which can reflect high entry costs (especially as regards industries and technologies with high network effects) and lock-in effects and technological path dependencies.
- A lack of transformation of potential market needs into clear market signals: users do not know their needs, or cannot communicate their needs to producers. Here government can play a role in

[5] Demand-side policies can be defined as policies aimed at increasing the likely success of innovation by acting upon the forces affecting the purchase of innovative goods and services (Georghiou, 2006).

expressing grouped user needs (e.g. through catalytic or cooperative procurement[6]) to a set of potential innovators to stimulate the creation of a market to meet this unmet need.

Figure 3. Articulating demand to transform private and public markets



Source: OECD based on Georghiou, 2007.

31. Demand-side policies take a variety of forms. Innovation-oriented public procurement, innovation-related regulations and standards are the key instruments considered in this paper (Table 1 sets out the main features of these instruments). However, tax policies are also very important (e.g. in the context of environmental innovation). With the recent exception of experiences in the United Kingdom, Finland and the European Union, demand-side innovation policies have typically been sector-specific (e.g. in the United States defense-related R&D procurement schemes have operated for decades).

32. In the energy sector, demand-side policies have included guaranteed tariffs (for renewables), and specific power purchase agreements with local utilities. Targeting consumers, governments might offer rebates, for instance on energy efficient products, as has happened in many countries with Compact Fluorescent Lamps. Governments might also promote comparison labelling (to inform consumers on the relative efficiency of products) or endorsement labelling (e.g. "CFC-free").

33. In the pharmaceutical sector, regulation has been used to promote the development of Orphan Drugs. As neglected or orphan diseases affect only relatively low numbers of patients, there is a lack of incentive for pharmaceutical companies to invest in R&D in these areas (due to the small market size). To give firms strong incentives to develop new drugs, the European Union, the United States and Japan have adopted the Orphan Drug regulation, which provides firms market exclusivity of 7 years in the United States and of 6-10 years in the European Union.

6 Catalytic procurement occurs when the state is involved in the procurement or even initiates it, but the purchased innovations are ultimately used exclusively by the private end-user. Co-operative procurement occurs when government agencies buy jointly with private purchasers and both utilise the purchased innovations (Edler and Georghiou, 2007).

Table 1. Key features of demand-side policy instruments

Demand-side policy	Procurement	Regulation	Standards
Objective	New product or service	Market uptake, increased competition, social goals	Market uptake, interoperability, transparency
Input	Money, Performance requirements, Skills	Legal process, need to co-ordinate	Standards agencies, need to co-ordinate
Participatory incentive	Sales, Preferential treatment (e.g. SMEs)	Mandatory	Voluntary
Main player	Government	Government	Industry
Effects on success	Improved public services and stimulation of innovation	Reducing market risk	Reduce market risk
Possible risks	Insufficient skills in the public sector, idiosyncratic demand	Conflicting goals, lengths of the process	Technology lock-in

Source: OECD based on Aschhoff and Sofka, 2008.

34. This being said, responses from OECD member countries to the STI outlook policy questionnaire 2010 (Table 2) indicate that demand-side innovation policies rank low among the priorities of new national STI strategies recently adopted.

Table 2. Level of priority of demand-side innovation policies

Level of priority	Country
High priority(8)	Finland
Medium-high priority (6-7)	Austria, Korea, Japan, Norway, Slovenia
Medium priority (4-5)	Canada, Germany, Hungary, Netherlands, Spain, Sweden
Medium-low priority(1-3)	Denmark, France, Israel, New Zealand, United States

Note: Based on self-reported country responses on a scale of 1 to 8 (0 suggests it is not important and 8 very important in the new national STI strategies).

Source: Country responses to the 2010 STI Outlook questionnaire.

Timing of demand-side innovation policies

35. The timing of any government intervention through demand-side innovation policies is of primary importance (as is the duration of these interventions). If governments encourage demand for a specific technology or product that is still at an early stage of development, prices will tend to be very high and the pressure on producers to invest in a further improvement of the technology might be eased; technological trajectories might thus be defined at a sub-optimal level. Moreover, there is a great risk that by encouraging demand for specific technologies or products, governments may support sub-optimal technologies or technology trajectories. Edler *et al.* (2006) suggest that six phases can be identified in the innovation cycle (see Figure 4 below) and at each phase different measures may be required to help pull innovations to the market: while in general measures in support of supply are important at the beginning of the innovation cycle, a combination of both supply and demand-side measures are appropriate in the middle of the cycle, while demand-side measures become more important at the later stages of the cycle.

1. *Discovery and Exploration.* Issues are mainly on the supply-side. On the demand-side, the needs for new technology or applications can be expressed.

2. *Euphoria.* Again, issues are mainly on the supply-side. On the demand-side, foresight (technological and demand) is important.

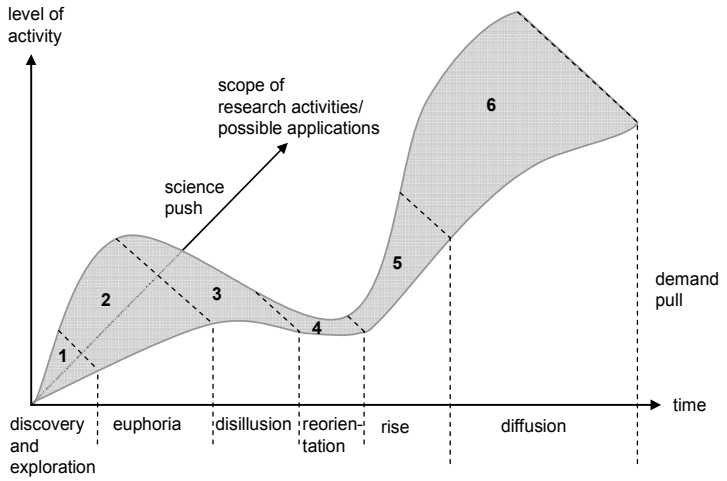
3. *Disillusion*. Issues are still mainly on the supply-side. On the demand-side, public awareness raising (*e.g.* demonstration projects) can help to check demand and build trust.

4. *Re-orientation*. A strong focus is needed both on the supply and the demand sides through user involvement (lead user, key user), focused technological assessment and lead market testing.

5. *Rise*. The focus on demand-side measures is central (regulations, subsidies, procurement, catalytic procurement, broad awareness-raising measures, training).

6. *Diffusion*. The focus is mainly on the supply-side for the next generation of products.

Figure 4. Stages of the innovation cycle



Source: Dreher, Ebersberger, Edler, Schmoch 2006, Jochem et al 2007, co-developed by Meyer-Krahmer, Dreher, Schmoch FhG ISI.

Policies matching demand and supply-side measures

36. Recognising the inter-dependency between demand and supply in the innovation process, a number of OECD countries have introduced measures addressing the entire innovation chain, thus combining both supply and demand-side instruments to make innovation policy more efficient.

37. In Australia for example, the Victorian state government has introduced a combination of both demand and supply-side measures to support SMEs with a high-growth potential in focusing their commercialisation efforts on technology that meets market demand. The Boosting Highly Innovative SMEs (BHIS) initiative thus includes two main components:

- The Technology Commercialisation programme: supporting the establishment and development of fast growth, technology-oriented SMEs by reducing the time and resources needed to bring technology to global markets;

- The Market Validation programme: using Victorian Government technology demand (i.e. pre-commercial procurement of R&D) as a driver for technology SME development and commercialisation (see Case Study 1, DSTI/IND/STP(2010)1/REV1/ANN).

38. In the United States, both supply and demand-side measures were adopted in parallel to favour the adoption of electronic health records (EHRs) which has been slow due to the structure of the health care sector.[7] To accelerate the adoption of EHRs, the government has introduced a series of supply side measures (e.g. the SHARP programme, health IT programmes at NIH, NSF and NIST). The government has also set up incentives to stimulate demand for EHRs and assist their uptake by users: physicians and hospitals demonstrating "meaningful use" - rather than adoption only - of health IT will receive incentive payments (Box 3).

Box 3. Demand-side incentive payments under HITECH

Following a broad stakeholder consultation, a new regulation was issued in the United States in July 2010, the *Health Information Technology for Economic and Clinical Health Act* (HITECH). This introduced incentive payments programmes (up to USD 44 000 through Medicare and USD 63 750 through Medicaid per clinician) and established criteria for "meaningful use" of EHRs in 2011 and 2012. The term meaningful use includes meeting several standards that the EHRs must conform to. These standards are separated in two categories: 1/ core objectives (e.g. entry of basic data, use of several software applications and using records to enter clinical orders and medication prescriptions); and 2/ additional important activities from which providers will choose to implement several in the first two years (e.g. provide reminders to patients for needed care or incorporate clinical laboratory results into EHRs). The regulation also specifies the rates at which providers will have to use particular functions to be considered meaningful users.

To support the diffusion of EHRs, the government has funded the establishment of a number of health information extension centers that will assist physicians and hospitals in learning how to better use electronic health records and how to demonstrate "meaningful use". Other programmes have been funded to establish regional health information exchanges, to enable health information to be exchanged (securely) among hospitals and care providers in a particular geographic region.

Source: Blumenthal D.(2010), The "Meaningful Use" Regulation for Electronic Health Record *New England Journal of Medicine* (More information can be found at: http://www.cdc.gov/nchs/data/hestat/emr_ehr/emr_ehr.pdf or http://healthit.hhs.gov).

7 A number of issues have made the implementation of the EHR system difficult. The actors implementing EHRs (i.e. physicians and hospitals) are not those who see the most benefit arising from it (benefits would mostly accrue to insurance companies). This means that organizations that have made most progress in implementing EHR are those who both provide and pay for care (e.g. Veterans Administration).

39. A number of policy instruments have also been developed to mobilise knowledge resources that would be better synchronised with business needs. These are aimed at achieving a greater mobilisation of knowledge to match industrial demand and the (supply of) public research. They typically have two dimensions.

40. The first dimension is a co-operative or collaborative dimension, which is reflected in a move away from traditional "supply push" policies to commercialise and transfer public research results to industry (*e.g.* sale or licensing of university patents) towards a model based on joint development. Such joint development models include public-private partnerships and involve networks of firms and actors outside national borders. The partnership may have a technology or sectoral focus (e.g. electric vehicles, clean car initiatives) but they may also be focused on a global challenge (*e.g.* AIDS). For example, the Australian Federal Government competitive grants programs (Green Car Innovation Fund and Climate Ready) provide matched funding for businesses to develop cutting edge technologies to mitigate the effects of climate change (see Case Study 1, DSTI/IND/STP(2010)1/REV1/ANN). This type of programme is very much a combination of demand- and supply-side instruments.

41. The second dimension concerns the market-based or contractual relationship between public research and demand from the business sector. Firms innovate by drawing on a variety of sources of tacit and codified knowledge. Public research is one source. OECD data show that business funds some of the supply of public R&D (around 6% in 2006), but firms also contract research. But evidence also shows that large firms co-operate more with public research than smaller firms. To facilitate demand-oriented co-operation, especially in SMEs, several countries (including the Netherlands and the United Kingdom) have introduced innovation voucher programmes – which subsidise the purchasing of collaborative research.

42. To better match supply and demand, there is also a growing interest by governments to empower various types of users with the skills, knowledge and platforms necessary for them to become more effective players in the innovation game. Hitherto, firms have largely concentrated on gaining a better understanding of consumers' behaviour and preferences and less on learning from the experiences of the users themselves and the knowledge they acquire through their experimentation of products and services. This represents a new area of potential policy intervention for governments and where policy instruments remain fairly untested or new. A pioneer example in this regard is the Danish Programme for User-Driven Innovation (Box 4).

Box 4. The Danish policy focus on User-Driven Innovation

The Programme for User-Driven Innovation has been introduced over the period 2007 to 2010 to stimulate user-driven innovation in companies and in public sector institutions through grants. It focuses on the three dimensions needed to spur user-driven innovation in organisations: i) helping companies to integrate customer experiences and needs in their product development process; ii) facilitating companies' access to the skills and competencies necessary to assess customer needs (whether through their own employees or through external partnerships); iii) providing firms with the means to accurately make use of user surveys.

For companies to obtain grants, projects must examine user needs in new ways, for example through the introduction of new methods, or through the building of competencies. The programme has a special focus on some areas where Denmark has a strong business specialisation, areas where innovative solutions are needed to solve societal issues, or areas where public welfare is involved (e.g. environment and energy technology, construction, health, design and foodstuffs, childcare and elderly citizens). Projects so far have included developing the use of cell phones for games and exercise, developing products and services for the elderly and developing an all-in-one system controlling the consumption of energy in houses.

The ultimate aim of the user-driven innovation programme is to obtain a significantly higher number of successful innovations -new products, services or concepts - meeting user satisfaction. The aim is also to upgrade the qualifications of employees taking part in the innovation process.

A midway evaluation of the programme highlighted the difficulty of unleashing user-driven innovation because uncovering user needs does not necessarily lead to innovation, innovation from users takes time and requires involvement of top management in firms. The Danish government has recently re-oriented the programme, moving away from broad calls for projects to more focused projects meeting societal needs (e.g. green business development, welfare and healthcare sectors).

2.2 Demand-side policy instruments

43. In addition to general framework policies, targeted demand-side policies to foster innovation are focusing on a range of specific instruments that can help develop markets for innovative products and services. These include public procurement, regulations, standards, lead market initiatives and consumer-oriented schemes (often based on tax measures).

Public procurement

44. The concept of fostering innovation through procurement is not new and some countries have pursued active technology procurement policies for decades. Public procurement has for instance been a key determinant of the emergence of a number of high-tech sectors. In France, public procurement has been used to develop high-speed rail technology and nuclear energy technologies. In the United States, military demand - in systematic conjunction with military R&D programmes – contributed to the development and diffusion of technologies such as Internet and the Global Position System (GPS). However, the potential of public procurement for innovation has received renewed impetus and a range of government initiatives in OECD countries in recent years have aimed at incorporating an innovation dimension into general public procurement:

- Australia introduced a ten point plan in 2007 entitled *New Directions for Innovation, Competitiveness and Productivity*. The role of public procurement was highlighted as an important area to support innovative Australian firms;

- Germany has created a new Agreement on Public Procurement of Innovation by which six federal ministries (interior, economics, defence, transport, environment and research) will promote innovative procurement. All six ministries will publish long-run demand forecasts, engage in continuous market analysis to identify potential new solutions, offer professional training on the legal options to promote innovation, and foster a strategic dialogue and exchange of experiences between procuring agencies, end-users, and industry and procurement agencies on all state levels.

- The Netherlands has introduced measures to make government procurement more innovation oriented, notably through the Public Innovation Procurement (PIP) programme. Currently, a monitoring process is underway to assess the number of procurement cases aimed at finding innovative solutions.

- The United Kingdom has instituted several innovation-based procurement-related policies since 2003. It issued procurement guidance in 2007, *Finding and Procuring Innovative Solutions,* and introduced an Innovation Procurement Plan in 2009, making innovation a key requirement in large facilities and capital programmes.

45. Two levels of public procurement can be distinguished, but are not usually treated separately in the literature.[8] First, there is regular public procurement, which occurs when public sector organisations

[8] The definition and differentiation of public procurement here is based on Edler (2007) and Uyarra and Flanagan (2010).

buy ready-made products for which no R&D is required. In this case, public procurement can be made "innovation-friendly". That is, it can be made more conducive to innovation. Innovation-related criteria can for instance be incorporated in the tender specifications and in the assessment of tender documents. Public procurement can be made more supportive of innovation (or at least not hinder it) for a vast number of products and services purchased by public authorities, from construction, transport, energy and catering services, to health products and equipment.

46. This type of general procurement usually operates in several stages: defining the subject matter of the contract, drawing up the technical specifications and the contractual parameters for products/services, and determining the best bid. This general structure is similar to procurement procedures in the private sector, although public authorities obviously have a set of additional criteria to apply - they have the responsibility to get the best value for taxpayers' money and must ensure that all competitors (including foreign firms) have a fair and equal opportunity to compete for the contract.

47. Secondly, public procurement can also be strategic. This occurs when governments request specific technologies or services for the delivery of public services. This technology procurement (or innovation-oriented procurement) is typically associated with sectoral policies (e.g. transport, health, defence) and therefore generally neither initiated nor co-ordinated by the ministries responsible for innovation. Public technology procurement involves purchasing a not-yet-existing product, service or system, which could be developed within a reasonable amount of time, based on novel technological development work on the part of the companies or institutions responding to the call for tender (Edquist and Hommen, 2000). Ideally, functional requirements of demanded products are predefined by government (e.g. a defence department requiring equipment with new functionalities).

48. A third modality - which differs from the procurement of other goods and services for public use - is when the public sector directly procures R&D to support the activities and decisions of government and public authorities. This is the case of pre-commercial procurement of R&D (with no guarantee that the public sector will buy the goods or services developed), which has been implemented for many years in the United States through multi-stage, multi-competitor R&D programmes, not only in the defence sector, but also in areas such as energy, transport, health and in the cross-sectoral Small Business Innovation Research (SBIR) programme (see Annex 1 for examples of SBIR-type programmes). Here innovation-oriented public procurement is designed the help counter gaps in the supply or risk finance for small early-stage ventures. In some cases, procurement is structured to offset biases against SMEs in public procurement. This is for example the case in Korea where there is a guarantee for SMEs that government will purchase developed innovations (see Case Study 7, DSTI/IND/STP(2010)1/REV1/ANN).

49. Finally, there are procurement strategies where the state buys, not only to fulfil its own original mission, but also to support private purchasers in the decision to buy. Catalytic procurement for instance occurs when the state is involved in the procurement, or even initiates it, but the purchased innovations are ultimately used by private end-users. In order to ensure a wider social benefit from a specific procurement, the supplier firms must however subsequently find buyers in the wider public or private market (Dalpé, 1994). This can be challenging, as public sector demand may be different than, complementary to, deeper than or anticipatory to private demand. This approach to public procurement was for example adopted in Sweden to boost the production, improvement and diffusion of energy-efficient technologies. The Swedish energy agencies NUTEK and STEM implemented a complex policy scheme with a technology specific mix of instruments. Public procurement was used as an ice-breaker and catalyst and was followed by a mobilisation of private demand through a whole set of awareness measures, organised discourse with users and – in selected cases – complemented by direct subsidies to procurers. The instrument mix and the targeting of specific markets was not equally successful for all technologies, but evaluations showed that for many technologies market diffusion had significantly accelerated (Edler and Georghiou, 2007; Neij 1999).

50. The rationale for using public procurement to support innovation is that, because of their purchasing power, governments shape innovation directly and indirectly. They can foster innovative activities within firms - firms benefit because procurement can help them recuperate the sunk costs of large and sometimes risky investments over a pre-determined period of time. And by creating a signalling effect as a lead user they can also influence the diffusion of innovation (the expectation of course is that an advance in innovation caused by procurement policies will translate into benefits for the domestic economy, rather than for overseas suppliers of innovative goods or services).

51. Innovation-oriented public procurement can be justified on a number of grounds (Edler and Georghiou, 2007). Firstly, procurement of leading edge products and services potentially allows the improvement of public services and can contribute to better achieving public missions. The delivery of essential public services can also become more cost-effective as new innovations are diffused and integrated throughout the public sector. In many cases, the new products or services may also enable governments to develop their own innovations to improve process efficiency and enhance the quality and availability of public service delivery.

52. Secondly, innovative public procurement can be used as an instrument to reach public policy goals such as sustainability or energy efficiency. Through the use of public procurement, governments can develop a market for a new technology that is considered important for the achievement of policy challenges that are time-bound. Here public procurement acts as a market-stimulating instrument, transforming new needs into demand. This goal of public procurement is exemplified in the search for commercial-scale low carbon emission technologies.

53. Public procurement can take different forms and procurers can influence the degree to which demand is dedicated or generic, more or less standardised or specialised. Uyarra and Flanagan propose a fourfold typology of public procurement (Table 3 describes the risks associated with the use of each procurement type):

- *Efficient procurement:* procurement of standardised products serving a generic market: (common preferences, large number of purchasers, little need for variety from end users, e.g. office supplies);

- *Adapted procurement*: procurement addressing specific demand niches, but employing known production methods and practices: (new or more complex requirements e.g. customised software);

- *Technological procurement:* procurement encouraging new technical solutions to meet a generic need: (e.g. waste management);

- *Experimental procurement*: procurement with adapted technological solutions: (e.g. specialised technical equipment).

Table 3. Procurement types and possible effects of public sector interventions on innovation

	Role of the Public sector	Main motivation of procurement or award	Potential innovation type	Innovation-related risks on the supply-side	Geography of procurement
Efficient procurement	Large efficiency-driven user	Best value for money	Incremental	Overdependence on public markets, risk of obsolescence	Centralised specifications (standard)
Adapted procurement	Niche user	The best adapted solution	Market niche	Market uncertainty	Regional specifications, regional procurement
Technological procurement	Large (sophisticated) customer	The best available solution	Architectural	Insufficiently reliable demand to justify investment	Centralised specifications, national procurement
Experimental procurement	Experimental (lead) user	The most innovative solution	Radical	Market uncertainty, difficult user-producer communication, insufficient incentives (e.g. IP protection)	Regional specifications, national procurement

Source: OECD adapted from Uyarra and Flanagan, 2010.

54. The use of public procurement to stimulate innovation involves a number of challenges. Public procurement must be designed to be efficient and to not distort competition. Thus, the design of pro-innovation procurement mechanisms, as with traditional procurement, must avoid the risk of capture by large firms and/or other anti-competitive effects, including across borders. An additional challenge for governments is that procurement itself is often highly fragmented across local, regional and national governments agencies.

55. Some OECD countries have issued guidelines to favour innovation-oriented procurement (e.g. United Kingdom), while others (e.g. Finland see Box 5) have even introduced funding instruments to encourage government agencies to undertake innovation-oriented procurement. Also in Germany, the method of "best available technology" in Green Public Procurement (GPP) has long been used to facilitate innovation in environmental sectors and has helped make German companies a world-leader in this sector (Blind, 2004).

Box 5. Funding innovation-oriented procurement in Finland

Finland's broad-based Innovation Strategy*, adopted in 2008, emphasizes the role of the public sector in developing, applying and introducing innovations. Demand and user-driven innovation policy is one of four key areas in the national innovation strategy. Annual public procurement in Finland amounts to some EUR 23 billion (USD 32 billion), offering considerable purchasing power with which to promote and encourage innovation. The 2010 *Action Plan for the implementation of demand and user-driven innovation policy* includes several proposals for enhancing demand for innovations through public procurement. These consider: the development of central and local government procurement procedures and methods, strengthening the role of actors supporting public procurement and examining different incentive and risk management models. In addition, the Government public procurement strategy** was revised in 2009 and includes guidelines for promoting innovation in government procurement (*e.g.* by encouraging the search for innovative solutions together with suppliers).

Under the management responsibility of Tekes, a procurement funding instrument was launched in June 2009 to provide incentives for promoting innovation through public procurement. Public procurement units and public utilities (at central and local level) can apply for funding for public procurement of innovations. Tekes funds can be used both for the planning and R&D stages. External advisors can be utilised in the planning stage (*e.g.* in legal, commercial and technological as well as user experience issues) in order to support the procurement process.

During the first year of operation of the funding instrument, Tekes has focused on areas such as energy, environment, construction and health, as these are considered important to meet future demand and address societal challenges. However, activities in other areas are also eligible for funding. To date, 12 projects have been accepted for

funding. Projects mainly focus on local authority services, especially in the social and healthcare sectors. Sustainable development and energy efficiency are objectives in a few of the projects.

Preliminary surveys show that interest in the funding instrument has emerged more slowly than expected, in part because the funding target group is a new group of customers for Tekes. Finally, the criteria for obtaining funding from Tekes are stringent: they require that goods or services procured must either be entirely innovative (not available on the market) or that the procurement results in new forms of public service delivery.

Note:*http://www.tem.fi/index.phtml?l=en&s=2411;**http://www.vm.fi/vm/en/04_publications_and_documents/01_publications/08_other_publications/20091008Govern/name.jsp.

56. A further consideration is that the procurement of innovation entails a number of distinct risks (above and beyond those entailed in all procurement procedures). The European Union (2010) identified major risks associated with the procurement of innovation, including the following:

- Technological risk – that is, non-completion risk stemming from technical features of the good or service to be procured. One option to address this risk is contract design, for instance by using cost-reimbursement or incentive contracts. As compared with procurement of standard off-the-shelf items, uncertainties inherent to innovative items create difficulties in writing contracts that frame incentives to reduce or eliminate risk. For instance, the expected quality of a wholly new item might not be verifiable beforehand. Another approach is to use framework agreements or multi-stage procurement processes. The latter effectively restricts the degree of competition in the final stage of the process, while giving opportunities to screen out more risky bids during early stages of the procurement. The report also recommends involving potential users in the process, although difficulties can arise with respect to the permissible extent or timing of any pre-contract interaction with suppliers.

- Organisational and societal risks – that is, risks stemming from within the procuring organisation and/or those related to uptake of the good or service by users. The former can stem from such issues as inadequate absorptive capacities in procuring institutions or incompatibilities with existing technologies or routines. Such risks can be addressed through joint foresight exercises with public and private lead users as well as early user involvement in the procurement process. Transparency of procurement goals should also be maintained, and caution should be exercised if procurement involves prompt introduction of significantly new technologies to an institution.

- Market risks – these risks exist on the side of both supply and demand. On the demand side, risks are greatest for wholly novel items. Public bodies might reduce such risk by implementing additional demand-side measures, such as user training schemes or using demand aggregation, in particular by bundling public demand. However, possible downsides of aggregating procurement contracts – such as limiting the opportunities for SME participation - may also need to be countered. On the supply side, the main risk is that suppliers do not respond to the tender. To mitigate this risk, market intelligence capacities should exist, developed for instance through structured exchanges with internal or external experts.

Innovation-oriented regulations and standards

57. Regulations and standards play important roles in structuring markets for goods and services. There is often complementarity between these instruments: regulations set the essential levels of safety, environmental or health protection and are frequently complemented by harmonised consensus-based

standards-setting on technical specifications. This allows other economic actors to collaborate with public authorities to design the most appropriate implementation standards and to regularly update them to take stock of evolving needs and technical progress. In Japan, for example, METI's Top Runner programme involves a dynamic process of setting and revising performance standards by taking the current highest energy efficiency rate of products as a benchmark in 21 product groups. This flexible setting of benchmarks creates positive incentives and competition among manufacturers to quickly improve their product performance, without calling on public financial support (Box 6).

58. For some time, much of the policy attention given to regulation has not been concerned with innovation. Rather, the focus has been on the ways in which regulations influence overall framework conditions, in particular their effects on burdens for doing business and on the functioning of market signals. This subject is not treated in detail here, save to say that competition and firm entry are clearly central to innovative activity and that well-functioning product and labour markets enhance the adaptability of firms and lower the chances of becoming locked in to given technologies.[9] Lower administrative burdens also facilitate business creation, an important seedbed for innovation. The focus in this section however is on regulations that have some sector- and/or innovation-specific intention or effect. In many cases, regulations play a key role in areas where market-based instruments are not effective in influencing market behaviour.

Box 6. The Japanese Top Runner Programme

While in many countries the energy efficiency of electrical appliances is controlled by minimum efficiency standards, Japan has adopted a more ambitious model of standard setting to save energy with the Top Runner programme. Developed in 1999 and under the realm of the Energy Conservation Law, the programme sets targets for product categories (*e.g.* cars, television sets, computers, fluorescent lights or air conditioners). For each category, the most efficient model currently on the market is used to set the standard to be attained within four to eight years. By the target year, each manufacturer must ensure that the weighted average of the efficiency of all its products in that particular category is at least equal to that of the top runner model. The top runner standards are set by committees with representatives from the manufacturing industry, universities, trade unions and consumer organisations. This framework commits stakeholders subjected to the regulation through involvement in common standard setting. The framework also takes consumers' perspectives into account.

Despite weak legal leverage the programme achieved good results in incentivising manufacturers to develop more energy-efficient equipment: failure in reaching, or attempting to reach, targets is publicised and harms the brand image of the company. Consumers are also made to assume a role. A complementary energy-saving labeling system has been introduced to inform consumers of energy efficiency of home appliances and promote energy efficient products. Products that do not meet the target are not withdrawn from the market, but receive an orange label, while products who achieve the top runner standard receive a green label. The most common critique directed at the Top Runner Programme however, is that the approach encourages incremental improvements, as more radical innovations receive no incentives under the scheme.

Regulations

59. Regulation refers to the implementation of rules by public authorities and governmental bodies to influence the behaviours of private actors in the economy. Regulation influences innovation indirectly,

[9] Aghion *et al* (2002) find evidence that the degree of product market competition bears an inverted U-shaped relationship to innovation. Aghion *et al* (2009) also found evidence that the threat of technologically advanced entry spurs incumbent innovation and productivity in sectors close to the technology frontier.

since it affects the framework conditions for firms and involves no direct outlay of public funds (Geroski, 1990).

60. Regulations can affect the performance (quality, compatibility) or consequences (health, safety, the environment) of products or services (*e.g.* labelling, recycling regulations, emission standards etc.), thus having a direct impact on demand for innovative goods and services. Metcalfe and James (2001) note the importance of regulation in the area of medical devices, where public policy has been critical in shaping innovation processes in Europe and in the United States. The Promotion of Renewable Energies Heat Act (2009) in Germany is an example of regulation that promotes the diffusion of innovation. The Act stipulates that owners of newly-constructed buildings must use renewable energies. Moreover, building owners who use particularly efficient innovative technologies, or that have low emissions figures, will receive funding from the state. In addition, positive innovation-related effects of regulations for firms can also stem from the increased acceptance of new products by consumers. However, the effects of economic regulation on innovation are far from straightforward, and can be ambiguous *a priori*.

61. Mahdi *et al* (2002) review the impact of health, safety and environmental regulation on the chemical industry in Europe. This study was spurred by concerns that the more stringent regulatory conditions in Europe would retard innovation relative to competitors in the United States. But their findings indicate that rates of new chemicals notification between Europe and the United States had experienced convergence over the previous decade. Their review of the literature suggests that in most cases regulation both inhibits and stimulates innovation. They conclude that "Despite a long tradition of research on the question of how regulation influences innovation in different industries and in different countries, it is far from clear where the balance between these two effects falls".

62. The impacts of regulation on innovation are likely to be highly technology and industry specific; some evidence shows that anticipation of regulatory change in some sectors has induced innovation. Studies of asbestos product development (Ashford *et al* 1985) and SO_2 removal technologies (Taylor *et al*, 2005) are cases in point. However, Nemet (2009) examined wind-power technologies and found that an array of demand-side policies in California had not spurred significant innovation, in part because a dominant industry technology had already been identified.

63. To assess the appropriateness of regulatory policy targeted at a specific sector, analysts also need to explore whether the market would introduce the right level technology in the absence of the regulation. For instance, with respect to regulation on fuel efficient vehicles, if the market were efficient in terms of fuel economy technologies the regulation could be redundant. Whether the market is efficient or not will likely have industry-specific considerations.

64. The precise form that the regulation takes will also affect its impact on innovation. For example, uncertainty in the duration of a regulation could reduce the strength of influence on demand conditions. And in the United States the Corporate Average Fuel Economy (CAFE) regulation introduced in 1978 was framed in such a way that increases in average vehicle fuel efficiencies could be achieved through manufacturers changing relative car prices so as to sell fewer large cars and more small cars. Regulations in the United States enacted in the 1970s and governing energy efficiency in refrigerators served to increase efficiencies over time, but only up to levels already existing in equivalent appliances in Europe. No technological innovation was seen initially. And in the environmental sphere, the empirical evidence suggests that market-based instruments such as tradable emissions permits are more likely to stimulate innovation than direct regulations such as technology-based standards (OECD 2010a).

65. OECD (2010a) provides additional evidence on the role of regulation in encouraging innovation. This work, based on patents data, considers the characteristics of environmental policies – including direct regulation - that are likely to induce innovation. The authors observe that, when considering environmental

impacts, it is important to take account of the specific design characteristics of different instruments (whether market-based or regulation-based). Thus, they note that to induce innovation, the ideal policy instrument will be one which is:

- sufficiently stringent to encourage an optimal level of innovation;
- stable enough to give investors adequate planning horizons for risky investments;
- flexible enough to encourage innovators to create genuinely novel solutions;
- closely targeted on the policy goal, so as to avoid misallocation of innovative effort;
- provide incentives for continuous innovation.

66. The potential innovation stimulus delivered by market-based and regulation-based instruments needs to be assessed against these criteria. As this work makes clear, there is no automatic correspondence between the type of instrument and the critical design attributes. For instance, different environment-related taxes can have different combinations of these design attributes, and a regulatory standard might have more in common with a tax than a technology-based standard.

67. A further critical consideration is that even in cases where regulation spurs innovation, regulation-based policy might be cost-ineffective overall. Kleit (2004) provides a detailed economic cost benefit analysis of the vehicle efficiency regulations in the United States. The analysis shows that a small increase in the gasoline tax would deliver equivalent savings in fuel consumption but at a much lower cost to society (in part because the regulation lowers the marginal cost of driving and thus induces more driving, with concomitant increases in pollutant emissions, accidents and congestion).

68. The time period over which policy yields impact might also vary from one regulation to another, again reflecting industry specificities. Greenberg *et al* (1979) found a six year lead period in the ammonia industry and were unable to identify specific regulatory effects using an econometric model.

69. It can also be relatively difficult to isolate the specific effects of regulation from other influences. This reflects the inherent complexity of the pathways by which regulation might shape innovation, the possibility of long lead times between a regulatory stimulus and an industry response, the simultaneous impacts of an array of supply-side factors, as well as inherent uncertainties in the dynamics of innovation (including exhaustion of the research frontier).

Standards

70. Standards are documents based on various degrees of consensus (industry wide, national, regional or international) which lay out rules, practices, metrics or conventions used in technology, trade and society at large. They range from proprietary standards (e.g. exploited by a company and based on patented technologies) to formal international consensus-based standard (e.g. those produced by the International Organisation for Standardisation, ISO). The scope of standards cuts across all areas of economic, environmental and social issues. They can for instance specify terms and definitions, codes, dimensions, physical interoperability, product and service safety and quality (Bryden, 2010).

71. The economic benefit of standards has become clearer to policy makers in recent years. A study in the United Kingdom by the Department of Industry and British Standards Institution (BSI) has estimated that standards make an annual contribution of GBP 2.5 billion (USD 3.9 billion) to the national economy. Similar studies in the United States, Australia or Canada corroborate the benefits of standards.

72. There are multiple routes through which standards can affect innovation and other economic outcomes. Standardisation helps create critical mass in the formative stages of a given market. Standards can focus demand for innovations that might otherwise be spread over multiple technical solutions. Standards are especially important in network industries, such as ICTs, in that they can facilitate a critical mass of users. In this connection, standards ease the emergence of technological platforms - independently supplied yet inter-operable components with shared technical standards. Many successful platforms, such as the Internet and the cellular telephone, are based on open standards. Swann (2000) provides a comprehensive review of the literature on standards, which includes evidence that successful standardisation can have some of the following effects on innovation:

- Standardisation drives innovation because innovation requires competition and competition requires interoperability. Successful standards facilitate that interoperability.

- Standardisation can increase trade.

- Standardisation codifies and diffuses information on technology and best practice. By setting ground rules, common terminology, development methods and measurement techniques, standards enable the diffusion of innovation. Publicly available standards in particular have a potentially powerful effect on the dissemination of information about technology, from both domestic and international sources. In some markets - such as automotive parts supplies, flat screen TVs and mobile telephony - quality certification and consumer safety rules are important role in shaping demand and the diffusion of innovations.

- Standardisation reduces risks for producers and consumers. For instance, standardisation of measurement helps producers of innovations demonstrate innovative traits to consumers. And standards lower the risk of investing in a redundant technology.

- Standardisation reduces transactions costs between producers and between producers and consumers.

- Standardisation may protect against situations in which high-quality producers are driven out of the market by low-quality producers because information is not fully available to consumers on the quality content of their output (Gresham's law).

- Standardisation may efficiently reduce unnecessary variety among products (in construction, for instance, there might be no need for production of a continuous variety of steel girder widths).

73. There is a clear trend towards standardisation work being conducted at the international level because, in a globalised economy compatibility and interface across borders are important. Countries and firms that play primary roles in setting international standards can enjoy advantages from doing so, to the extent that the new standards align with their own national standards and/or features of their productive base. Broader participation of stakeholders is expected to lead to better quality standards, but takes longer to effect (it takes about 3 years on average to produce an international standard).

74. The public sector's role largely involves measures to include under-represented groups in the process of developing standards, and support for the process of preparing international standards. In the United Kingdom the government has provided GBP 2.5 million in direct support for standards development in emerging technology areas - Box 7 presents the case of government support for standardisation in the area of biometrics. Unlike regulation, the setting of standards is mainly the responsibility of industry bodies – with government acting as facilitator or coordinator.

Box 7. Standardisation in the United Kingdom

In his report, *Race to the Top (2007),* Lord Sainsbury recognised that interaction between standards and innovation is key to stimulating research, establishing communication networks and encouraging industrial development – all prerequisite steps to the commercialisation and widespread uptake of new technologies. He recommended greater collaboration within the United Kingdom standardisation infrastructure in order to better co-ordinate support for emerging industries.

Since the publication of the 2007 report, the United Kingdom has provided GBP 2.5 million (USD 3.9 million) in direct support for standards development in emerging technology areas through the Department for Business, Innovation & Skills (BIS). Biometrics, nanotechnology and regenerative medicine were jointly identified in 2005 by BIS' predecessors as areas to benefit from funding for standardisation. A preliminary study of the impact and effectiveness of these key emerging technologies was carried out by Ernst and Young on behalf of BIS. The findings of the study indicate that this support is appropriate and beneficial and that Government should develop the model and apply it to other emerging technologies as appropriate.

The case of biometrics

A biometric system is a system for the automated recognition of individuals based on their behavioural and/or biological characteristics. Wherever there is a need to identify or verify a person there is a potential application for biometrics. This includes entry control to buildings and secure areas, as well as access control to resources such as bank accounts and entitlement services.

The United Kingdom government decided to support standardisation in the area of biometrics, and technical standards supporting interchangeability and interoperability. The objective was for standards to reduce the risk for the procurer, system integrator and the end user, because they simplify integration and enable vendor substitution, technology enhancement and development.

The Government's support of biometrics standardisation in the United Kingdom had several aims:

- to open public procurement contracts to competitive tender through reference to standards, in turn facilitating access for smaller companies and potentially saving public money;
- to create confidence that the United Kingdom's view of biometrics systems development is aligned with international advances in technology (the British Standards Institution provides the United Kingdom's input to the international biometrics subcommittee and its working groups);
- to facilitate information exchange with other national authorities.

An independent 2009 review of standardisation and innovation programmes in the United Kingdom found that funding in the area of biometrics had facilitated the diffusion of technology in the marketplace, made procurement more cost-effective and eased access for SMEs to the procurement market:

- open-systems based standards had saved the United Kingdom Government considerable sums by enabling competition on identity card contracts;
- the use of standards had accelerated progress on biometrics programmes, such as that run by the Identity and Passport Service, and had future-proofed the technology;
- standards had enabled United Kingdom-based system integrators to operate in a fair and open market and had prevented domination by a small number of overseas companies.

There are however challenges linked to standardisation and biometric technologies. These relate in part to the changing global security situation, which may create new demands for work and new calls on public resources. Furthermore, the typical timeframes for publication of standards - at around three years - could conflict with the shorter funding horizons typical of government.

Lead Markets

75. One demand-side tool that has received increased attention in recent years is "lead markets" whereby innovations that are taken up in one market eventually spread and are adopted in other markets; changing the dynamics in lagging markets and fostering further competition and innovation.

76. There are well known examples of lead markets some of which have involved some degree of government intervention such as the development of the GSM mobile telephony standard in the Europe which then was taken up in North America (Beise, et al. 2004). Usually for the creation of a lead market, supply-side measures as well as demand-side measures are combined.

77. In the case of the EU's Lead Market Initiative (LMI) the policy rationale rests on addressing several of the market and systems failures, notably information asymmetries between users and producers and regulatory and standards-related barriers to the adoption and diffusion of innovation (Box 8).

78. At the national level, Germany's recently revised High Tech Strategy has identified four lead markets in *a)* health, *b)* climate protection / resources conservation / energy, *c)* mobility, and *d)* security for promotion over the 2009-2012 period. A key element of the strategy is aligning various policies such as environmental and innovation policies. In Japan, the government's new growth strategy focuses on fostering green innovation and life innovation by combining both demand and supply side innovation policies. Similarly, China's Five-year plan (2011-2015) for economic development targets certain sectors for development including alternative energy, advanced materials and the biomedical sector.

Box 8. The European Union Lead Market Initiative

Promoting the creation of lead markets is a new EU policy initiative focusing on creating demand for innovations. It is the first comprehensive effort at the EU level for coordinated demand-side policy. The initiative aims to provide better conditions for the creation and growth of new markets for innovative products and support the development of worldwide operations by pioneering companies operating in Europe. It is held that the fragmented nature of the internal market and innovation system slows the creation of lead markets in the European Union. Following intense stakeholder consultations, the EU Lead Market Initiative was launched in 6 sectors in 2008: eHealth, protective textiles, sustainable construction, recycling, bio-based products and renewable energies. These markets have been selected because they are highly innovative, address broader strategic, societal, environmental and economic challenges, have a strong technological and industrial base in Europe and depend more than other markets on the creation of favorable framework conditions through public policy measures. The European Commission, Member States and industry work together to carry out action plans for the following 3-5 years in order to facilitate the emergence of new products or services in these 6 Lead Markets. A combination of policy instruments will be used to facilitate the uptake of new innovative products and services, including, regulation, public procurement and standardisation. Some of the demand-side measures identified in the "roadmaps" include:

- *Bio-based products:* Elaborate new European standards for bio-based products. There is a lack of suitable European standards for this sector and two standardisation mandates were issued in 2008.
- *Sustainable construction*: Screening of national building regulations to provide orientation towards more convergence on local building regulations with respect to EU legislation.
- *Protective textiles.* Promote innovation in clothing for public service delivery (e.g. fire-fighters, emergency services, police forces by establishing networks of public procurers ('contracting authorities') in protective textiles.

A mid-term review of the LMI highlights 3 key policy lessons, namely 1) the need to build bridges among suppliers, customers and stakeholders; 2) the greatest impact may be medium-long term; and 3) the need to make the initiative visible.

Source: van Eijl and Herrmann presentation at the Joint CSTP-CIIE Workshop on Demand-Led Innovation, 14-15 September 2009.

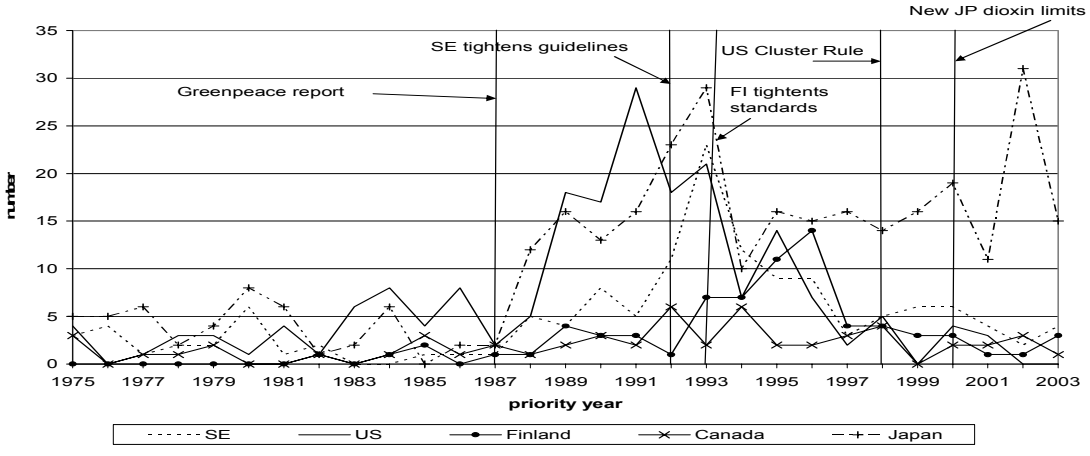
Consumer policies

79. Understanding the cultural, economic and social intricacies of different consumer markets and how certain products and services are constructed, particularly, through their mode of provision, manner of access and delivery, and through the social context of their consumption, helps policymakers understand how consumer preferences are shaped and how their needs are expressed and met. For example, a recent OECD Household Survey on Environmental Behaviour found that there are strong links between environmental preferences and the type of purchases people make, which explain significant differences between countries (OECD, 2010d forthcoming). Home owners and those concerned with the environment tend to invest more in environmentally friendly products and services (*e.g.* energy efficient light bulbs and electrical appliances) than those renting a property.

80. Regulation and standards are frequently used to channel social and cultural expectations into the process of introducing new goods and services. But information campaigns and awareness are also used as instruments to change and influence consumer preferences and behaviour, which in turn can translate into public pressure to introduce new regulations or set certain standards, which can also provide an opportunity for businesses to innovate. For example, much of the early demand for reductions in chlorine came from consumers, rather than from regulators. In fact, patenting activity in the pulp industry suggests that increased public scrutiny played an important role in influencing this first wave of innovation in this industry (Leflaive, 2009).

81. Figure 5 below shows patents granted in each country to domestic inventors, sorted by the first priority year. The data show that patenting increased before regulations were put in place, rather than in response to regulation. These increases occurred even in countries that did not pass early regulation. This suggests that increased public scrutiny played an important role in influencing these first waves of innovation.

Figure 5. Domestic ECF and TCF Patents by Country



Source: OECD (2008), Environmental Policy, Technological Innovation and Patents.

82. With the exception of Canada, every country experienced an increase in Extracellular fluid (ECF) and (transcellular fluid) TCF patents that began after release of a Greenpeace report in 1987. While there was some regulation at this time, the initial regulations were not very strict. Sweden, the first country to pass stringent guidelines, did so in 1992. While the United States did announce plans for strict regulations that would declare TCF to be the best available technology in 1993, the lack of response from

inventors in the United States suggests that this initial proposal was not perceived as credible (this proposal was eventually withdrawn, and replaced by the weaker Cluster Rules in 1998).

83. Public concerns about a lack of accountability in public enterprises after a series of corporate scandals in the United States resulted in a number of regulations that became unintended drivers for innovation demand, such as new privacy laws and the Sarbanes-Oxley Act of 2002 on corporate governance. Both of these regulatory drivers created a need for internal accountability, audit and other systems to help demonstrate compliance. This extended not just to software but accountancy services, and spawned an entire new class of business professionals called Chief Privacy Officers. This being said, while any regulation may lead to new innovations, a question remains as to whether these also improve consumer welfare.

Labelling and awareness-raising initiatives

84. Initiatives to promote education and awareness can help improve transparency and assist consumers to develop the skills, knowledge and confidence needed to improve market outcomes, thereby increasing consumer welfare. In developing consumer awareness, information can be used not only to inform but also to influence consumer behaviour. For instance, government campaigns to encourage healthy eating or discourage smoking are cases in point. This is an important policy instrument that can be used to counter inertia and scepticism towards new goods and services, and helps improve the flow of information between users and developers. To be effective, education and awareness strategies must go beyond addressing information asymmetries in individual transactions: they should help promote critical and active engagement by consumers generally (OECD, 2010c).

85. The key differences between an awareness campaign and an education initiative are the timeframes in which each operates and the depth of knowledge each imparts. Awareness campaigns are generally short-term, media-oriented actions that focus on a particular consumer issue. For example, a campaign may make consumers aware of their ability to choose an energy or telephone supplier or of the dangers of a newly-identified unsafe good or scam.

86. Education initiatives, on the other hand, take a long-term approach, as the focus is on developing lasting skills and/or on bringing about changes in consumer behaviour (OECD, 2009b). Many education initiatives also make use of awareness campaigns as part of their strategy. For example, school children might be taught about financial topics generally, thereby raising their literacy, but this can be augmented by raising the student's awareness of the risks associated with high levels of consumer debt. Such campaigns may promote more considered investment and borrowing decisions in the future.

87. The objectives of consumer awareness and education initiatives are widely cited in consumer policy literature (see, for example, Bannister and Charles, 1983; Hellman-Trutert, 1999). In general the goals could be seen as falling into one of three categories:

- Improving decision-making abilities.
- Raising awareness of consumer rights and avenues for redress when the rights have been violated.
- Promoting more responsible behaviour (for example, in purchasing products which are more environmentally benign).

88. The goals can be pursued in either a generic or specific context (Box 9). The OECD's 2010 Consumer Policy Toolkit addresses consumer policy issues in greater detail.

Box 9. Generic and specific consumer skills

Generic consumer skills: In a 2004 study, the United Kingdom's Office of Fair Trading identified a number of generic transferable skills that consumers require. These include the ability to: *i)* research, assimilate and critically analyse information according to individual needs; *ii)* manage resources effectively; *iii)* assess risk and exercise balanced judgement in making responsible decisions; *iv)* communicate effectively in a wide range of consumer situations; *v)* solve problems where they arise; and *vi)* know when to seek professional advice (UKOFT, 2004).

Specific consumer skills: Education and awareness initiatives can also focus on developing specific consumer skills, whether those skills relate to a particular product, industry or stage in life. For example, the United States Federal Trade Commission's "Deter, Detect, Defend: Avoid ID Theft" campaign seeks to assist consumers in learning how to avoid identity theft – and to learn what to do if their identity is actually stolen (USFTC, undated). A variety of resources have been employed to support this aim, including brochures, consumer education kits and a short audio-visual presentation.

3. THE CHALLENGES FOR DEMAND-SIDE INNOVATION POLICIES

89. Some demand-side policies arguably carry the risk of too strong a government intervention by comparison with policies to stimulate the supply of R&D and foster knowledge spillovers. Also, demand-side policies are fraught with design and implementation challenges. The systemic nature of this form of policy implies that more coordination is needed compared with traditional supply-oriented innovation policy. This means that demand-side measures need to be closely articulated with supply-side measures. However, matching supply with demand is not an easy task and requires building bridges along the value chain, which takes time. Moreover, several demand-side policies imply a lead role for a public sector that is not always best placed to support the innovation process. Thus, new capacities may need to be developed to implement innovation friendly regulations, standards or procurement practices.

90. This chapter presents the strategic and governance challenges associated with the design and implementation of demand-side policies. It also discusses challenges and risks linked to the use of specific demand-side policy instruments.

3.1 Strategic Challenges

91. A demand-side innovation policy framework faces a number of strategic challenges. As with supply-side policies, the first challenge a government faces in the area of demand is determining whether there is a rationale for policy intervention (e.g. societal need and/or market or systems failure), explore the best possible policy option given budgetary constraints, and consider the timing of the intervention.

92. A second challenge relates to the complex value chain of innovation. A typical assumption is that the initiation of an innovation is the most critical phase in an innovation process and that the remaining phases will shape up seamlessly. In reality, many innovations fail to succeed because they require significant complementary investment in competencies and capabilities by a host of other players along the value chain from suppliers to end-users. A weak absorptive capacity along the value chain can thus become a major barrier for innovation and its diffusion (Brandenburger and Stuart, 1996; Afuah, 2000).

93. Thirdly, the inherent uncertainty associated with innovation activities makes it difficult and risky to plan in advance and identify the most appropriate solutions for existing or anticipated needs. The Danish case study on user-driven innovation has shown that inciting firms to uncover unmet customer needs is challenging: it takes time and does not always lead to more innovations (see Case Study 3, DSTI/IND/STP(2010)1/REV1/ANN).

94. Some governments have tried to address this challenge of anticipating demand for innovations by using foresight programmes and by monitoring international developments in markets, science, and technology. Governments also make extensive use of international cooperation and partnership programmes to improve their monitoring and tracking capabilities. Nevertheless, predicting market developments remains extremely difficult and uncertain.

95. Fourthly, government-sponsored drives to stimulate the development of certain innovations to provide socially desired outcomes might encounter so-called ‘technological lock-ins’ (Arthur, 1989) and ‘dominant designs’ (Utterback and Abernathy, 1975). Consequently, an innovation that might have been

considered superior could find itself being locked out by inferior existing products or processes.[10] Alternatively, governments might decide to back a technology or innovation that proves inferior to other existing or emerging technologies.

96. Indeed, some research suggests that the introduction of an entirely new technology, product or service is best served by firms that are not already too integrated in existing value chains and which are not locked into dominant designs or existing technological regimes (Bower and Christensen, 1995; Malerba *et al*, 2007). In fact, established firms might pursue defensive business strategies against unwanted disruptive innovation for different reasons, among which would be the desire to avoid incurring new and additional learning and adjustment costs (Edler, 2006; Afuah, 2000). Some research has found that demand-pull innovation policies have a greater impact on stimulating incremental innovation *(i.e.* modifications) than radical innovation (Mowery and Rosenberg, 1979; Walsh, 1984; Nemet, 2009), which is better induced through technology (or supply)-push policies. This insight underlines the importance of ensuring a high level of entrepreneurial activity across the economy. Recent OECD analysis in the context of the Innovation Strategy, for example, pointed to the important role of new firms in innovation in general, and in more radical innovation in particular.

97. Also, the evaluation of demand-side policies poses particular challenges: how might the evaluator for instance create a control group to assess the impact of a technology-oriented regulation or standard? How can the influence of supply-side drivers of innovation be separated out when assessing the role of demand? For example, technology-oriented regulations could have a positive effect on innovation, but nonetheless be inefficient overall. And how can the secondary benefits of technology-oriented public procurement be properly captured (e.g. increases in private financial support for firms that win procurement contracts).

98. The available literature on the evaluation of demand-side innovation policies is thin (Edler *et al*, 2009). Related to the lack of evaluation experience, good metrics on demand that can underpin the evaluation process are scarce. However, measures such as surveys of consumer attitudes to technology and innovation (*e.g.* EU Eurobaromoter Survey) or manufacturing surveys can be exploited to assess attitudes towards certain demand-side measures such as public procurement. The CIS-4 Survey could be exploited, especially using micro-data, to assess the importance of purchasing, procurement, and other proxies of private demand for technology and innovation. Such data could be useful in measuring impacts such as additionality or behavioural change from demand-side policy interventions.

3.2 Governance challenges

Alignment within government

99. The complexity of the public sector can make it very difficult to achieve internal alignment. The public sector plays an important role in a demand-side innovation policy due to its control of large procurement budgets, and its control of the instruments for formulating regulations and setting technical standards. Multiple levels of government (*e.g.* national, regional and municipal) and the plethora of government departments, bodies and agencies give rise to governance restrictions. Communication, coordination and alignment become very difficult. In addition, budget cycles and budgetary restrictions often give priority to cost considerations rather than innovation objectives.

100. A demand-side innovation policy assumes a more pivotal role for the public administration (*e.g.* through procurement, regulation, setting and certifying standards) and hence puts greater pressure on it to

10. For example: Light water nuclear reactors prevailed over heavy water ones, and the VHS video cassette recorder standard won out in the competitive race over Betamax.

play a leading role in driving innovation. This requires investments in skills and competencies in public administrations, as well as changes to organisation and culture to allow the public administration to play its role as an innovation champion.

101. There are many structural features of government that inhibit risk taking and innovation. These barriers include cost-based budgeting and departmental structures, as well as audit and accountability processes. These create an environment in which uncertainties are significantly reduced, but also one in which the space available for innovation is limited. For example, despite a government drive for innovative procurement in Finland, very few projects have been put forward by the public sector (Lehto, 2009).

102. Furthermore, the globalised nature of business activities and innovation means that governments often need to align themselves with other governments and international bodies. This is particularly so in the area of regulation and standardisation, where fragmentation remains the norm despite significant efforts to remove such barriers.

Alignment with the private sector

103. Demand-side policies face the challenge that they need deep knowledge of the leverage, entry points and barriers to stimulating demand. Decisions must be taken close to public and private users and be informed by knowledge and data on preferences, habits and aspirations. Thus, a demand-side innovation policy will require a closer public-private partnership to achieve a greater alignment of policy instruments, investments, and strategic planning. This requires a shared vision regarding priorities and future orientation between government and businesses. The need for strategic vision has been recognised in some new government demand-side initiatives, such as those in Denmark, Japan, Germany and Finland. The existing experience with forward-looking tools such as foresight and roadmap exercises can also help develop better informed demand-side innovation strategies.

104. Building the necessary partnerships along certain value chains takes time, and requires effective platforms for communication, coordination, and sometimes delivery. The priorities for different stakeholders might vary too, which gives rise to conflict, competition or disinterest. For example, many firms (42%) do not regard public procurement as an important source of business (Gallup Innobarometer 2009, Van Eijl, 2009). And many firms, while recognising the importance of users as test-beds for new ideas, do not recognise their importance as co-innovators (Mahdon, 2009).

Alignment with the social sector

105. The social sector is an increasingly important arena of innovation and demand in socio-economic fields ranging from domestic care to environmental protection. Important actors in this sector are voluntary organisations, charities, not-for-profit, and for-profit-for-social-causes organisations (examples of the latter include the Mondragon group (Spain), and the Third Italy Group). The social sector is growing in importance (for example, 35% of all new entrepreneurs in the United Kingdom are social entrepreneurs, and the estimated size of this market is GBP 42 billion) (Harding, 2008; Murray, 2009). With many of the innovations stemming from this sector (*e.g.* micro-finance) being taken up and amplified in the market and public sectors, social enterprise has the potential to act as a space for experimentation for both private and public sectors.

106. But the fragmentation of actors in this sector makes it difficult for government to coordinate policy. Many social enterprises embody a distributed model of organisation, with spin-offs, networks, and formal collaborations; and governments have yet to identify the right set of instruments that would allow markets in these areas to flourish. The fragmentation and small scale of this sector also make it a difficult to diffuse good practices and ensure a wide take-up of innovative practices (Murray, 2009).

3.3 Challenges linked to the different demand-side policy instruments

Challenges linked to public procurement

107. The notion of public procurement is multifaceted and encompasses the acquisition of a set of very diverse goods and services, from common equipment (such as office stationary) to cutting edge technology equipment (see for instance the case of Gran Telescopio Canarias (GTC) in Spain, Case Study 8, DSTI/IND/STP(2010)1/REV1/ANN). In particular, public procurement for innovation raises important issues of governance and coherence between its primary goal (purchasing quality products and services for the public sector) and its potential secondary goal for governments: support for research and innovation in the public and private sectors. The Spanish government for instance also used the procurement of the GTC - the world's largest single aperture telescope - as a way to promote innovation by fostering supplier capabilities and favouring the creation of spin-offs to commercialise the technology.

108. The traditional focus on value-for-money, as well as the problem of fragmentation of public demand (often between different levels of government) can limit potential scale effects for innovative procurement. Many agencies with responsibilities for public procurement operate separately from line ministries or government agencies with a remit to foster innovation. Also, in many OECD countries numerous sub-national units of government play important roles in the public procurement market. Indeed, almost 60 % of public procurement is implemented at the local level and by social security sectors (OECD, 2002). This in turn creates challenges in terms of governance, coordination and strategic planning and enhances the difficulties in using public procurement as a tool for promoting innovation in a systemic approach (Uyarra and Flanagan, 2010). At the local level in particular, where the procurement system is decentralised and where professional procurers are few, the lacks of skills for innovative purchasing is an important challenge. The Finnish case study for example shows the difficulty to use procurement at the local level to promote innovation: although funding was offered to local governments for purchasing innovative products and services, interest from local governments was relatively limited (see Case Study 4, DSTI/IND/STP(2010)1/REV1/ANN).

109. A further requirement for innovation procurement is to define which markets and technologies to tackle. A major requirement for a strategic procurement policy is to bring future needs and future supply together at an early stage. However, while suppliers need to be given early signals regarding concrete future public demands, there is uncertainty on what suppliers are actually ready to provide in the future (Edler and Georghiou, 2007). In addition, technical expertise in the respective fields of innovation may be lacking in the procurement bodies. On the supply-side, many firms do not see public procurement as a relevant source of business, which can limit the scope of policy action.

110. As discussed in Chapter 2, procurement of innovative products and processes carries a number of risks, such as technological risks, organisational and societal risks, and specific market risks which need to be mitigated. Risk aversion which is traditionally part of the culture in the public sector makes the use of procurement to stimulate innovation challenging. This is especially the case for procurement of innovations from SMEs, which carries even more uncertainty as regards quality and reliability. The Korean case study shows that insurance mechanisms can be an effective way to stimulate innovative procurement from SMEs (see Case Study 7, DSTI/IND/STP(2010)1/REV1/ANN).

111. Finally, in adopting innovation-friendly procurement, several pitfalls need to be avoided. One of these is large-player dominance, as government contracts tend to favour already established enterprises (which have more manpower to respond to government tenders) over new innovative SMEs and start-ups. The risk of large player dominance is particularly high in areas where the potential for learning by doing is high.

112. Public procurement is sometimes also used to exclude foreign competition in specific markets. Procurement has for instance been found to be protectionist through the use of direct or indirect "national purchasing" requirements - in the area of renewable energy, public purchasing power has been used to attract foreign manufacturers and maintain employment in the region[11].

113. Demand-side innovation policy in public procurement also runs the risk of locking in public users along certain technological trajectories and dominant designs. Governments should thus be aware of this problem and remove barriers to entry and or provide support and incentives for new firm entry.

Challenges in using regulations

114. As regards regulation, the policy focus has traditionally been on avoiding and reducing regulatory burdens, rather than on the targeted use of regulation to encourage the emergence of innovations and new technologies, which is challenging to implement. In fact, errors in the setting of key regulations could have far-reaching economic consequences. This is complicated by the fact that the effects of economic regulation on innovation - and the timing of these effects - can be complex and ambiguous.

115. Moreover, the effects of regulation on innovation are likely to be highly technology and industry specific, which implies a need for significant industry-specific intelligence among policymakers when framing innovation-oriented regulations. Such intelligence also relates to the need to assess the appropriateness of regulatory policy in terms of whether the market would introduce an appropriate level of technology in the absence of the regulation. The precise form that regulation takes will also shape its impact on innovation. The case of environmental regulations discussed in Chapter 2, shows that consideration should be given to policy design features such as stringency, predictability, flexibility, incidence and depth.

116. A further critical consideration is that even in cases where regulation spurs innovation, regulation-based policy might be cost-ineffective overall. Other less costly means might be employed to achieve the same goal, and conflicting regulatory goals might also exist. In many markets, market-based instruments, such as tax or price schemes, tend to be more efficient better than regulations. However, in other markets, such as the market for rental housing, regulations are an important complement to market-based instruments. This underscores the importance of performing cost benefit analysis on key regulatory decisions.

Challenges in standards setting

117. The development of standards is likely to experience some degree of market failure, as the market may by itself provide too few standards as this entails fixed costs and while gains may not be fully appropriated by one firm. The public sector's role with respect to standards largely involves measures to

[11] China adopted an "Indigenous Innovation" policy which requires that no less than 60% of the cost of purchasing technology and equipment should be spent on domestic firms. In response to foreign company concerns about market access, the MOST, MOF, and NDRC jointly issued a draft notice in April 2010 making some changes to its indigenous innovation policies. In the Circular 618 released in 2009, to be considered "indigenous innovation," a product must have had a trademark that was owned by a Chinese company and is registered in China; the company must also have full ownership of the product's intellectual property (IP) in China. Under the 2010 draft notice, these requirements have been loosened; a product would be eligible for indigenous innovation accreditation as long as the applying party has exclusive rights to the product's trademark in China and is licensed to use the IP in China. At regional level, the Province of Ontario in Canada has also introduced a "local-content requirement" in renewable energy procurement - it requires that 50% of the goods and services used in a large solar project must originate in Ontario.

include under-represented groups in the process of developing standards, and support for the process of establishing international standards. Unlike regulation, the setting of standards is mainly the responsibility of industry bodies – with government acting as facilitator or coordinator.

118. Yet procedures in standards bodies can be slow and bureaucratic and can be held up by large players, which raises the important issue of timing. If standards are introduced too early it could exclude better technologies. But if standardisation occurs too late then the costs of transition to the new standard could be high enough to slow or prevent diffusion. If product life-cycles are shortening, the issue of timing is likely to raise further concerns in standard-setting. While the broader participation of stakeholders is expected to lead to better quality standards, it takes longer to take effect as it takes about three years on average to establish an international standard. Another limit on the role of governments in standards-setting is that for many technologies, standards are set openly at the international level. Therefore, efforts to impose nationally-based standards through public procurement, for example, are risky and costly due to technology lock-in and the fact that it is difficult to determine *ex ante* the dominant standard given rapid technological change and global market dynamics.

Challenges in fostering lead markets

119. Although lead market initiatives have attracted attention as they involve combing demand and supply policy instruments, government should not underestimate the complexities and challenges entailed in attempting to foster lead markets. Firstly, governments and firms alone do not have enough information to know future market requirements for innovation. For example, at what point in the technology cycle or the development of the market is support for demand justified (i.e. has the market or the technology sufficiently matured). For this reason, knowing when and where to intervene requires bringing together the fragmented information base that lies across different stakeholders (e.g. suppliers, customer, regulators, standards-setting agencies, etc).

120. Second, policies to foster lead markets also require highly specialised knowledge and competencies in government to ensure that the incentives of the different stakeholders are well aligned as well as co-ordination. Third, the long lead time required for implementing some lead market initiatives raises the risk of technology lock-in. Knowing which instruments to use and at what point in the market/technology cycle is also a challenge because policy instruments have different time-frames, for example, standards and regulations. Finally, there are costs associated with co-ordination between and among stakeholders. These costs may increase at the international level due to differences in national legislation, product standards, public procurement rules and consumer preferences (i.e. high per capita income and/or low price elasticity).

Challenges in using consumer policies to foster innovation

121. Traditionally consumer policies have focused on protecting consumers rather than encouraging them to consume certain products or services. Over the past decades, consumers have become more active in the innovation process- enabled by consumer education, competition policies and the spread of ICTs. Using consumer policy as a means to encourage consumption (demand) for certain innovative goods, however, can be at odds with consumer choice and democratic processes. For instance, because both the benefits and risks of innovation accrue directly to the users, consumers are in the best position to assess their own risk tolerance as well as the risks that they undertake in using or purchasing certain technologies or services. And while enhancing the education of consumers can help them better assess their benefits and risks, in practice, consumer education takes a long time to diffuse. Another relates to aligning consumer policies with other measures such as product market regulations, standards setting, quality certification and tax incentives (e.g. lack of stability of government tax incentives for green purchasing).

4. KEY MESSAGES AND RECOMMENDATIONS

122. The likely success of demand-side policies will depend on a number of factors: policy measures need to be clearly targeted and take into account sector and market specificities. The most promising level for demand-side policy making is thus perhaps the sectoral level, as it is easier to match demand-side policies with supply-side policies in a specific sector. The combination of different policy measures to support demand for innovation also makes policy co-ordination and good governance essential.

123. The different case studies reviewed in the Annex to this report reflect the considerable interest in demand-side policies in a number of OECD countries. However, they also show that demand-side innovation policy measures are often still at a pilot stage and lack of evaluation, which makes evidence-based policy making a challenge. This chapter draws on the academic literature in Chapters 1 and 2 as well as on the evidence gathered from the country case studies (see DSTI/IND/STP(2010)1/REV1/ANN) to present the main findings and principles for demand-side innovation policies.

4.1 General principles for demand-side innovation policy

Assess the rationale and opportunity for intervention

124. Policies in support of demand ought to operate mainly indirectly to address market distortions (e.g. through macro-economic policy, competition policy, tax policy or entrepreneurship policy). The key issue in fostering demand for innovation is to get "prices right" and to remove general barriers that affect the expression of demand and the market uptake of innovations through the creation of favourable framework conditions for innovation.

125. In some cases, however, removing such general barriers may not be sufficient and there may be a case for providing incentives through more targeted demand-side policies, using subsidies, tax credits, public procurement, regulations or other instruments affecting demand. Because government is but one of several actors that influence demand, policy makers should always consider whether the action undertaken is efficient from a market and budgetary point of view and whether it improves social welfare.

126. Governments should also be cautious in planning and implementing targeted demand-side innovation policies: they should be clearly focused on meeting their policy objectives and evaluated for impact. Also, a government drive to stimulate the development of a certain innovation to provide socially desired outcomes might encounter "technological lock-ins". This can be observed in many OECD countries in areas requiring large-scale investment in R&D and infrastructure, such as ICT and transportation. Rather, government should use demand-side innovation policy as a tool to remove barriers in innovation value chains and should avoid picking winners.

Consider market and sectoral differences

127. Stimulating demand for innovations will undoubtedly have to take different forms, depending on the different markets and technologies. Thus, there is a case for pursuing some of the questions and issues raised above through a sectoral or technological lens. Because of market characteristics and consumption

requirements, demand for innovative goods and services in the automobile sector will obviously be expressed in different ways from demand for innovation in the health sector. In the environment and energy sectors, the obstacles to stimulating demand for innovation may require a variety of tools - from changes in regulations and tax settings to public procurement (*e.g.* municipalities purchasing electric cars) and infrastructure. In the defence sector, in which demand by government is critical, procurement can be a major part of demand-side policies.

128. Market structure also matters. The experience of the Belgian Pilot Project in Flanders (see Case Study 2, DSTI/IND/STP(2010)1/REV1/ANN) shows that market structure (in this case an oligopoly) is likely to affect the legal framework for innovative procurement. Therefore, analysing the role of public policy in influencing demand for innovation and market creation through a sectoral perspective is necessary to identify more specific and practical policy messages. In all cases, government policy needs to carefully consider the rationale for policy action: just because government can take policy action does not imply that it should.

Match and combine demand with supply-side innovation policies

129. As discussed, neither supply-side nor demand-side policies can be very effective in isolation. Fostering innovation requires addressing the entire innovation chain through policies aimed at increasing the opportunities for new value creation. Although the benefits of innovation emerge only when new technologies and innovations are adopted in the market place, most policy interventions are still supply-oriented and aim at generating new technologies and innovation.

130. Experience suggests that demand-side policies have the highest leverage when combined with sectoral policy goals. There is hence a need to mobilise sectoral ministries and agencies for the broader innovation agenda. Public-private partnerships are one way to link sectoral missions with market demands and opportunities. Other examples of policy instruments to match demand and the (supply of) public research include cluster policies, technology platforms, voucher schemes for SMEs in the Netherlands or SBIR-type schemes such as the Smart SMEs Market Validation Program (MVP) recently implemented in Australia, with the aim to link R&D grants for SMEs research to market demand (see Case Study 1, DSTI/IND/STP(2010)1/REV1/ANN). Demand and supply policies should not stand in isolation, but need to be joined up if they are to be effective.

131. For the success of demand side policies it is important to structure programmes by combining the relevant instruments. Recent measures included in the crisis-response stimulus packages in the energy sector for instance resulted in several failures[12]. Thus it may be necessary to combine government subsidies with performance standards that ensure that the subsidies meet their objectives. In Germany, the subsidies granted for the renovation/replacement of windows and heating systems, as well as for thermal insulation of the outer walls, were accompanied by new regulations setting performance standards. To ensure a certain level of quality on the technical level the regulations also stipulate that the renovation work must be carried out by professional companies.

Develop mechanisms to enhance government coordination and stakeholder involvement

132. A demand-side policy requires the vertical and horizontal alignment of demand and supply policy instruments in order to respond to potential supply restrictions and market related barriers. Vertical alignment involves multiple levels of governance ranging from central government departments to delivery

[12] For example, incentives for developing solar plants in Spain have been stopped because solar plants installed were of low-quality and poorly designed. In Australia, the home insulation programme was ended in 2010 because it was found that poorly executed home insulation had led to fires and injuries.

agencies specific to regions or sectors. Horizontal alignment involves the coordination of policies and instruments across government departments. A whole-of-government approach, which goes beyond ministerial/regional boundaries, is arguably needed for cross-governmental coordination.

133. In addition, as discussed in Chapter 3, for demand-side policies to be successful, alignment needs to be achieved with actors outside government, particularly in industry and increasingly in the social sector. While alignment both across government and between government and other economic and social players is not easy to achieve, there are a number of administrative or policy tools that governments can use. One of these is joint advisory councils with business, economic and social representatives to help support and foster strategic alignment between the different sectors in the economy. The starting point for strong coordination appears to be an explicit vision linking different levels and sectors of government (this was for instance achieved in the United Kingdom as regards public procurement).

Evaluate demand-side innovation policies

134. Demand-side innovation policies should be carefully and regularly evaluated for impact. Evaluation is essential to enhance the effectiveness and efficiency of policies to foster innovation and is key for the legitimacy and credibility of government intervention in innovation processes. With the broadening of innovation policy to new instruments, improved approaches and methods for evaluation will be required. However, as this is a new policy area, there is little direct experience to draw on to date, with the exception of public procurement.

135. Demand-side innovation policy should adopt a longer-term technology–neutral perspective rather than short-term political considerations. For example, although fostering innovation in renewable energies is politically visible, investment in more energy-efficient technologies such as smart-grids might have greater techno-economic merits from a societal view.

4.2 Encourage public demand for innovation

Stimulate innovation-friendly public procurement

136. Because of their purchasing power, governments can shape innovation: well-designed approaches that set aside specific public procurement budgets for higher risk development contracts can have long-term social benefits. However, despite the fact that public procurement accounts for around 16% of GDP on average in OECD countries and a higher ratio in non-OECD countries (OECD, 2009), only a very small part of procurement explicitly considers innovation. Providing clear guidance, tools and support can help clarify the scope for public agencies to foster and benefit from public procurement of innovation (*e.g.* considering functional specifications, in market studies, including innovation into selection and evaluation criteria, *etc*).

137. This is for example the approach followed in the United Kingdom where government departments are required to establish and develop an Innovation Procurement Plan. In such a centralised procurement system, formal procedures such as regulation and guidance can work to make public procurement more innovation-friendly. In more decentralised systems on the other hand, incentives, collaboration and platforms could prove more efficient to enhance innovation procurement. As the case study on the European Union (innovative public procurement under the LMI) shows, the creation of networks of public procurers can help for the setting up of common learning platforms and for the exchange and consolidation of expertise in procuring innovative goods and services (see Case Study 7, DSTI/IND/STP(2010)1/REV1/ANN).

138. Finally, it is important that innovation goals be balanced against the need for competition, transparency and accountability in public procurement. As large player dominance is a risk linked to public

procurement, governments should take measures to ensure this does not occur, sourcing competitively from different firms and preventing discrimination against SMEs in public procurement. To avoid large player dominance and protectionism, OECD countries should also adhere to national competition and public procurement rules as well as related international standards and obligations (*e.g.* the WTO Government Procurement Agreement).

4.3 Stimulate private demand for new market creation

Provide adequate incentives through regulation, pricing, taxation and competition policy

139. The needs, wants and preferences of users and consumers are becoming the key drivers of innovation. It is the absence of a market, or the low level of development of a market, that leads to a lack of demand for products and innovations. In some cases, what may appear to be a lack of consumer demand for a product may be caused by a lack of understanding of a product and/or its functionality. Government therefore also plays a role in shaping the behaviour of consumers and thus affects private demand.

140. Under certain circumstances public sector actors may be well placed to play the role of lead users. But even in these cases private demand is needed to sustain a market. The development of lead markets can help innovating firms achieve critical mass and competitiveness, bring prices down and encourage further diffusion and adoption of innovations.

141. In the case of subsidies timing of intervention should be carefully considered. The development and implementation of appropriated incentives guaranteeing a specific level of support to different technologies should reflect diverse degrees of technology maturity. For less mature technologies such as solar photovoltaic that have not reached a critical mass and thus have not achieved cost competitiveness yet, very stable low-risk incentives such as feed-in tariffs (FITs) are more effective than feed-in premiums. [13] More market-oriented instruments like feed-in premiums can be used for low-cost gap technologies (e.g. wind onshore). For example Denmark changed the fixed feed-in tariffs in wind power to feed-in premium in 2002 once wind power was able to compete with more conventional electricity supply sources.

Establish shared visions and roadmaps with industry and stakeholders

142. As some demand-side innovation policies such as standardisation and lead market initiatives involve many actors - including industry, consumers, and public authorities - developing a shared vision and policy objectives together with stakeholders is an important element for the success of these policies. First, a shared vision with stakeholders enhances the visibility of policy initiatives, which is an essential factor of success in the case of lead market initiatives. Shared visions might also help to assess and project future spending and market conditions, reducing the risk inherent in innovation.

143. Governments often support the standardisation process by encouraging self-regulation (norms, standards) on the part of firms, by monitoring or by moderating the standardisation process. Governments may also at times mandate and encourage consumer groups to participate in standardisation negotiations facilitating rapid market acceptance.

13 Feed-in tariffs (FITs) and Feed-in premium (FIPs) are granted to renewable energy producers for the electricity they feed into the grid. They are preferential, technology specific and government regulated. FITs take the form of a total price per unit of electricity paid to the producers, whereas the FIPs come in addition to the electricity market price. An important difference between FITs and the premium payment is that the latter introduces competition between producers in the electricity market.

144. Public Private Partnership (PPPs) in particular can provide effective ways to mobilise private and public demand for longer term growth by bringing together the distinct advantages of private and public sectors. For example, in Australia, the Green Car Fund uses competitive grants to foster public/private partnerships to address global challenges of climate change (see Case Study 1, DSTI/IND/STP(2010)1/REV1/ANN). Although Australia does have a national car industry, it retains important production and global supply chain facilities. It therefore seeks to encourage research and innovation in clean cars to assist the Australian car industry to take advantage of the shift to a low carbon economy.

Use consumer policy and education as a tool to enhance user-led innovation

145. As consumers and users become catalysts for innovation, in creating demand and facilitating the diffusion of innovation, consumer policy is of growing importance. Consumer policy regimes and consumer education play a role in promoting innovation in key innovative markets and can help ensure that confident consumers make informed choices. Bottlenecks including Internet fraud, lack of consumer education or product safety risks can significantly slow innovation by negatively affecting demand.

146. Initiatives to promote education and awareness can thus help improve transparency and assist consumers to develop the skills, knowledge and confidence needed to improve market outcomes. Consumer policy and education is an important instrument that can be used to counter inertia and scepticism towards new goods and services, and help improve the flow of information between firms and users. To be effective, education and awareness-raising strategies must go beyond addressing information asymmetries in individual transactions. They should also help promote critical and active engagement by consumers generally.

ANNEX 1. SBIR-TYPE PROGRAMMES: A TOOL TO FOSTER DEMAND FOR TECHNOLOGY AND INNOVATION

Innovative small firms often face difficulties in attracting investors to support their innovation projects - especially at the seed stage. This has incited governments to play a role in funding the development of new technologies in small companies through R&D contracts. From the governments' perspective, SBIR-type programmes have a double aim: to stimulate technological innovation while at the same time providing government agencies with new cost-effective solutions to their needs. In some countries an integral and advantageous feature of such programmes is their facilitation of small-firm access to public R&D contracts. Allowing recipients to retain rights to any resulting intellectual property is another feature that can make such contractual arrangements attractive to firms.

United States –SBIR programme

The Small Business Innovation Research Program (SBIR) introduced in the United States in 1982 requires government agencies (mainly Department of Defense, National Institutes of Health, NASA, National Science Foundation, Department of Energy) with a certain level of external R&D budgets to set aside 2.5% of their funds for the programme, which offers competition-based awards to small innovative firms in three phases.

Phase 1 (six months), USD 100 000 for a feasibility study allowing small firms to test the scientific and technical value of their R&D effort and its feasibility.

Phase 2 (2 years), USD 750 000 for a full R&D effort.

Phase 3, the firm pursues (with non-SBIR funds) the commercialisation objectives resulting from Phases 1 and 2. Phase 3 follow-on projects can benefit from US government R&D funding; awards are then funded from mainstream budget lines.

The SBIR programme is worth over USD 2 billion annually and makes over 4000 awards a year. SBIR funds are designed as a first step on the procurement ladder. Awards are linked to public sector customer requirements and the details of the topic are published on the Internet. The majority of award-winners have less than 25 employees (CBR, 2006).

Some evaluative work has shown that that SBIR funding has led to increased growth and employment creation and a greater likelihood of attracting venture financing (Lerner, 1999; NRC, 2000), although other analyses have cast doubt on the additionality of SBIR impacts (Wallsten, 2000). Another criticism has been that SBIR-like initiatives tend to develop a technology to a certain level of readiness, while most major commercialisation successes would require substantial subsequent funding (NRC, 2008). The perceived success of the programme has nonetheless inspired similar programmes in other OECD countries, notably in Australia, the United Kingdom and the Netherlands.

The United Kingdom - Small Business Research Initiative

Introduced in 2001, the United Kingdom's Small Business Research Initiative (SBRI) earmarks a share of the government's procurement budget (about 11 per cent of the budget in financial year 2007/2008) to be assigned to SMEs through competitive R&D contracts. The SBRI has been reformed several times to increase its performance, reach and impact. The last reform was launched in 2009. The new SBRI involves a pre-commercial procurement process. The Technology Strategy Board is the agency in charge of the programme. Funding operates in two phases: *1)* a feasibility phase (GBP 100- 000 (USD 156 000)); and *2)* a development phase (GBP 250 000 – GBP 1 million (USD 390 000 - USD 1.6 million)). There are currently 370 contracts - in the areas of defence, health and construction - with a total value of GBP 25 million (USD 39 million).

The SBRI programme has been evaluated by the former Department for Innovation Universities and Skills (DIUS). Problems encountered in the early days of the programme were linked to a lack of participation from government departments, the low total value of the contracts going to small firms and the fact that these were rarely

linked to technical development (this led to the reform of the SBRI in 2009). Some studies still point to insufficient participation across government, and also state that awards are highly skewed towards a number of very small phase I demonstration projects (CBR, 2010).

The Netherlands – SBIR programme

The government launched a small scale SBIR on several different themes: agriculture, energy, transport, water management and defense. SBIR is managed by the Dutch Agency for Sustainability and Innovation (SenterNovem). It incorporates the basic features of the United States' SBIR programme, providing funds to SMEs on a procurement basis to develop innovations that could contribute to solving societal challenges. SBIR projects are procured via tenders and funds are granted in two phases, a feasibility phase (EUR 50 000 (USD 69 000)), and a development phase (EUR 450 000 (USD 625 000)). SBIR's budget was EUR15 million (USD 21 million) in 2008. An independent committee evaluates proposals and makes a ranking, which the Minister uses in the choice of candidate projects.

Using data from 88 firms, a first evaluation of the SBIR pilot programme in 2007 showed that SBIR brought in companies that were new to the procurement market, that companies receiving funds are small (less than 100 employees) and that they co-operate more with other companies and research institutes than firms that did not receive a contract.

Australia - The Victorian State Government Smart SMEs Market Validation Programme

The Market Validation Programme (MVP) was introduced by the Victoria State Government in 2008 as part of the Boosting Highly Innovative SMEs (BHIS) programme (Victoria is one of eight state/territory governments in Australia). The programme commits AUD 40 million (USD 31 million) over four years and is administered by the Victorian Department of Innovation, Industry and Regional Development (DIIRD).

The aim of the Smart SMEs MVP is to help SMEs commercialise new intellectual property and develop globally competitive technologies, products and services. The MVP seeks to yield R&D proposals that deliver a solution to a public sector technological requirement.

Structurally, MVP is a demand-side programme. It uses a 3-stage approach involving specification of technology requirements by agencies, feasibility studies and proof of concept. The MVP engages two stakeholder groups – public sector entities and SMEs. The MVP is broadly modeled on the United States' SBIR programme. As with the SBIR it is a tendering and contractual scheme based on solicitations using a description of the problem rather than pre-determined solution specifications. The MVP also follows a milestone funding model, along venture capital lines, which allows for 'fast fail' decisions and systematic evaluation. SMEs own intellectual property developed under the programme.

One important difference between the SBIR and the MVP is that the MVP aims to encourage participation from public sector entities by providing funding through a central and independent agency (DIIRD). DIIRD also undertakes extensive administrative work. Thus, participating agencies are not required to exclusively use their own human resources to manage the programme.

The MVP is open to over 300 public sector agencies and organisations in Victoria. It is at a pilot stage and is expected to operate for 4 years and include two funding rounds. It will then undergo an extensive evaluation - the programme is currently establishing measurable performance indicators.

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