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Demand-oriented innovation policy

Summary

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SUMMARY

The Committee on Education, Research and Technology Assessment commissioned TAB to carry out a policy benchmarking project on the subject of »demand-oriented innovation policy«. The present study was prepared under the overall control of a team from the Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, and completes the project.

This report was completed in the spring of 2005. The print date was delayed as the result of a longer acceptance procedure, brought about among other things by the new elections for the Bundestag. As a rule more up to date developments, such as for instance the High-Tech Strategy of the BMBF (Federal Ministry of Education and Research), could no longer be included. This is justifiable, as the report does not so much focus on the latest events, but rather describes and analyses fundamentally interesting concepts of demand-oriented innovation policy.

OBJECTIVE AND LAYOUT OF THE REPORT

The importance of the demand for innovations is to a large extent underestimated. Empirical investigations however substantiate the fact that signals from the market to the producers of innovations, and the willingness of the market to accept innovations, are essential for the creation and diffusion of innovations.

The central question of this Policy Benchmarking report is how the state can contribute, through a stimulation of demand, to the encouragement of innovations and the speeding up of their diffusion. In other words, where are the opportunities and boundaries of demand-oriented innovation policy? The object of the investigation, demand-oriented innovation policy, is understood here as the entirety of the public sector measures that induce and speed up the development, launching and diffusion of innovations through pulic demand or through the support of private demand.

The object of the report is to define success factors for an innovation policy which is based upon demand, and to extrapolate recommendations for action for a demand-oriented policy. First of all a conceptual basis for demand-oriented innovation policy was formulated with this in mind (Chap. II). The subsequent empirical review is subdivided as follows:

- To begin with there is an overview of demand-oriented instruments in six selected countries: the United Kingdom, the Netherlands, Sweden, Finland, the USA and Germany. The importance of demand-orientation in innovation policy is outlined in each case, in order to then describe measures which seem of particular interest in the countries and to draw conclusions from them (Chap. III.2.1–2.7).
- In order to gain a deeper insight into demand-oriented approaches in various policy areas or for various technologies, this is then followed by a discussion of demand-oriented measures in selected policy or technology areas in an international comparison. These are the fields of energy and environmental technology, biotechnology and information and communications technology (Chap. IV.2-4).
- A further chapter (Chap. IV.5) concentrates on examples of regulation, because the importance and formulation of regulations is generally underestimated with regard to its effect on innovation – including and in particular as for demand.

The most significant insights are summarised and options educed from this empirical, comparative account in a final chapter (Chap. V).

A CONCEPT OF DEMAND-ORIENTED POLICY

Reasons for and goals of a demand-oriented policy

The starting observation of the report is that there is effectively no institutionalisation of demand-oriented innovation policy and thereby no generally binding demarcation and definition. What is generally understood as innovation policy in a narrow sense – the policy, which is primarily responsible for the promotion of innovations or the creation of suitable basic conditions for innovations – largely masks out demand-orientation. It tends to concentrate itself on the creation of innovations – thereby influencing the supply side – through diverse and differentiated approaches. There are of course numerous demand-oriented measures which have effects on innovations; however these are only carried out or co-ordinated by the ministries responsible for innovations in exceptional cases. This is astonishing, because the literature which describes and analyses the conditions for innovations to occur in so-called innovation system approaches, incorporates the users of new knowledge and the buyers of innovations and attaches great importance to them.

However there are currently intensive discussions in several countries and also on a European level about the use of demand for innovations, whereby a clear emphasis lies on direct public demand.

There are three essential rationales to explain government activities in relation to the demand for innovations: Structural barriers to a start up of demand; the pursuit of particular political objectives through the stimulation of demand; and the improvement of state services through the use of innovations:

- A series of structural barriers obstruct the market launch and the market diffusion on the demand side. Overcoming these barriers with the aid of state policy is the essence of demand side innovation policy. Policy can exert a controlling influence on certain products or services, which are marketable in principle, but either do not make the breakthrough or do not diffuse rapidly enough into the market. The reasons for the obstruction of innovation are diverse: High start-up costs, the absence of network effects (especially with ICT products), the conversion costs from old to a new technology, a lack of information or awareness on the part of the customers.
- A decisive precondition moreover, ensuring that signals from potential customers to manufacturers also lead to innovation impulses, is adequate competence on the part of the customer. Government offices are often not able to specify their needs and correctly classify potential innovations. Likewise, potential private customers often lack the necessary competence to use innovations, to formulate needs and to review proposed solutions. Additionally, there is often a lack of interaction between those who have a certain needs and manufacturers, meaning that potential needs in the market are not identified.
- A further justification for demand side approaches lies in the fact that politically formulated targets are promoted through the use or the diffusion of innovations. Demand concepts have a particular justification through the objectives they have been deployed to achieve. These are for the most part social, sectoral policy objectives (e.g. sustainability, mobility) or the »creation of a market« stimulated by economic-policy. They are as a rule more directly linked to social needs as the – supply side – promotion of research in certain scientific or technological fields.
- The achievement of certain sectoral objectives is closely linked to the improvement of government support and services through the implementation of innovative technologies, goods and services. If, for instance, a city with modern information services adapted to its needs is able to offer decentralised customer-oriented citizens' services efficiently, this has innovation effects for the producers and the ICT service providers at the same time.

FIVE TYPES OF DEMAND-ORIENTED APPROACH

It is possible to differentiate between five types of state measure, which initiate innovations or stimulate the diffusion of innovations through demand:

> The most direct form, using policy measures to stimulate demand for innovations, is public procurement itself. Average public expenditure on goods and services in Europe is approx. 16% of gross domestic product. This public purchasing power makes up a large part of the demand in certain submarkets – civil engineering, healthcare, energy efficient technologies in public buildings. It has been empirically proven, that there is a great potential for innovations in this demand power, and there are estimations, according to which procurement policy is a »more efficient instrument to use in stimulating innovation than R&D subsidies« (Geroski). The explanations as to why innovations are generated by public demand of all things are manifold. One explanation sees the state as a very demanding customer, who requires innovative solutions in order to fulfil its tasks in society. In connection with political tasks or defined »missions« the state is also frequently more willing or able to pay the higher entry-level prices at the beginning of the life cycles of innovations. Moreover state demand often leads to a critical customer mass, which creates sufficient incentives for innovators. Furthermore the public use of innovative products also sends strong signals to private users; the subsequent diffusion impulses are sometimes considerably stronger than through purely public demand.
> A second dimension of demand-oriented innovation policy by the state is the direct financial support of private demand for innovative products. These measures play a subordinate role in innovation literature. A differentiation can be made between two types of financial support: Demand subsidies and tax concessions. Under very specific conditions private or industrial customers receive a grant or can reduce their tax burden. These conditions normally derive from social needs and from sectoral policy targets as a rule, for example in the field of sustainable development or energy efficiency. In the majority of cases such instruments initially bring about the diffusion of innovations, followed by an innovation dynamic in the form of complementary innovations or further development.
> Alongside the monetary incentives for demand, a further approach is control in the form of the creation of awareness, building up of competences and information. With this an attempt is made to raise the acceptance and receptivity of the private market for innovations. The potential of such measures was shown empirically. In a survey of over 1,000 companies and 125 associations on the conditions for the acceptance of innovations in the market, the four most important barriers were given as the insecurity of the customers with regard to the

security and quality of innovations (75% of the sample), a lack of awareness of innovations and their functionality (67%), the high costs of the innovation or the products and services connected with it (62%) and the lack of skills on the part of the customer to use the innovation (52%). Demand competence was therefore not without reason referred to as the »key to the diffusion of innovations«. There are a large number of measures available to break down these barriers for consumers, such as universal information campaigns on the use of new technologies, the consultation of companies when introducing new process technologies or information measures and demonstration projects. Measures such as these are primarily targeted at giving customers the information base necessary for their purchasing decisions. At the same time they exert permanent pressure on manufacturers to satisfy increased demands for security with the help of innovative technologies. The support of voluntary labels is a further confidence-building measure, which manufacturers use to send clear signals to the market about the security or quality of new products. Finally, public vocational training and further training measures, such as in the use of the Internet and software, serve to broadly build up the skills necessary for the use of new technologies in the market.

> A further category of policy measures are regulations. The effect of regulations is first of all direct, in that they create security for the use of innovations. The regulations on electronic signatures for example make it possible for legally secure transactions to be carried out via the Internet. Innovations in electronic business would otherwise be considerably more difficult. A second, indirect effect on demand is had by regulations, which have direct effects on manufacturers, e.g. environmental regulations, security standards, rules on ingredients or on labelling, compliance with which however builds trust or reduces information costs for customers. A third form of regulation are those measures, which have direct effectson markets, i.e. create markets or influence market conditions in such a way, that the demand for innovations grows. Examples of this are emissions trading, which can be stimulated through replacement investments in the form of more energy efficient technologies, or the price regulation of alternative energy sources, which can stabilise the market for sustainable power production and thereby the demand e.g. for wind-driven power stations.

> A final group of measures comprises those which combine different instruments. Two different approaches can be differentiated here. There are strategic approaches, which restrict themselves to the combination of different demand side instruments, such as for instance public and private demand in connection with the generation of awareness, demonstration projects and further education. The objective of such extensive measures here is the speeding up of diffusion and the establishment of new markets. An even more extensive form are

those approaches which combine demand side and supply side mechanisms: The state plans a policy for a specifically selected technology, which guarantees both the necessary provision of factors, e.g. through R&D promotion, as well as establishes favourable demand conditions (quantity and quality). Seen historically German environmental technology is an example of this. Here in the 1980s research programmes and high environmental standards worked together to make Germany a so-called pioneer market, and thereby blessed the German environmental technology industry in several fields with a leading market position worldwide.

CURRENT STRATEGIES AND GOOD PRACTICE IN SELECTED COUNTRIES

Selection of countries

The selection of the countries for this report covers different types of countries, which differ with regard to the importance of innovation orientation in public procurement, the share of public procurement in the gross domestic product, as well as the speed with which innovations diffuse into the national market (diffusion potential). The following overview shows the categorisation of the six selected countries.

CHARACTERISTICS OF THE SELECTED COUNTRIES

Country	Innovation orientation of procurement and regulation	Public procurement/GDP (%)	Diffusion potential
Sweden	high	high	high
Finland	high	average	high
United Kingdom	average	high	low
USA	average	average	high
Netherlands	average	average	low
Germany	average	average	low

Germany is characterised here as having a relatively sluggish market for innovations (low diffusion potential), a rather average public demand-orientation as well as rather average potential to induce innovations through direct public procurement in an international comparison.

DISCUSSION OF THE COUNTRIES

The United Kingdom

For the United Kingdom there is a series of concrete signs of a very systematic and sustainable commitment to demand-orientation in innovation policy. This signifies a new start, because demand-orientation in innovation policy has no tradition here either. This new way of thinking runs horizontally through several ministries and also vertically includes public agencies and regional actors. As a result of this the DTI, the ministry primarily responsible for innovation, has explicitly incorporated a mixture of very different measures into its innovation strategy and takes care of their co-ordination. In part initiatives are being integrated into the strategy, which have already started in various places within the political system without co-ordination. The strategy is however focussed on public procurement; a growth in private demand is only aspired to in the long-term as a supplementary effect, for instance through a transfer of new government practices to industry. The mobilisation of the private sector or end customers through the creation of awareness or financial incentives is in contrast not very pronounced.

The impetus for this widely communicated demand-oriented innovation strategy was that the DTI recognised the innovation potential the state has when fulfilling its very own tasks. With this rationale it overcame – at least in the strategic concept – a typical barrier to the promotion of innovations in public procurement, namely that of the risk of the reliability of public services through the implementation of innovations and the higher start-up costs for the procurement of innovations.

On the whole, through the concept of innovation-oriented procurement, some basic conditions of demand-oriented, complex innovation policy have been fulfilled, which is why the British strategy can be regarded as »good practice«:

> a clear vision in the area of procurement, which innovation responsibility (DTI) is linked to procurement responsibility (Office of Government Commerce, OGC) and sectoral responsibility (further ministries),

- the support by studies which scientifically analyse the needs and the innovation lever of policy and the structure of »market intelligence«, i.e. an appropriate approach to the overcoming of barriers to innovation through transparency in the market (analyses) and dialogue (industry – procurers),
- the strong leadership by the DTI and normative backup through the commitment to the recommendations of high-ranking strategy documents,
- wide-ranging interministerial co-ordination for the establishment of stability in expectations, trust and mutual understanding,
- the integration of all levels of state and numerous representatives of industry,
- well-developed process management.

A further characteristic of British policy is the attempt to make market developments foreseeable by conducting consistent foresight activities and bringing together representatives of suppliers and customers in a discussion process. This discourse orientation not only creates a mutual awareness, but ultimately also leads to a better co-ordination of the development of supply and demand towards innovative goods and services.

The increased orientation recently on innovation is also reflected in general consumer policy and regulations. The mobilisation of innovation-oriented consumers, in addition to consumer protection, is an essential characteristic of consumer policy. Compared with the other countries covered in this study this explicit orientation is unique. A recent plan to systematically examine all supply and demand-oriented regulations for innovation effects is similarly innovation-oriented.

Due to the relatively recent concentration of innovation policy on demand-orientation and the mobilisation of other policy areas for innovation, an overall assessment of the effects is not yet possible. What remains to be noted is the consideration of the dimensions of innovation and competitiveness apparent throughout the different policy areas and with that the attempt to combine the fulfilment of social needs with innovation.

The approaches of the United Kingdom allow for two important conclusions to be drawn: (1) Complex strategies and new structures are necessary in order to activate public demand, and (2) innovation-orientation should be systematically included in different policy areas and in regulations as a horizontal dimension.

Netherlands

In terms of conceptual developments, the Netherlands were pioneers in defining public procurement as a lever for innovations in the 1990s. The specific, broad

influence of public procurement on innovative activity in concrete practice is yet to come, however. Following an intensive discussion about the opportunity of providing the impetus to promote innovation through targeted public demand for new goods and services, it turned out that the professionalisation of public procurement represents a necessary condition for the success of the procurement measures. Attention is thus currently directed to those measures which lead to a professionalisation of public procurement. The area with the most far-reaching measures for the procurement of new goods and services is found in conjunction with the goal of organising ecologically sustainable procurement; however there is no explicit innovation orientation.

The example of the Netherlands can be used to identify barriers to the implementation of specific measures for stimulating innovation-inducing demand. Attempts were made for instance to promote electricity from regenerative energy sources (green electricity) through liberalisation, through demand subsidies (tax incentives) and subsidies for producers. The low success rate of these measures can be explained by the fact that although demand for green electricity was strengthened through subsidies; the resulting surplus in demand which investment in production capacities could have induced in electricity from regenerative energy sources, was cancelled out by a supply-oriented measure of additional supplier subsidies being granted, which also strengthened foreign suppliers. This means that measures for demand-oriented innovation policy – if they are to be successful – must not only be aligned with sectoral targets, but also co-ordinated with other, if need be supply-oriented, measures.

The Netherlands have developed a successful public strategy for the promotion of information and communications technology in the public sector (e-government). The main pillars comprise of an information centre for the public administrations, as well as in the attempt to introduce software with open standards and open source code into the administrations. The implementation of this strategy has been taken over by a specialised agency, which combines the individual measures and makes them widely visible. This allows for a selective international and national exchange of information.

Initiatives for the distribution of open source software and open standards as conducted in the Netherlands are interesting not only for reasons of efficient public performance, but also from the viewpoint of demand-oriented innovation policy. The measures appear to be well thought out and well co-ordinated both in concept as well as in implementation, even if concrete results cannot yet be quantified. The measures initiated seem however to have contributed to a positive image and for the diffusion of open-source software already.

Sweden

Sweden practised demand-oriented approaches as early as the beginning of the 1990s with systematic, technology-oriented procurement in the sector of energy-efficient technologies. These were regarded as »good practice« already a few years ago. On the other hand however, demand-orientation did not find its way into official strategy documents on general innovation policy until 2004. The corresponding concrete formulation, to say nothing of the implementation, of a strategy is still in its early stages. To what extent the co-ordination necessary for this and also the learning across institutional borders will succeed remains to be seen. No lessons can accordingly be learned from innovation policy strategies, but very well however from individual measures.

The Swedish market transformation programmes in particular have influenced the style in other countries in the area of energy efficiency, and can rightly be regarded as pioneers and consistent examples of extensive demand-orientation. The most important lessons that can be drawn from them are:

> a connection between the accepted social need (energy efficiency) and innovation,
> exact market (supplier and consumer) and technological knowledge, establishment of market transparency, carrying out of preliminary studies before procurement,
> targeted selection of technology sector and functional definitions, without specifying concrete products,
> targeted mobilisation of public and private demand,
> inclusion of the whole demand chain, not only the end customer,
> supporting measures for the generation of awareness, if necessary also initial demand subsidies,
> monitoring and evaluation of the effects.

These examples can be considered as problematic in that there was no consistent attempt to transfer the experience gained from the programme into general innovation policy and that no appreciable co-ordination has taken place between agencies.

In the policy for the establishment of the information society there are also indications that Sweden's success has been supported by the efforts of the state, through the setting of a good example (»lead user«). In this the Swedish government combined the improvements in efficiency and the citizen friendliness of their administration with the diffusion of ICT technologies (electronic ad-

ministration). Moreover it relied and relies on the wide-ranging generation of awareness – as well as vocational training and further training measures for as many sections of the population as possible. The philosophy applies that well-informed citizens who are familiar with ICT technologies demand and quickly pick up and use innovative ICT products and services.

The example of a new road safety strategy – »Zero Vision« – reflects the importance of a clearly communicated social vision for the market development and the innovation situation. The strategy represents a radical change in thinking; accidents and their impact on traffic are to be radically cut back. Technological innovations are an element of its implementation. The economic potential, i.e. the mutual reinforcement of safety vision and economic innovation effects, has meanwhile been consciously absorbed as part of the strategy. In the course of demand-orientation and the creation of lead markets for security technologies in Sweden's new innovation strategy, the high social acceptance of the strategy in the country is mobilised for the creation of sufficient public and private institutional demand. At the same time, markets abroad are also being prepared for innovative Swedish safety technologies through the consciously conducted, international discussion of the new strategy.

Finland

In Finland pure demand-orientation in innovation policy simply leads a shadowy existence. At the same time however the diffusion of new technologies, in particular of information and communications technology, is very well-developed. This applies both to diffusion in private households and in companies as well as in the public sector. Finland has been attempting to speed up the application of information and communications technology across the breadth of the innovation system for more than a decade. Policy measures which are explicitly responsible for the diffusion of technologies are however not identifiable in the documents examined and in the personal discussions.

The foundation for today's successes in Finnish telecommunications was evidently laid a long time ago. Strong state actors were able to trigger positive demand and standardisation stimuli through pressure on national producers. As the strong state actors increasingly disappear under the sign of deregulation and liberalisation of the markets (to be replaced by an oligopoly of private actors), this potential will in future be smaller. And where demand in the field of telecommunication infrastructure is to be used specifically to generate innovations, the effort of the co-ordination will increase significantly.

The so-called Makropilotti programme, a cluster programme in the healthcare system, was based upon the insight that through a diffusion of new information and communications technology in the healthcare system, as well as the adaptation and harmonisation of technologies, the quality of performance could be improved and new services offered. The weak point of this programme lay in the political time pressure which was exerted. This led to a situation whereby radical innovations were not demanded, and only adaptations of existing technologies from established manufacturers and manufacturer networks were undertaken. This example teaches us that success in the implementation of demand-oriented policy is also dependent on the co-ordination of the actors in planning and execution. At the same time the co-ordination of heterogeneous public and private demand and for the most part private suppliers is no trivial task. The Finnish example of the Makropilotti programme also shows that the measures of demand-oriented innovation policy need time to bring about positive effects. If the political pressure is too great, there is a risk that the measure will become overloaded and there will be a fall back upon established technologies.

USA

American research and innovation policy is essentially mission-oriented, i.e. research programmes are launched, financed and implemented by individual ministries in order to achieve defined objectives. The USA accordingly has no central ministry which is responsible for innovation policy. In addition the research and innovation policy approaches of the various ministries are as a rule supply-oriented. An orientation on demand is referred to and called for in newer government papers; it has not yet been strategically planned and put into practice however.

The example of the USA shows however that sectoral government requirements can be important drivers of technological development and have great potential for private markets (e.g. GPS, FEMP energy management programme). Yet even the policy actors, who are responsible for the mission-orientation of research and innovation policy, often fail to recognise and realise this commercial potential, as they do not follow innovation policy or industrial political, but sectoral policy objectives. Even the mission-orientation does not therefore automatically solve the typical demand-orientation problems of the lack of co-ordination between sectoral and innovation-related political objectives.

The central characteristic of the measures of public procurement discussed for the USA is the co-ordination of diverse institutions. The FEMP (Federal Energy Management Program) of the Office of Energy Efficiency and Renewable

Energy in the Department of Energy for example, promotes the purchasing of energy-efficient technologies in federal authorities and thereby seeks to contributes to greater energy efficiency. An essential criterion for success is that it is supported by the political leadership in the White House through a large number of ordinances as well as through an interministerial task force. In addition to this there is the specific inclusion of other public initiatives (labels, standards), a system of incentives for the purchasing of energy-efficient technologies as well as the mobilisation of private demand.

The investment in a new toll system in a number of US states (EZ Pass) is a successful example of how through the close co-operation of individual states in the northeast of the USA the procurement of systemic innovation could be placed upon a sound basis. This resulted in volume effects with manufacturers and service providers and synergetic effects with users. These were further strengthened by co-ordinated marketing and through the expansion of the applications. The initial high investment costs were thus amortised very quickly.

A programme to install photovoltaic arrays in public and private buildings combined a conscious strategy for the procurement of new technologies with – among other things – a quality enhancement for the connected service (installation, maintenance) and a growth in demand for local service providers. The economic benefit of the increased demand on the supplier side thus at least partially remains in the region which financed the programme.

The example of the Manufacturing Extension Program (MEP), which contributes considerably to the diffusion of new technologies in small and medium-sized businesses through individual public consultation services, also shows the potential which lies in the co-ordination of different political levels and different types of institutions. The advantages of a major central programme for the diffusion of technologies are combined here with specific strategies adapted to suit the local conditions.

The discussion of emissions trading shows that market-creating regulations evidently have a high potential for the stimulation of demand for energy-efficient technologies. In particular the dynamic components of trading – a reduction of the total volumes of emissions – appear obviously useful.

The regulative measures for the reduction of motor vehicle emissions in several federal states (in particular California) ultimately combine very demanding regulative guidelines with a range of positive incentives for customers (use of traffic lanes, free parking, demand subsidies). The USA are obvious pioneers especially

in the area of regulation concerning the release of innovative potential, and further deeper analyses would surely also be informative for the German situation.

Germany

In Germany, as in most of the countries observed, there is no explicit demand-orientation in innovation policy. Neither public procurement nor the promotion of private demand is integrated in innovation policy strategies. There are indeed activities within the area of the procurement of sustainable technologies and products or within the area of defence, as well as newer approaches to bring innovation more strongly into public procurement through the mobilisation of public procurers. These were included in the so-called High-Tech Strategy of the federal government in autumn 2006 and thereby after this report went to press (BMBF 2006). Initial attempts can be found there to determine the potential of lead markets and thus to align research more strongly with market potential. No statements can yet be made concerning the structure or even implementation of these intentions. In spring 2006 the BMWI published a brochure on innovation inducing procurement, in order to raise awareness among decision makers and public procurers. No statement can be made about the implementation of the principles explained there either. There is however no co-ordinated strategy to mobilise public procurement for innovations through the federal ministries and their sectoral policy.

Nevertheless extensive measures to raise the demand for innovations can be found in several sectoral policy areas. The measures concentrate both on financial incentives in the field of energy-efficient technologies or renewable energy, and on measures concerning the advertising, the creation of awareness or vocational training and further training measures in the sector of ICT technologies. The variety of measures in the energy sector is considerable in an international comparison. They almost exclusively target private demand, both from companies as well as households, as opposed for example to measures in Sweden or the USA. The innovation effects of these measures have not been systematically recorded. They generally affect the diffusion of innovative technologies and thereby contribute to the creation of markets. In some fields, such as for instance photovoltaics or building technologies in the sector of low energy or passive houses, the measures are regarded as exemplary even in an international comparison. Moreover there are indications that general consumer policy could in future also be deployed more to mobilise for innovations.

One historic example from Germany in the sector of industrial technologies is remarkable both in design and impact. The indirect-specific promotion of com-

puter-assisted production and design processes in the 1980s and 1990s (CAD/CAM and CIM technologies) combined financial incentives for the users of these technologies with instruction and guidance. They targeted SMEs and had a double innovation effect: The diffusion of these technologies was heavily promoted through demand, and the companies became more innovative in their own creative processes through their implementation. The very comprehensive financial extent of these measures, which was in part also criticised, has to be compared to this double effect. In any case it is problematic that the demand effect of the technologies promoted cannot be restricted per se to the domestic market. This is however a universal problem with demand measures. Indeed what is true is that the increased demand for innovative technologies also provides an innovation dynamic in the domestic market.

In Germany there are ultimately several examples, in which demand-oriented and supply-oriented measures have interacted. The issue of wind energy is one example, in which substantialR&D programmes were launched in an early phase, which then were complemented or replaced step-by-step by demand-oriented measures. In the sector of environmental technologies, German regulations have strongly influenced the demand for environmental and energy technologies, also in combination with R&D measures. In both sectors Germany has developed to become one of the leading markets. The examples indirectly demonstrate the effectiveness of a combination of measures. To bring packages of measures such as these into action for specific technology sectors is the challenge of more complex approaches.

Along these lines a current initiative within the scope of the »Partners for Innovations« innovation offensive is attempting – for three technologies – to define the conditions for pioneer markets in discussion with industry, to shed light on the possible role of the state as customer, promoter or regulator, and to get co-ordinated packages of measures off the ground.

DEMAND-ORIENTATION IN SELECTED TECHNOLOGY FIELDS

As a complement to the country overviews, in which the strategic role of demand for innovation policy and selected instruments is discussed, there follows an analysis of the significance of demand-oriented approaches for individual technology or policy areas in a second empirical section of the report. This overview extends beyond the six countries and allows further technology-specific conclusions regarding the situation in Germany.

Demand-oriented measures in the energy sector

In the last 15 years in Germany, but also in the European Union, demand policy in the energy sector has initiated important energy efficiency and innovation effects. The innovation effects are particularly pronounced in technologies for the use of renewable energy. Seen as a whole, the effects on the entire national economy are comparatively small, but those industries which press ahead with the development of new, energy-efficient technologies evolve more dynamically than the average industry. In the next 20 years it can be expected that their importance in the economy will grow still further.

The chosen mix of instruments in the individual countries depends heavily upon the sector as well as upon the social environment. The country analyses have shown that in Europe – also as a result of the implementation of EU guidelines – regulations play an important role. The application of other instruments – financial incentives, creation of awareness, procurement policy – takes place very much more differently in the individual European countries. In particular the use of procurement policy as an instrument of innovation policy is systematically less developed. Germany – in an international comparison – is characterised as having a strong focus on regulations and financial incentives; the creation of awareness and procurement play a subordinate role.

For demand policy in the energy sector it can be inferred that successful approaches as a rule combine various instruments such as regulation, financial incentives, information and, in some cases, binding obligations. In Sweden for example procurement policy is only successful if it is supplemented by other measures related to its specific technology.

Consistent systemic approaches combining different measures are rarely found. Thus with cooling devices for example direct demand-oriented energy labels were combined with indirectly perceived minimum standards (although with such a large time interval, that they hardly had any effect). Great Britain is without doubt counted among the positive examples of a systemic approach linking demand and supply instruments, and has taken the opportunities offered by improvements in efficiency for a number of years through consistent and continual programmes. The most important measures for this are the Energy Efficiency Commitment (EEC), investigations of the effects and opportunities of efficiency technologies on innovation, the communication of these effects at the highest political level and the formulation of comprehensive targets by the year 2050.

There are currently only a few EU countries with comprehensive strategies for the establishment of pioneer markets as important routes towards a future demand-orientation (Germany: photovoltaics, Denmark: wind). The implementation of the EU Lisbon strategy through »lead markets« with sustainable energy technologies was indeed demanded, but is not yet practised enough on a national level, and therefore the EU is still centrally pushing forward against very heterogeneous backgrounds.

Overall it holds that enormous innovation successes have been achieved in the sector of energy efficiency, that however a continuing consistent orientation towards incentive and procurement programmes on the level of innovation technologies holds even greater potential for innovation in the future.

Example: Generation of awareness for the diffusion of the fuel cell

The fuel cell with its range of power and applications is an interdisciplinary technology. It also represents a challenge because different knowledge and technology fields have to be integrated in system development. In all countries observed, the promotion of research and development presently dominates, however this is increasingly accompanied by demonstration and pilot schemes. All leading countries have started to prepare the market for fuel cells through supporting the development of standards and norms, testing and certification concepts as well as with information campaigns and offers of instruction. In the USA and Japan there are already differentiated roadmaps for the transition to a hydrogen economy with fuel cells, which integrate supply-oriented and demand-oriented instruments. These two countries are good examples of how a national change can be organised, which includes elements of self-commitment. It is still too soon to judge to what extent the plans can actually be put into practice, however it is evident that optimism prevails over doubt. Canada and Great Britain are also on the road to establishing a national consensus and the »commitment« of the relevant actors, however they started considerably later.

The preparation of a national consensus, for example in the form of a roadmap developed jointly between the economy, science and politics, was set about late in Germany, but there has recently been a consolidated attempt to concentrate the numerous activities and initiatives. In the meantime this also includes participation in initiatives on a European (e.g. European Hydrogen and Fuel Cell Technologies Platform) and international level (International Partnership for Hydrogen Energy, IPHE). The importance of such consensus building and communication processes cannot be overestimated, as it offers guidance for private and public investment decisions and reduces insecurity. Several programmes,

which are currently under discussion in countries such as the USA, Canada and Japan, are however considerably further developed, at least conceptually. Nevertheless, also these approaches should ultimately be assessed on their implementation which is imminent.

Example: Stabilisation of the demand for wind energy technologies

The so called Stromeinspeisegesetz (literally the »energy feed in law«) is a valid example of a complex measure with an impact on innovation pressure and the market diffusion of innovations (and since 2000 the Renewable Energy Sources Act, EEG). The basic idea is to make electricity supplied by renewable energy sources competitive through fixed feed-in prices. Degressive prices were established in the EEG to keep up the pressure to innovate. The success factors of this approach relating to the development and market diffusion of wind-driven power stations can be summarised as follows:

> minimisation of risk due to sales assurance for the end product (electricity) through the purchase commitment and a fixed purchase price,
> accompanied with this, the creditworthiness of the investors in wind-driven power stations,
> keeping up the pressure for efficiency on the benefiting suppliers of wind-driven power stations through a degression of the regulated purchase price.

In comparison with the other types of support, particularly tax reductions, the reduction of risk through the guaranteed purchase at a calculable price is evident. Countries with more favourable natural conditions, but with other support measures (tax concessions, quotas, certifications) than Germany, have not experienced a comparable push during the installation or production of wind-driven power stations. This allows for an initial conclusion for demand-oriented approaches reaching beyond the example: Regulations, which credibly reduce risk in the market may be more effective than monetary incentives.

The EEG can – with regard to the innovation and diffusion of wind-driven power stations – be described as a success, in particular if one looks at the market developments in countries which have promoted the technology with other incentive mechanisms. The success of regulation is also accounted for by the long period during which a political majority could be secured for the underlying social objectives. A second conclusion accordingly is that the lasting success of regulative politics which target demand requires social acceptance.

Thirdly, the example shows that the orientation towards market diffusion is only meaningful if the technological prerequisites are available on the supply side. In the case of wind energy in Germany the promotion policy of the federal government contributed to that end. Without these advance concessions, the effects of the market diffusion policy would have been considerably weaker, or foreign producers would have profited further from it.

Indeed there is currently a problem here as well: A further dynamic development, especially in the offshore sector, increasingly leads to technological bottlenecks, and thereby reduces the effect of the innovation lever of current policy. The degression of the feed-in price will only be successful in the long run, if the supply of innovative technologies keeps up. This means that the cultivation of the market should again be accompanied by intensified R&D efforts with suppliers.

APPROACHES IN BIOTECHNOLOGY

In the field of biotechnology there have on the whole to date only been a few approaches of a demand-oriented innovation policy in Europe. This could be connected to the still relatively early development stage of biotechnology, in which the priorities of innovation policy lie more on the supply side, thus on the development of a knowledge base for biotechnology and its transfer to implementations.

The existing instruments can be allocated to three types of demand-oriented policy: Support of private demand, generation of awareness and regulation. The BIO-WISE programme in Great Britain counts as a successful instrument for the support of demand for biotechnology. This approach should help to support the adoption of biotechnology in industrial methods of production. The programme covers a wide range of instruments for the promotion of this process. One lesson to be learned from this programme is that a combination of direct project development instruments with information measures to raise the awareness for the potential of biotechnology in established processes – including demonstration projects – is crucial for success.

General awareness-generating measures have in contrast been as yet little used to specifically build up demand for products and technologies. It seems that the generation of awareness that is not specifically related to a concrete product or a concrete technology does have an informative impact, but does not however directly increase the acceptance of and demand for biotechnology.

Regulatory approaches in biotechnology extend practically exclusively to biotechnology applications in the pharmaceutical sector and are applied to two entry points which are close to the market: to the approval process and to the »return on investment« for medicines. The so-called orphan drug status signifies extended market exclusivity and thereby better protection from competing products, ultimately a higher »return on investment«. The Orphan Regulation is a European instrument and for that reason also accessible for German drug manufacturers. Furthermore, individual access to drugs which do not yet have definitive marketing approval is possible throughout Europe within the scope of the »compassionate use« regulation. The French ATU regulation goes even further than this, making drugs without definitive approval accessible to large numbers of patients. This makes innovations easier for particularly serious illnesses by reducing initial requirements and enables the satisfaction of quite specific needs. This makes it also interesting from the point of view of transferability to Germany.

Ultimately, the comparative analysis of the different approaches shows, that a well-directed combination of suitable regulations, concrete support, and information is appropriate in order to increase the demand for innovative products in the sensitive and complex field of biotechnology.

APPROACHES IN THE FIELD OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

In the field of ICT technology it appears that the awareness of the necessity of demand-oriented policy measures has greatly increased in the past five to ten years. As a reaction to the EU »Europe – An Information Society for All« plan of action, a number of European countries have taken measures which should increase the distribution of information and communications technology (ICT), i.e. raise the demand for corresponding products and services. These demand side measures have gradually been integrated into the traditional (supply side) portfolio of research or innovation policy over the years. Within the major national plans of action today in particular, both supply as well as demand side instruments can be found, mostly interlaced with each other. However there is still a considerable predominance of traditional development instruments. The objective of this interlacing is to promote the development of innovative technologies, products and services as well as at the same time to stimulate their use by broad sections of the population.

Even if the spectrum of potential instruments is broad, the majority of European states focus on the promotion of open standards and open source software, often in connection with their e-government activities, the strengthening of private demand for ICT products and services through infrastructure measures (broadband, digital audio broadcasting) and information services as well as vocational training and further training measures as a precondition for a more intensive use of innovative technologies. As only very few demand-oriented measures had a central goal of strengthening innovative abilities, it is almost impossible to evaluate their innovation promoting effects. However, the impression can be gained that such effects are of a more indirect nature: Because the distribution and use of innovative ICT technologies is strengthened, manufacturers find themselves increasingly able to turn the associated network effects into monetary benefit, and therefore tend to be prepared to take action in research and development.

Germany is above mid-table on demand-oriented policy measures within Europe. The Scandinavian countries are leading with a more than 15-year tradition in the systematic promotion of ICT use following the liberalisation of the telecommunication markets. Overall the impression remains that in Germany – also as result of its federal structure – the linking of supply and demand-oriented instruments has not yet made as much headway as for example in the Netherlands, where policy measures are strongly oriented towards the inclusion of all social groups or institutions.

REGULATIONS

The review shows how diverse the effects of regulations can be on the demand for innovations. All those regulations which relate to the relationship between suppliers and customers are applied directly to demand. They influence the awareness and the acceptance of customers. Innovation-friendly regulation here therefore means giving the customers security, information, trust in new products and their use. Regulations, which apply to production factors or external factors concerning the environment or employees, have more indirect effects. Demand for innovations is raised here as new technologies or processes are (have to be) introduced in order to comply with standards and provisions.

The significance of regulation for innovations and especially the demand for innovations has up to now been completely underexposed. As a rule regulations are looked at from the viewpoint of their innovation-hampering effects and for that reason are also frequently criticised. In newer approaches, such as the the Regulatory Impact Assessment, which is valid in the EuropeanUnion for regu-

lations, attempts are made to estimate the economic effects of regulations even before they are passed, in order to formulate regulations in such a way that they have few negative or even where possible positive effects on the competitiveness of industry. It appears however, that the effect on the demand for innovation by the end customer or producer is at the same time neglected. For this reason it would be desirable if in future, politics and administrations on a European, but in the implementation also on a national level would considerably more strongly include in their deliberations opportunities to also contribute indirectly to a specific demand for innovations through regulation.

Example: markets for emissions and their impact on the demand for new technologies

Emissions trading is a – relatively new – form of regulation, which through the allocation of pollution rights uses market logic to achieve environmental goals as economically as possible. This regulative innovation does not only bring about different distribution policy results according to the national structure, but rather also differences with regard to the likelihood of investment in new, energy-saving technologies. An initial, necessarily qualitative and in part still speculative reflection on the innovation effects of emissions trading shows in what way structuring regulations could have effects on the demand for innovative technologies, in particular for production-related innovations. The blame for deficits relating to innovation effects is less to be laid at the door of the instrument of emissions trading itself, than simply its specific structure.

If the structuring regulations of the various National Allocation Plans (NAP) are considered, it can be seen that several – not all – of the regulations from the German NAP count among the most innovation-friendly in an international comparison. This positive assessment is based above all upon the transmission regulations from existing infrastructure to replacement infrastructure, timely information regarding future allotments for new market players as well as benchmarking regulations for homogeneous product groups in some industrial sectors.

Due to the relatively generous allotment of rights within the EU, as well as the prohibition on being able to carry over surplus emission rights from the first into the second period throughout (almost) the whole of the EU, only slight price and cost induced innovation incentives can be reckoned with in the first phase of the EU emissions trading system. These incentives can be raised through a stricter allotment throughout the EU in the subsequent phase from 2008. Other structuring regulations have in addition proven themselves to be critical and should therefore be reconsidered in future, also in view of their innovation effects when

drawing up future National Allocation Plan. The report has several concrete suggestions for this, such as for instance the raising of the share of certificates, which can be traded by auction, the closure of existing infrastructure without sanctions or – most important – a permanent determination of the applicable regulations.

The structuring of emissions trading in the EU member states illustrates the gulf between theory and practice also in the light of the innovation effects. The definite structuring regulations are not least the result of political negotiation processes and compromises, whereby in some cases (e.g. closures and new emitter regulations) there is definitely a area of tension between efficiency and innovation goals on the one side and distribution goals on the other side. The regulations established in individual member states now require an empirical analysis, in order to be able to use the insights gained for the structuring of future allotment regulations. Innovation aspects should be an important criterion of this evaluation. In the end it will depend on the success or failure of the EU emissions trading system for CO_2, in what respect this instrument can be used in other environmental areas.

Example: Functional Food

The food sector is an example of how in a lot of innovation fields the basic political and legal conditions in the EU do not keep up with developments in science and technology on the one hand and with the demand side on the other hand. With internationally co-ordinated regulations in particular this leads to clear delays with a phase of considerable legal insecurity, which has hampering effects on innovation activities. This does not only apply to fields in which there are acceptance reservations by consumers or users of a technology (such as e.g. genetic engineering or food irradiation), but rather also in segments in which consumers have a generally positive attitude towards new products (such as e.g. functional food). Here there is a clear need for action for a clarification, harmonisation and specification of the legal regulations in the coming years.

In particular in those innovation fields with a heavy interdisciplinary orientation in the food industry (such as e.g. functional food), the prevailing institutional conditions and administrative competences have moreover a restraining effect on innovation activities, as different authorities with different decision factors and procedural processes are often responsible for the implementation, administration and control of existing regulations. For this reason scientific-technical innovations require organisatory reforms as well. At least in the authorities which are responsible for the food industry in Germany, these are often only carried

out with considerable delays. Therefore in future a flexible framework should be created, which can formulate legal regulations in newly opening fields with greater participation from (early) innovators.

In spite of the growing importance of international integration and regulations, the respective national conditions remain a central area of influence on innovation activities in the food industry. This will only gradually change in the coming years, as consumer's demands and consumption habits relating to food in particular are largely characterised by sociocultural conditions in the individual EU member states and these will only very slowly come closer to one another. In addition the knowledge base of the food industry, the funding of R&D activities, co-operative behaviour, as well as in part the basic legal conditions (notably the implementation of existing regulations) also have a strong national character.

CONCLUSION

General principles

The central conclusion of this study is that alongside the promotion of research and development (supply), future-oriented innovation policy should also more closely identify and make full use of the potential which lies in the demand for innovations. For the further development of demand-oriented policy there are two starting points: the improvement in the efficiency of public services and the social needs of the future.

In order to put the potential of demand-oriented innovation policy into practice, the connection should be made between innovation policy goals on the one hand and specific needs and thereby sectoral policy objectives on the other hand – such as for instance sustainability, security, and health care. To achieve this a generation of awareness is required in the political arena itself, across department boundaries, concerning the possibilities of satisfying social needs through increased demand for innovative goods, technologies and services.

The connection of sectoral objectives and innovation goals is however tied to important preconditions. In particular the objectives must be broadly accepted, and potential conflicting targets between the innovation effect and sectoral objective have to be taken into consideration. An innovation-oriented strategy moreover should bear the whole range of the measures discussed in this sector in mind, and while doing so aim for a suitable combination of measures for the respective technologies, products or services.

In that respect an inter-ministerially co-ordinated process could be set in motion in Germany. The process should be led from where the competence for innovation lies, by the BMWA and/or the BMBF. According to the subject such co-ordination should also be opened up to other levels of government and private representatives of industry.

As regards content such a process should have the following elements:

> extensive integration of the innovation idea in sectoral policy,
> review and potential analysis of sectoral ministries with regard to the innovation effects of their existing demand-targeting measures,
> definition of innovation policy goals and the connection of these goals with the sectoral measures,
> determination of pilot activities and definition of systems to monitor the effects of measures initiated,
> inspection as to what extent priorities could also be established in R&D policy, so that they better complement needs-oriented measures in sectoral ministries.

Public procurement

The following specific criteria can be derived from public procurement:

> Innovation should become a generally accepted criterion when evaluating offers in procurement.
> Procurement should be more professionalised and structurally adjusted (specialisation, concentration) on all levels.
> Public or sectoral needs should have more specific targets and a longer-term orientation, this process should be combined with an open discussion with the relevant market actors.
> Selective public demand should be combined with additional supply and demand side measures.

Stimulation of private demand

Financial measures to stimulate private demand – especially in the area of sustainability – should be implemented where possible so that the innovation effect is maximised. That means in particular, that the financial grant should be flexible and concentrated on the beginning of the respective diffusion cycle, the over-early promotion of demand on a wide scale – when for instance the technology still is not mature enough for the market– is to be avoided.#

Furthermore there should be an examination of the extent to which selective programmes for industrial modernisation by SMEs in particular through consultation and co-financing of investments, could trigger off a double innovation push for producers and users of industrial technologies and services. It would be conceivable for instance to further strengthen the production-related application of biotechnology through such measures, in connection with awareness-generating measures.

Awareness-generating measures must in general be correctly combined, adjusted, and allotted, i.e. they have to do justice to the individual specialist areas and be very exactly attuned to the possibilities and capabilities of potential customers.

All regulations which influence the decisions of potential consumers (e.g. obligation to label) should be inspected for their innovation effects. This is particularly true for the conversion of European regulations into German law. In that respect during the national structuring of emissions trading, among other things measures could be contemplated such as the raising of auction shares (better access for new market players, equal treatment of existing and replacement infrastructures), the closure of plants without the revocation of emission rights as well as a more reliable and longer-term determination of the rules (planning reliability for investors).

Regulations in the functional food sector are required to clarify both the legal status and standardisation, to work towards an EU-wide regulation on health-related statements (Health Claims) and as a bridging measure to introduce voluntary self-commitments for the use of health-related statements. Supplementary to this, communication with consumers should ultimately be improved, as the absence of knowledge and low trust are considerable barriers for the acceptance of functional food.

In order to raise the demand for innovations permanently, combinations of measures should be chosen in systemic approaches that address all of the crucial bottlenecks (cost, knowledge, skills).

To politically induce the development of pioneer markets is full of preconditions. It is therefore necessary to have a selective strategy co-ordinated with all relevant actors, based on very solid knowledge on producers, domestic demand and foreign market conditions and needs. The initiative of the »Nachfragefaktor Staat« (government demand factor) impetus group addressed in the case study of Germany is heading in the right direction here. It should be consistently car-

ried forward in selected pilot examples, which also includes a systematic analysis of the export capability of the selected technologies.

Measures in selected specialist areas

Supplementary to the conclusions previously put forward for discussion an introduction to several selected options for the shaping of specific specialist areas should follow. Systemic approaches in the sector of energy efficiency should be expanded to combine research funding and demand stimulation. As Germany has a good starting position in environmental technologies, pilot schemes for pioneer markets also can be carried out in this sector. For this – as for demand stimulation in general – public procurement should be even more strongly and above all specifically oriented towards energy-efficient technologies. The conversion of the CO_2 savings commitment for public federal buildings proposed but not yet delivered on by the federal government at the beginning of the last legislative period could form a basis for this. In order to make greater use of the opportunities for German innovations in the energy sector in international markets, there have to be more concerted attempts to break into in international markets. One potential government measure would be a further intensification of the »Standort Deutschland für nachhaltige Energietechnologien«, (Location Germany for sustainable energy technology) marketing measures which have already been set in motion by the export initiative for renewable energy (under the responsibility of the German Energy Agency).

In the wind energy sector demand-oriented measures have very successfully contributed to the establishment of a market. In addition supply-oriented measure development programmes should be implemented here to develop more efficient technologies.

For the market diffusion of the fuel cell, government measures should concentrate on clearly defined niche markets – such as special heating and electricity supplies (e.g. lorries, emergency power, transmitters), portable applications (e.g. laptops for medical services) or special vehicles (e.g. fork lift trucks) – so that the market launch horizons are not pushed too far into the future. Public demand should also be mobilised for support here, in particular to send clear signals to the private market. Ultimately in Germany, like in other countries as well, information and communication processes should be organised, to incorporate the various users with their different requirements productively.

In view of the apparent deficits, co-ordinated information and demonstration campaigns, particularly in the industrial applications sector, could give biotech-

nology a push. Furthermore consideration could be given to how regulations could be used or created for a more rapid launch of new medicines, as has been done for example in France.

The opposite problem can be found in the information and communications technology sector: There are a very large number of different measures here, and there are indications that better co-ordination of these measures could more efficiently and more effectively lead to demand for innovative products and services.

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