HIGH LEVEL GROUP ON KEY ENABLING TECHNOLOGIES

REPORT OF WORKING GROUP 6: POLICY OPTIONS

EXECUTIVE SUMMARY

Introduction

Following the Commission Communication on Key Enabling Technologies (Sept 2009), the High Level Group on Key Enabling Technologies (KETs) was established to develop a strategy for ensuring that the EU remains a competitive location for the development, commercialisation and manufacturing of KETs, and KET-based products and services. This first phase of this work, analysing the position of KETs in the EU was completed in January. The second phase of work, to develop recommendations on specific policies to support KETs, is being taken forward by 7 Working Groups, focused on different policy areas relevant to the development and commercialisation of KETs.

Scope of the Working Group 6 Report

The report of Working Group 6 (Policy Options), covers the following areas:

- **Strategic Policy Objectives**: setting key goals that will shape lead markets for KETs and co-ordinate activity at all levels within the EU;
- **Fiscal Policy**: tax measures that can improve the competitiveness of the EU as a location for developing KETs;
- **State Aids and Competition**: the framework of rules of the programme and funding thresholds, but not programme design, or rules related to applications or the evaluation of these;
- **Lead Markets and Public Procurement**: creating lead markets for KETs and using public procurement to support this;
- **Standards and Regulation**: use EU and international standards to create markets for KETs based on European technology; and
- **External Competitiveness and Intellectual Property**: ensuring the EU remains globally competitive and can protect its proprietary IP.

Key Conclusions

Public policies have a significant impact on the competitive position of the EU in global markets, and influence the level and direction of innovation and technology development. The EU Single Market, the network of public and private sector research and technology expertise and the level of investment in technology development are great assets for the EU. However, the EU faces the challenge of co-ordination across the policies, institutions and funding streams of 27 Member States as well as EU level programmes. Unlike competitor countries, the EU does not have, or find it easy to agree, common objectives, policies and mechanisms, and the high level of discretion afforded to Member States or sub-national governance structures in the EU makes it difficult to co-ordinate activities and resources on specific outcomes.

If the EU is to remain a globally competitive location for the development and commercialisation of KETs, and capture substantial parts of the value chain linked to these, then it needs to adopt a more co-ordinated approach. To achieve this, we recommend an approach based around the use of strategic policy objectives in key areas to create a common vision and set direction, which will then enable the creation of lead markets through co-ordinating a range of EU and Member State programmes and policies. This will facilitate more focused effort but without mandating the use of common institutions, approaches or mechanisms that the EU has historically failed to agree. In parallel, the EU needs to take steps to ensure that it remains a globally competitive business environment, and that its systems of taxation, regulation and the funding it provides for technology development are competitive with those offered in other countries. It must also provide strong support for EU companies to trade in global markets and to protect their intellectual property.

STRATEGIC POLICY OBJECTIVES

Role of Strategic Policy Objectives in Promoting Innovation

Strategic policy objectives seek to deliver a significant shift in economic and wider societal activity over 10-20 years, providing a framework for market development and changing consumer behaviour. They can play an important role in providing an incentive to innovate, and in increasing the speed of the diffusion and adoption of innovation. They achieve this through:

- setting a vision and strategic direction for the co-ordination of public and private sector activity, and the development of technologies and products and services, through providing a clear, definite and measureable goal;

- creating the link between broad, multi-faceted societal challenges and commitments (e.g. 60-80% reduction in CO_2 emissions compared to 1990 levels by 2050)[1], and the policies, institutions and funding programmes that will deliver these, by focusing effort on key objectives;

- establishing parameters for the analysis of what needs to be done, and co-ordinating activity at all levels in the public sector, whilst allowing flexibility as to how objectives are delivered;

- helping to determine future regulatory frameworks and enabling the development of public procurement strategies, helping to create lead markets; and

- providing certainty about the long term policy and regulatory environment to the private sector and other stakeholders, enabling them to plan their own investment programmes.

Strategic Policy Objectives in the EU

The EU possesses both advantages and disadvantages as a location for developing and commercialising new technologies, and as a market for KET-based products and services. The EU is the largest single market area in the world, with a GDP of US15.95 trillion, and a population of over 490 million people[2]. It is the location of world class research infrastructure, a well-educated population, major companies in a range of sectors, and a number of dynamic and innovative technology clusters.

However, it is not a fully integrated research or market area, with even more fragmentation in innovation. Whilst there are common government structures, laws and funding programmes within the EU, it remains a union of 27 separate countries, which retain competence in a number of key areas relating to innovation, notably education, and retain a high level of national discretion in other areas, such as support for research and technology development. There are also: 28 different constitutions and political structures at EU, national, regional and local level; different tax systems, laws and legal systems; different languages, cultures and 11 currencies; different regulatory structures and policies in key sectors, including electricity and other utilities; and different innovation systems with specific funding and operating models, and degrees of independence from national policymakers. These factors make it difficult to adopt a common European approach to technology development and commercialisation, as the slow completion of the European Research Area and the failure to agree the creation of a European Patent demonstrate. It is also a major barrier for the needed cross border cooperation along the various value chains, thus weakening the exploitation of a significant European strength and competitive advantage.

Within the EU, strategic policy objectives have the potential to offer a new approach to supporting innovation and the development of value chains in the EU from R&D to manufacturing. The advantage of adopting an objective-led approach to societal challenges is that it enables co-ordination of effort and direction of EU-level programmes and policies and those of Member States, whilst allowing flexibility across different institutions, legal and regulatory approaches and funding mechanisms as to how these objectives are met. Whilst this approach will require common political will to agree the objectives and then implement such objectives, the EU is disadvantaged in comparison with key competitors such as China (in the field of Solid State Lighting), where large scale strategic commitments are driving the creation of new markets. Although there has been some use of this mechanism in the EU, in areas such as broadband access and smart grids, there is scope to complement these

[1] European Council Conclusions, EUCO 2/1/11, 4 February 2011
[2] 2010 estimates. CIA World Factbook.

existing objectives and make wider use of this approach in order to create markets for KETs and brigade activities that will support their development and commercialisation in the EU.

Recommendations

- **The European Union should identify a limited number of strategic policy objectives to provide a vision and set the strategic direction for the development of markets for new key enabling technologies in and from Europe. These strategic objectives should: have a tangible impact on major societal challenges; form the basis of European Innovation Partnerships; be transdisciplinary in nature and require a range of technology solutions; demonstrate benefits from concerted EU action; facilitate the development of EU value chains that reinforce EU strengths; enhance the clustering of competencies across Member States; and the objective should provide a significant demand side pull to the development of KETs and KET-based products and services.**

Case study: Building the Micro and Nano Electronics Value Chain

The European Micro- and Nano-electronics industry value chain will strengthen access to Information Technology applications and products for a smart, sustainable and inclusive European 2020 Society. The first pillar of the strategy for the European Micro- and Nano-electronics Industry is to build on its leading position in specific technology and application domains. The second pillar of this strategy is for Europe to be positioned at the forefront of new emerging markets with high potential growth rates and to become a worldwide leader in these domains. Today's emerging markets include: Energy Efficiency, Health and Ageing Society, as well as some particular areas such as Safety and Security, Communication and Automotive.
The Mission encompasses the following elements:

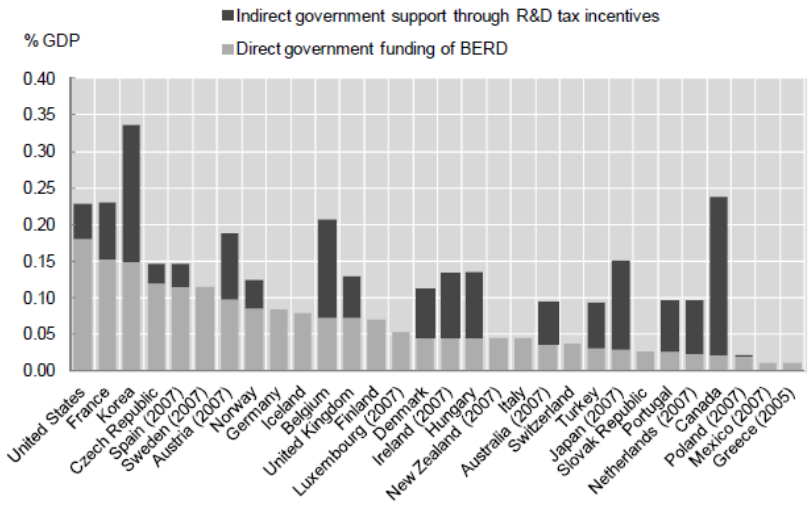
- **provide innovative and sustainable solutions to societal challenges in areas like energy, mobility, health, communication and safety;**
- **strengthen those sections of the value chain where Europe can gain global competitiveness and new market shares through differentiation;**
- **enable an adequate level of advanced CMOS manufacturing capability in Europe;**
- **foster the advancement of European "More than Moore" production sites and European foundries in the most advanced market areas;**
- **set up and support mechanisms to integrate the strengths and capabilities of SMEs and research institutes;**
- **endorse the creation of R&D platforms for design, equipment, materials, manufacturing and silicon processes."**

FISCAL POLICY AND INNOVATION

Overview

Taxation is one of the key factors influencing the business environment. Taxes on corporate profits, labour, capital investment and various allowanced related to these affect all businesses, including innovative and technology-based companies, and have an impact on activities across the innovation cycle, from research to commercialisation. However, these policies can have a particular importance for technology-based companies, which are often more capital intensive, and make longer term investments with a higher level of inherent risk than non-technology companies.

Figure 1. Direct and indirect government funding of business R&D and tax incentives for R&D, 2008
As a percentage of GDP



Note: The estimates of R&D tax expenditures do not cover sub-national R&D tax incentives. The Austrian estimate covers only the refundable research premium. The estimate for the United States covers the research tax credit but excludes the expensing of R&D. Italy and Greece offered R&D tax incentives in 2008, but estimates of the foregone tax revenues are not yet available.

Source: OECD (2010), *Measuring Innovation: A New Perspective*, based on OECD, R&D tax incentives questionnaire, January 2010; and OECD, Main Science and Technology Indicators Database, September 2010. *http://dx.doi.org/10.1787/888932333006*

The balance between direct (e.g. R&D contracts or grants) and indirect (e.g. tax incentives) is a policy choice for governments. Direct grants can support innovation through targeting particular technology areas, or ones likely to have a strong economic or social return for a country. Tax credits provide a broad incentive to invest in R&D and the capability to conduct this by reducing the marginal costs to companies; this then generates the positive spillover benefits associated with R&D activity[3]. The optimal balance of direct and indirect support will vary between countries, and needs to take account of wider policy objectives and the sectoral mix of the economy. Data on this is collected annually by OECD, through the NESTI survey[4].

As OECD research has concluded[5], taxation measures can provide powerful incentives to increase the overall level of innovation activity, and to support the adoption and diffusion of innovative products, services and processes. There are five main ways in which tax policies can do this:

- building innovation capability and incentivising greater investment in innovation through reducing the costs of undertaking innovation-related activities or for capital investment linked to innovation (e.g. through tax credits for R&D, or accelerated depreciation schemes);
- lowering the rate of tax payable on profits derived from innovative products (e.g. through patent box schemes such as those in the Netherlands and Switzerland);

[3] Estimates of the social return from R&D investment vary, but there is a consensus that these are in the range of 20-50% (e.g. Terleckyi, 1974, Nadiri, 1993, Medical Research Council and the Wellcome Trust, UK, 2008).
[4] The details of the annual questionnaire are set out in the OECD paper DSTI/EAS/STP/NESTI(2007)8
[5] *Taxation and Innovation* Working Paper, OECD 2010

- incentivising investment in innovative companies or for entrepreneurs (e.g. tax relief on capital gains for venture capital funds and business angels, or for share options offered to management teams in start-up businesses);

- encouraging the development and uptake of innovative products by taxing or requiring the purchase of permits for undesirable outputs of existing processes (e.g. taxes on waste going to landfill, tradeable permits for CO2 emissions); and

- providing positive incentives for the uptake of new products and services which have improved performance (e.g. lower vehicle excise duties on low emission or zero emission vehicles).

Tax in the EU

Within the EU, tax policy is used in all these ways. However, consistent policies are not applied in the Single Market area, as tax is a Member State competence. There are 27 separate taxation jurisdictions and systems. Because of this, the role of the EU under the Treaty on the Functioning of the European Union is limited to where EU action is essential, such as preventing discriminatory taxation undermining the Single Market[6], providing information to Member States and facilitating co-operation between them. The EU Tax Policy Strategy[7] embodies the principles that Member States are free to choose the tax systems that they consider to be most suitable, provided these respect EU laws, and that there is no need for tax harmonisation. The Strategy established the priorities for EU action as eliminating tax obstacles that damage the Internal Market, improving tax controls and combating fraud. These objectives are also linked to the Commission's general objective of ensuring tax policy supports wider EU policy objectives, e.g. the *Europe 2020 Strategy*, for smart, sustainable and inclusive growth.

The Commission has proposed the introduction of a single set of rules that companies operating within the EU could use to calculate their taxable profits. The Common Consolidated Corporate Tax Base (CCCTB)[8] would enable companies to file a single tax return for their EU activities, with taxable profits allocated to individual companies through a simple formula. Each Member State would retain the flexibility to set their corporate tax rate. The CCCTB would benefit technology-based companies, including those developing KETs or KET-based products and services. Technology companies, including SMEs and young enterprises, frequently operate across national boundaries, whether through trading, R&D or manufacturing operations. A single set of rules would reduce the administrative burdens these companies face, and strengthen the Single Market as a driver of innovation.

Global Tax Competitiveness of the EU

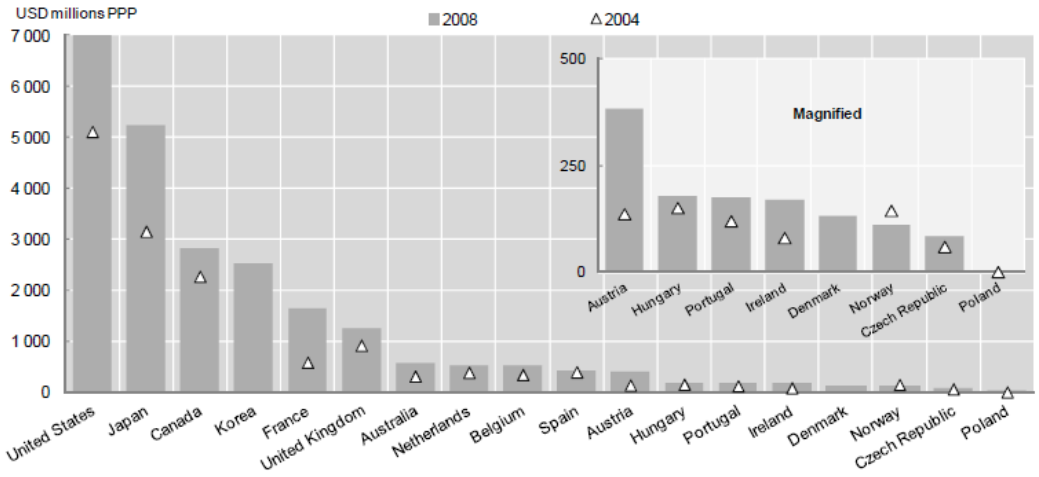
The EU is a relatively high tax area when compared to key competitor countries on the basis of the overall tax ratio (i.e. the sum of taxes and social security contributions). In 2008, tax and social security contributions as a percentage of GDP were 39.3% in the EU, compared to 26.9% in the US and 28.3% in Japan. Among major non-European OECD members, only New Zealand has a tax ratio that exceeds 34.5% of GDP[9]. The majority of this tax burden is accounted for by social security and other contributions, rather than corporation tax. Whilst there are wide disparities within the EU, ranging from a corporation tax rate of 35% in Malta to 10% in Bulgaria and Cyprus, the average corporate income tax rate in the EU is under 25%, lower than in most key competitor countries. The rate of corporation tax in the US is 40%, and is 30% in both Japan and the BRIC countries[10].

Therefore, tax incentives are an important element in ensuring the future competitiveness of the EU as a location for technology development. Many EU Member States offer tax incentives, including: Austria (an R&D Tax Allowance of R&D on volume); Belgium (a deduction for patent income, which decreases the effective tax rate to 6.8%); the Czech Republic and Denmark (both offer an R&D Tax Allowance of 200% on volume); France (a research tax credit, plus social security costs for PhD researchers are counted twice for 2 years after hiring when estimating eligible R&D); Hungary (a range of incentives, including an R&D wage tax credit of 10% for large firms, to 15% (SMEs); Italy (a tax relief of 10% on volume, or 40% if research is undertaken in universities or public research organisations); and the Netherlands (a payroll withholding tax for R&D wages, and an R&D

[6] Article 110, Treaty on the Functioning of the European Union
[7] EU tax policy strategy was set out in *Tax Policy in the European Union – Priorities for the Years Ahead* (COM (2001) 260), published on the 23 May 2001.
[8] The CCCTB proposal was established in 2001 (COM (2001) 582), confirmed in 2003 (COM (2003) 726, and the most recent proposal is set out in COM 20/2011/121.
[9] *Taxation trends in the European Union 2010*
[10] *Taxation trends in the European Union 2010*

income box, that reduces the effective tax rate to 5%). Ireland, Poland, Spain and the UK also have tax credit programmes[11].

Figure 2. Indirect government funding of business R&D through tax incentives for R&D, 2004 and 2008



Note: The estimates of R&D tax expenditures do not cover sub-national R&D tax incentives. The Austrian estimate covers only the refundable research premium. The estimate for the United States covers the research tax credit but excludes the expensing of R&D. The starting period is 2005 in Australia, Czech Republic, and the United States; 2006 for Portugal and Poland. The ending period covered in 2007 for Ireland Japan, and Spain.

Source: OECD (2010), based on OECD, R&D tax incentives questionnaire, January 2010; and OECD, Main Science and Technology Indicators Database, September 2010.

Future Challenges

The future challenge for the EU, across the Commission and Member States, is to ensure that fiscal policies fulfil the ambition of delivering meaningful support for EU policy objectives for smart growth, including through support for the development and adoption of KETs and KET-based products. Whilst it is unlikely to be possible to develop a legally robust definition of a KET for tax purposes, tax measures that can support R&D, encourage capital investment or greater investment in risk capital will have an impact in supporting companies developing these products. In future, EU funding programmes could also consider national tax credit programmes as eligible co-financing, where these will directly leverage private sector investment for KET-related projects. Similarly, in the context of a trend of increasing taxes on consumption[12], positive tax measures that encourage the adoption of new KET-based products (e.g. lower VAT on ultra efficient lighting (Solid State Lighting) or bio-based products, reduced vehicle tax on low carbon vehicles) could have a significant impact, particularly if these measures were based on products that performed to recognised EU standards. Similarly, negative tax measures that penalise products that use high levels of energy or produce high levels of waste can have a significant impact in encouraging the adoption of innovative, KET-based products.

In parallel, the EU has to ensure that the overall level of business taxation remains internationally competitive. As the Commission has noted, whilst high taxation has helped make the EU resilient in the face of the impact of the global recession, "*heavy taxation is believed to take a higher toll on growth during cyclical upturns, when it contributes to factor scarcity and exacerbates inflation*"[13]. As the economic recession has had a significant impact on the public finances and increased public sector deficits and debts, it is likely that changes to statutory tax rates (e.g. corporation or income tax) are likely to be less attractive to most Member States than measures aimed at the tax base (e.g. the introduction of exemptions or allowances such as capital depreciation). Where such measures are introduced, these should be focused on support for technology-based companies and the development and adoption of innovative, KET-based products.

[11] Sources: Therrien P. (2010), "R&D Tax Incentives and Government Forgone Tax Revenue: a Cross-Country comparison" (DSTI/EAS/STP/NESTI(2010)22) based on OECD NESTI R&D questionnaire, January 2010; OECD (2010), "OECD Science, Technology and Industry Outlook", OECD, Paris; Warda J. (2009), "An Update of R&D Tax Treatment in OECD Countries and Selected Emerging Economies, 2008-2009", mimeo and national sources.

[12] Since 2001, there has been a definite upward trend in the level of taxes on consumption (e.g. VAT, fuel or alcohol excise duties) and greater reliance on these, as set out in *Taxation trends in the European Union 2010.*

[13] *Taxation trends in the European Union 2010*

Taking account of the respective roles of the Commission and Member States in the field of tax policy, the principles set out in the EU Tax Policy Strategy and the trends in tax policy set out above, the main role for the EU will be to identify successful policies and best practice, and encourage co-operation in key areas. DG TAXUD should take an active role in working with Member States to identify successful tax measures that have supported the development and adoption of technology-based products and services and where these have had an impact on KETs, and produce an annual report on these for Member States. The external tax competitiveness of the EU should be evaluated as part of the broader external competitiveness review recommended in the chapter of this report on external competitiveness and IP.

Recommendations

- **The Common Consolidated Corporate Tax Base framework of rules should be implemented across the EU. This would strengthen the functioning of the Single Market as a driver of innovation, and remove barriers for technology-based businesses.**

COMPETITION AND STATE AIDS

Background

The State Aids framework in the EU exists to support the EU Single Market, through preventing public subsidies to business distorting competition and trade by favouring certain undertakings or the production of certain goods. Under Article 107 of the Treaty of the Functioning of the European Union (TFEU), all public financial assistance that constitutes a State Aid is forbidden unless otherwise provided for. It includes funding from national, regional or local government, other public authorities, grant funding, loans (or guarantees), venture capital investment and tax reliefs or other mechanisms by which public authorities do not collect money that would normally be owed[14].

The State Aids framework also enables the EU to meet its international commitments on subsidies in the World Trade Organisation (WTO). WTO rules are the worldwide equivalent of EU State Aids rules and are set out in Agreement on Subsidies and Countervailing Measures[15]. Part II of the agreement prohibits subsidies that are either contingent on export performance, or to encourage the use of domestic over foreign goods. Part III prohibits: subsidies that adversely affect the industries of another member; which are inconsistent with commitments made during trade negotiations[16]; subsidising operating losses (unless these are "*one-time measures*"); or grants for debt repayment[17]. Subsidy programmes have to be notified to the WTO, and dispute settlement rules apply, meaning trade remedies can be used if these are not withdrawn.

Part VI of the Agreement on Subsidies and Countervailing Measures specifically permits support for technology development activities, encompassing fundamental research, industrial research and "*pre-competitive development activity*"[18], which includes prototyping, the design of products, processes or services and demonstration or pilot projects, "*provided that these same projects cannot be converted or used for industrial application or commercial exploitation*". Routine alternations to existing products and processes are explicitly excluded.

Assistance for research and development activities is allowable, provided this does not exceed 75 per cent of the costs of industrial research or 50 per cent of the costs of pre-competitive development activity[19]. It also specifies that in projects spanning two phases of activity, assistance should not exceed the average of the allowable levels of support. Part VI[20] also allows assistance to economically disadvantaged regions, provided these are a contiguous geographic area, part of a general programme of economic development, and that the disadvantaged regions are designated by "*neutral and objective criteria*" (based on income and/or unemployment).

State Aids for Research & Development & Innovation

The existing State Aids framework for R&D&I came into force on 1 January 2007. The General Block Exemption Regulation allows Member States to fund certain types of R&D and innovation projects, high-tech start-up companies and research infrastructure and services without prior notification. The State Aid rules provide for maximum levels of funding for specific activities or for companies in designated geographical areas; decisions as to the actual level of support to be offered is at the discretion of the funding organisation, and public authorities may chose not to fund to the thresholds for budgetary or other reasons. Funding for business R&D projects is considered a State Aid. The framework provides for support for four main categories of innovation activity: fundamental research; industrial research; experimental development; and technical feasibility studies. The definitions of these are those developed by the Organisation for Economic Co-operation & Development (OECD), and contained in the Frascati Manual[21]. The definitions of these activities are:

- **Fundamental Research**: defined as "*experimental or theoretical work undertaken to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any direct practical application or use in view*";

[14] Other examples of State Aids include: interest rate relief; indemnities against operating losses; access to land or facilities on preferential terms; accelerated depreciation; preferential public procurement; and provision of goods or services on preferential terms by public authorities.
[15] The WTO Agreement on Subsidies and Countervailing Measures can be viewed at http://www.wto.org/english/docs_e/legal_e/24-scm_01_e.htm#ArticleI1a1_i
[16] Article 5, Agreement on Subsidies and Countervailing Measures
[17] Article 6, Agreement on Subsidies and Countervailing Measures
[18] Article 8.2a Agreement on Subsidies and Countervailing Measures
[19] Article 8.2a also limits subsidies to certain activities, including *inter alia* the costs of researchers, specialist equipment or premises, consultancy services including patenting, and the cost of materials used directly in research.
[20] Article 8.2b Agreement on Subsidies and Countervailing Measures
[21] An agreed taxonomy for classifying public investment in research and innovation, to enable effective international data gathering and comparison. These definitions form the basis of WTO and EU rules on subsidies.

- **Industrial Research**: defined as "*planned research or critical investigation aimed at the acquisition of new knowledge and skills for developing new products, processes or services or for bringing about a significant improvement in existing products, processes or services*";
- **Experimental Development**: defined as "*the acquiring, combining, shaping and using of existing scientific technological business and other relevant knowledge and skills for the purposes of producing plans and arrangements or designs for new, altered or improved products or services*", including developing commercially useable prototypes, although any revenues from these must be deducted from project costs; and
- **Technical Feasibility Studies**: preparatory to industrial research or experimental development.

In most areas of technology development activity, the aid intensities allowed by the State Aids framework are broadly consistent with the thresholds allowed under WTO rules. In the case of industrial research, the WTO rules allow 75% of the costs to be supported; the EU allows funding of up to 50% for single company grants for large companies, although with a 15% bonus for collaboration, and funding of 75% for medium enterprises which collaborate and up to 80% for small companies that do (e.g. this is more generous than the WTO rules). However, in the case of experimental development, including prototyping and demonstration projects, the EU imposes a much lower threshold of 25%, where WTO rules allow 50%. These rules undermine the ability of companies to undertake activities that are both crucial to the commercialisation of innovation, and which also involve considerable financial and technology risk for the company. The demonstration or first commercialisation phase places particular financial burdens on companies in capital-intensive sectors such as renewable energy, or sectors where large scale and complex manufacturing processes need to be developed and tested (e.g. Micro and Nano Electronics).

Aid Intensities: Project Aid

	GBER Threshold (per project)	Small Enterprise	Medium Enterprise	Large Enterprise
Fundamental Research	€20m	100%	100%	100%
Technical Feasibility Study		75%	75%	65%
Industrial Research	€10m	70%	60%	50%
Industrial Research involving collaboration	€10m	80%	75%	65%
Technical feasibility study for experimental development		50%	50%	40%
Experimental development	€7.5m	45%	35%	25%
Experimental development involving collaboration	€7.5	60%	50%	40%

There is also scope for further investment of EU funds in technology development and commercialisation infrastructure, investment in which may fall outside the State Aid rules. Most investments in education, skills, infrastructure (e.g. utilities, transport, ICT) fall into this category, and can have a significant effect in stimulating demand for KET-based products. Funding for such investments could be provided through the Framework Programmes or, in some cases, the Structural and Cohesion Funds. Investment in a limited number of large scale open access[22] demonstrators, which could be used by companies and their supply chains to explore and test new technologies in an environment that brings together research expertise, specialist equipment, testing and demonstration facilities. In some technology areas, this could build on existing institutions and facilities that exist. Such facilities would form the basis of a new EU capability to support technology development and commercialisation, and should be based around KETs, e.g. a factory of the future for new manufacturing technologies, or an applications testing facility for advanced materials covering industrial, domestic and other uses.

State Aid Framework Procedures

Certainty in terms of the State Aid framework and the speed of decision-making are also important factors in ensuring the EU is a competitive environment for technology development. The process needs to be streamlined and simplified for business to the greatest extent possible. In particular, there is a need for a clear timetable for decisions to be taken on State Aid cases, with a maximum time limit of 6 months within which a decision must be reached. The administration of the framework would also be made simpler if block exemption rules were applied

[22] An open access facility could be defined as one that is open to all companies based in the EU, provided that they are willing to contribute financially and participate in the project, and the facility has an independent governance mechanism.

to projects within the same framework (e.g.FP7 projects, ENIAC or CATRENE projects). If the Commission has approved the programme, then there should not be project by project assessment if the support for individual projects is consistent with wider State Aid limits. In addition, there is greater scope for use of case law and precedent; if authorisation has been granted for a similar project, with similar funding arrangements, then the presumption should be that subsequent cases should also receive approval.

Regional Development: Structural and Cohesion Funds

Support for regional development is an allowable subsidy under EU and WTO rules. Within the EU, the State Aids Framework allows for: the support of initial investment in projects (fixed capital relating to a new establishment); support for large investment projects; and in some circumstances (where proportionate and is time-limited), operating aid. A sliding scale applies to the aid intensity for large investment projects. Aid for eligible costs of up to €50m may receive aid at the full aid intensity, eligible costs of €50-100m qualifies for an aid intensity of half of the normal aid intensity and any eligible costs over €100m can only be supported at 34% of the normal aid intensity. Aid can also be offered to new SMEs for up to 5 years, up to a maximum of €3m in Article 107 (3)a regions and €2m in Article 107 (3)c regions.

Maximum Regional Aid Intensities*: Initial Investment

Article 107(3)(a) region < 75%GDP & "statistical effect" region	30%	40%	50%
Article 107(3)(c) "statistical effect" region	20%	30%	40%
Other Article 107(3)(c) region – higher cap	15%	25%	35%
Other Article 107(3)(c) region – lower cap	10%	20%	30%

*10% may be added to the regional aid intensity for medium sized companies, 20% for small companies.

The Structural and Cohesion Funds (SCF) are a significant source of support for innovation and technology development[23]. During the current Financial Perspective period (2007-13), the SCF will invest €86.4 billion in innovation, primarily through the ERDF (€65 billion) including:

- **€50.5 billion** will go to R&D and innovation, including €10.2 billion for infrastructure, €5.8 billion for activities in research centres, €5,7 billion for R&D, particularly in SMEs, and €5.6 billion for technology transfer and the improvement of cooperation of networks;

- **€8.3 billion** to entrepreneurship, including €5.2 billion for advanced support services for firms and €3.2 billion to support business start-ups; and

- **€13.2 billion** to innovative information and communication technologies to foster the demand side of ICT, in particular €5.2 billion for services and applications for citizens (e-health, e-government, e-learning, e-inclusion, etc.) and €2.1 billion for services and applications for SMEs (e-commerce, education and training, networking, etc.).

Under Commission rules (which ensure conformity with WTO rules)[24], the Structural Funds are focused on convergence and competitiveness objectives:, of supporting economic development in less prosperous regions, defined as where average per capita GDP is less than 75% of the European Union average, and supporting the convergence of regions undergoing structural economic change.

Whilst it is possible for EU funds for regional development to play a key role in supporting innovation and KETs, the legal requirements of the scheme rules and WTO disciplines mean that these funds must be spent in eligible regions and linked to the designated objectives. Therefore, it is likely that the key role Structural Funds can play in supporting KETs and KET-based products and services is through the use of these to support projects related to the development of these in regions where such capability exists, or to support the implementation of projects that will create demand for KETs (e.g. smart grids, roll-out of Solid State Lighting and broadband infrastructure). These projects should be prioritised within the framework of Structural Funds rules, as should projects which are

[23] Source, European Commission research, see http://ec.europa.eu/regional_policy/themes/research/index_en.htm.
[24] Regulation (EC) 1260/1999, published on 21 June 1999

intended to provide a demand stimulus for new technology-based products and services, many of which will be based on KETs.

Smart Specialisation

The European Commission has set the ambition of all EU policies and programmes supporting the objective of smart and sustainable growth, as set out in the EU2020 strategy. How regional policies and funding programmes such as the European Regional and Development Fund (ERDF) can support innovation is set out in *Regional Policy contributing to smart growth in Europe 2020*[25]. Regional authorities have an important role to play in supporting key elements of the EU knowledge infrastructure, such as universities, SMEs and the development of clusters. As at present only around 1 in 10 EU regions achieves the target of spending 3% of GDP on R&D, this support is essential.

However, the level of support given to research and innovation varies across regions. Therefore, there is a need to re-orientate this funding to support the development of innovation capability in all regions, by focusing funding on those areas "*which give regions the best chance of developing competitive advantage, and maximising synergy between the different sources of Community funding for innovation*"[26]. The mechanism for achieving this shift should be smart specialisation strategies. These: focus on a limited number of priorities linked to innovation; co-ordinate of all relevant policies and other activities; involve business, research centres and universities; and are co-ordinated with other EU funding programmes (e.g. Framework Programmes), and in future, the European Innovation Partnerships focused on societal challenges. Priorities for smart specialisation strategies could include support for KET-linked projects such as R&D, pilot lines and projects linked to competitive manufacturing, as well as clusters.

Smart specialisation is a welcome development in EU regional policy. All regions, not just those that are eligible for Structural Funds should consider developing smart specialisation strategies or reflecting these principles in their economic development strategies, to enable EU, national and regional funding programmes to be focused on sectors and activities in which regions can develop competitive advantage. This would have the double benefit of concentrating resources on sectors with growth potential, and also increasing the resources being invested in major European projects with wide societal benefits, such as smart grids and broadband infrastructure (to meet the agreed EU objective of complete broadband coverage by 2020), which will increase demand for KETs.

State Aid for Innovative SMEs

Under the GBER, there is a specific derogation for Young, Innovative Enterprises[27]. These can receive aid of up to €1m anywhere in the EU, and €1.5m in Article 107 (3)a regions and €1.25m in Article 107 (3)c regions. This derogation allows a high level of support to be given to early stage technology-based businesses, and can be a highly effective measure in supporting SMEs developing KET-based products and services. This derogation should be retained in future State Aid Frameworks.

Projects of Common European Interest

Article 107 (3)b of the TFEU permits "*aid to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State*". This article allows projects to be funded outside EU programmes and financial limits in exceptional circumstances. However, projects funded via this mechanism are still subject to WTO disciplines and could be made the subject of a WTO dispute. Projects also need political agreement amongst Member States. Therefore, this mechanism needs to be used sparingly, although it could be a means of supporting key projects that will build technology capability or help to create new markets for products and services. For example, this could be a mechanism that could fund large scale demonstrators of new manufacturing technologies (e.g. pilot lines) or KET-based applications (e.g. Solid State Lighting within a town, new recycling technologies and processes), that would prove these technologies can be deployed on a large scale and thus create lead markets for these in the EU, and the EU should consider how to use the mechanism in this way.

Future Development of the State Aids Framework

[25] SEC(2010) 1183, published 6 October 2010
[26] P6 Regional Policy contributing to smart growth in Europe 2020
[27] Article 35

DG COMP will be reviewing the framework of State Aid rules as part of the preparations for the next Financial Perspective period (2013-2020). The definitions of the stages of the innovation cycle, the activities included within each stage and the level of financial support for activities in these categories will be eligible for will be reviewed. The aim of this process should be to create a State Aids framework of rules that is fit for purpose for the period to 2020; this means anticipating likely future developments in the area of innovation, and planning these into the framework of rules that will operate from 2013-2020. In order to achieve this objective, it needs to take account of the following principles:

- that State Aids rules need to reflect the realities of the innovation cycle, and enable investment to remedy market failures at all stages of this;

- that State Aid rules are transparent and flexible, and maximise certainty for businesses and public authorities;

- that the thresholds for funding for projects and grants for individual companies reflect the rising costs of investment in technology development. This includes through reforming the regional aid decalage system[28], which disadvantages large-scale investment; and

- that the State Aids rules need to reflect the framework of international trade rules overseen by the WTO, in order to help ensure the EU remains globally competitive.

Recommendations

- **Adopt the principle that the level of funding that can be provided under the State Aids framework within the EU should match the maximum levels of support allowable under WTO rules on subsidies. This would raise the allowable level of support for industrial research to 75%, and experimental development to 50%; although the levels of support offered would remain at the discretion of the funding organisation at EU or Member State level. The development of pilot lines and applications demonstrators is likely to include activities across the categories of industrial research, experimental development and technical feasibility studies.**

- **In parallel, the EU should increase the authorisation thresholds under the GBER for support for technology development for individual projects to €20m for both industrial research and experimental research, and the threshold for a grant to an individual company to €10m. This should be accompanied by a reform of the decalage system. A simplification and streamlining of the rules and procedures relating to State Aids notification for projects is also required, including setting a maximum time limit for deciding cases and applying block exemption rules to projects within a programme.**

- **The EU should consider how to use the rules of Article 107 (3)b to support large scale open access technology development, testing and demonstration facilities, including pilot lines and applications demonstrators in technology areas linked to KETs where these would make a significant contribution to strengthening EU competitiveness.**

- **The framework of rules around the Structural Funds should be adapted to prioritise funding for KET-related projects linked to smart specialisation, large projects that will deliver wide societal benefits, or projects which will enhance the global competitiveness of existing or emerging technology clusters (including activities along the value chain from R&D to pilot lines and manufacturing) where co-ordinated action across the EU and Member States is a prerequisite of successful implementation.**

[28] Under the current decalage rules, investments of up to €50m are eligible for 100% of funding up to the threshold, investments of 50-100m for 50%, and over €100m 34%. This militates against large scale investment in upgrading facilities or manufacturing operations.

LEAD MARKETS AND PUBLIC PROCUREMENT

Introduction

Lead markets are potentially powerful drivers of innovation. While to date their direct application in the EU has been limited to the Lead Markets Initiative (LMI) focused on 6 distinct sectors[29] rather than KETs. However, the policy could be adapted to create significant demand for KET-based products and services. In particular they have great potential if integrated with wider strategic policy objectives and with European Innovation Partnerships.

Lead markets use a range of policy tools, including regulation and standardisation and public procurement. In some sectors and for a number of KETs, the public sector can form a credible lead market through the procurement of innovative products, while in other cases the public sector can drive innovation to underpin future markets through the procurement of research and pre-commercial procurement (e.g. programmes such as the US Small Business Innovation Research programme).

Current concepts for lead markets provide a strong framework for future initiatives. However, within the EU these focus primarily on creating markets for products and services, rather than supporting the development of value chains in Europe from R&D to manufacturing. This creates the risk that EU lead markets create benefit to exporters in other regions of the world, rather than reinforcing EU technology development and commercialisation capability. An example is the current facilitated import of solar panels into Europe from China. Future applications of this concept need to ensure that they support the whole value chain, and anchoring a significant part of this within the EU.

Lead Markets Concept

The Commission has defined lead markets as a market "*where an innovation is first widely used that later becomes successful internationally regardless of where that innovation was invented*".[30] Beise and Cleff go further to define lead markets as "*regional markets with specific attributes that increase the probability that a locally preferred innovation design becomes internationally successful as well*"[31].
Elgar et al provide a summary of a range of country-specific conditions that increase the chances of a country becoming a lead market:

- **Price advantage** whether through efficiencies or economies of scale or price differential in goods related to the innovation;
- **Demand advantage** where conditions allow local users to anticipate the benefits of local innovations that are later realised and adopted elsewhere;
- **Transfer advantage** through demonstration effects in particular through reputation and cultural perceptions of a country abroad;
- **Export advantage** where multinational enterprises based in one country provide a transfer mechanism to others; and
- **Market structure advantage** through strong domestic competition driving early adoption in the local market.

Lead Markets and KETs

Creating lead markets for KETs will require a balancing supply and demand side measures. Shared strategic visions could help to provide direction, and align supply and demand side measures towards particular goals. In terms of inducing lead markets, demand side measures are key, but the range of policy tools available is limited (standards, regulation, public procurement) need to be fully integrated with broader strategic objectives and policy measures. Care also needs to be taken in choosing sectors as lead markets will not work well for all sectors. KETs are by their very nature cross-sectoral and subject to demand from a number of actual and potential markets. Lessons can be learned from both the experience of the LMI and the DG INFSO-led Pre-Commercial Procurement Programme for ICT, both have which have highlighted the importance of engaging procuring organisations within the public sector, which are often at some distance from central government where policies are formulated.

[29] These are: e-Health; sustainable construction; protective textiles; bio-based products; recycling; and renewable energies.
[30] European Commission (2006) 'Chapter 6: The "Lead Markets" approach to innovation policy' *European Competitiveness Report 2006*
[31] Beise, M and T. Cleff (2004) 'Assessing the lead market potential of countries for innovation projects' *Journal of International Management* 10(4): 453-477

Lead markets are mostly about final products, and are less focused on developing supply chains, although there are some examples of good practice such as the UK's Forward Commitment Procurement Programme (see case study), and so require co-ordination with other policies supporting earlier stages of technology development. Therefore, care needs to be taken to ensure that KETs are not driven towards one application through a lead market initiative, to the detriment of other potentially more lucrative applications and markets that are not captured within a specific lead market programme. This highlights the broader danger that lead markets have the potential to create artificial markets if poorly designed, which could ultimately impede rather than encourage European leadership in foreign markets. Lead markets are most likely to be useful in driving forward KETs if designed to integrate KET considerations but without using standards, regulation or procurement in ways that might limit the innovation potential of KETs for other applications.

This underlines the need for a range of strategic objectives and linkages across the overarching EU framework for innovation. For example future LMIs could be more explicitly linked with broader EU programmes that facilitate collaboration on research and development for KETs. In particular linkages to European Innovation Partnerships will help ensure that KETs are integrated into any future LMI initiative, while maintaining their openness to other applications.

Public Procurement and KETs

Within a lead market framework, public procurement is one of the range of tools to be considered. Public procurement can help define and form the basis of a credible lead market. One means of using public procurement effectively would be to identify products and services that are purchased in large volumes by the public sector (e.g. construction products, ICT or telecommunications equipment, vehicles), and in tenders for these products to explicitly invite bids which incorporate innovative technologies, an approach consistent with the EU Procurement Directives. This approach would build on that adopted with regard to encouraging the open source IT sector, which has been particularly successful in Germany, where a number of tenders have been awarded to open source providers. This would benefit KETs such as industrial biotech, where there is a developing market for bio-based construction materials such as insulation foams, concrete made from vegetative aggregate particles and various composite materials.

The application of public procurement in encouraging KETs is wider than lead markets alone, incorporating pre-commercial procurement and the procurement of R&D which fit less well within a lead market framework. Pre-commercial procurement and mechanisms for the procurement of R&D have a potentially more direct role for KETs where the procurement need could be designed to drive forward KETs for a particular or multiple applications. Mechanisms including Forward Commitment Procurement, Pre-Commercial Procurement and the proposed EU-SBIR programme provide useful examples that could be fine-tuned within a KET context. However, at present, the rules pertaining to some EU funding programmes (notably the Competitiveness and Innovation Programme funded from the Structural and Cohesion Funds) cannot at present easily support innovation procurement activities, as co-funding of procurements in Member States is difficult. In future, EU programmes need to be designed with sufficient flexibility to do this, as is incorporated into the Framework Programmes.

Case study: Ultra Efficient Lighting for Healthcare

The Rotherham NHS Foundation Trust (RFT) Ultra Efficient Lighting for Future Wards project sought to deliver a step change in patient's experience and in the efficiency of lighting linked to a refurbishment programme at the hospital. With the assistance of the Photonics and Electronics Knowledge Transfer Network (PEKTN) the RFT developed a market engagement process followed by an outcome based procurement specification that was open to new technologies and new applications.

An initial market engagement process led to cross-sector facilitation and the creation of an Anglo-German consortium that represented a new supply chain, which worked together to respond to the procurement specification. Their winning solution – a smart 'future ward' modular solution that integrates lighting, trunking and storage – exceeded the RFT's expectations. Importantly, because of the cross-sectoral approach to the project and through integration with the PEKTN, the solution developed is open to future developments in photonics technology such as organic LEDs.

Recommendations

- **A key element of the design and development process for any EIP should be consideration of how this will support the development of KET-based products and services, and only EIPs that will have a significant impact in doing this across a range of KETs should be taken forward. In parallel, all EU funding programmes should ensure their rules are flexible enough to enable them to support procurement activities in relation to KETs.**

REGULATION AND STANDARDISATION

Introduction

Regulation and standards have an important, albeit complex, role to play in encouraging innovation and KETs. Because of the diversity of KETs, regulations and standards can create a mixed range of incentives. Cross-cutting regulations in areas such as competition are particularly important. So are technical regulations that set legal requirements for product performance and use, or standards that provide consumers with assurance about product performance. Innovation can be the focus of, or a beneficial outcome of a regulation or standard. Medium-long term regulatory frameworks can encourage companies to innovate and develop new products and services. But standards and regulation can also inhibit innovation, or the adoption of new innovations.

Regulation and KETs

Regulation, at a basic level, is a means of mandating positive behaviours or forbidding negative behaviours. Both types have a role to play in encouraging innovation. The role of regulation in the EU and in Member States has changed over time and the range of issues each is employed to deal with has expanded with the policy interests of governments. Recently, more complex regulatory instruments have been employed to encourage innovation by imitating market forces, notably emissions trading. These instruments represent an important shift towards outcome based regulation, where the means of achieving a desired goal are relatively open. In the EU and in some Member States, approaches to Better Regulation or Smart Regulation are being adopted, with the costs of regulations being considered and viable alternatives to regulation being more thoroughly considered. However, there is further to go in this process, and EU legislation or regulations have in the past imposed significant burdens on business.

Regulations can play an important underpinning role in encouraging the development of KETs through creating and shaping markets for KET-based products and services. Regulations can facilitate the rapid adoption and diffusion of new products. Regulatory changes in mandating the inclusion of 5% biofuel in petrol supported the production and use of this. EU regulations to reduce waste and encourage recycling have supported the development of the materials industry by creating a requirement to recycle a higher volume of waste, driving investment in these technologies. Similarly, the proposed legislation on vehicle emissions will promote the development and uptake of low carbon vehicles, which incorporate many KET-based products.

Existing regulations can inhibit the development of markets for innovative products, as is the case in the industrial biotech sector. In some areas where multiple standards and regulations exist, such as construction, bio-based products now offer alternative materials, but these are not being widely adopted as existing regulations and standards are not flexible enough to allow this. The EU Ad Hoc Advisory Group for Bio-Based Products recommended a number of regulatory approaches to support the development of the market for bio-based products[32]. These include:

- allowing bio-based plastic to enter waste collection and recovery systems, including allowing bio-based plastics that are certified as compostable to enter biowaste collection;
- introducing binding targets for certain bio-based products, drawing on the experience of biofuel quotas in the EU; and
- developing new standards to show that bio-based construction products comply with construction legislation and regulations.

The EU is also in danger of falling behind competitors in its approach to future regulation, and the integration of regulatory approaches into technology development. A US Food and Drug Administration White Paper[33] set out an approach to supporting regulatory science (the development of new tools, standards and approaches, including both scientific and social science methodologies) and to integrating this into the process of technology development. This will increase the speed with which technologies are available to patients, and help reduce the costs and time required for clinical or food product testing to ensure safety, by improving the approaches used. The EU should give consideration to developing a parallel approach and to integrating this into EU Framework Programmes; Member States should be encouraged to do the same in their own innovation programmes.

Standards and KETs

[32] *Measures to promote the market introduction of innovative bio-based products*, part of the Lead Market Initiative 3 November 2009
[33] Advancing Regulatory Science for Public Health, October 2010

Standards play an important role in innovation. They facilitate access to markets, enable interoperability between new and existing products, services and processes, giving consumers confidence in innovations, and disseminating research results. There are different forms of standards, including anticipatory, participatory and responsive ones. There are also pre standards or interim standards used at earlier stages of technology development and standards setting. It is important to match the standard to the maturity of the technology and the stage in the innovation process. They can also reduce or remove the need for regulation by achieving the same outcome by less onerous means

Standardisation is a mechanism that is increasingly widely used, notably in the US in the areas of smart grids and meters and in the US Food and Drug Administration Critical Path[34] initiative. There are also initiatives in Japan. The EU needs to do more to match this, and repeat the success of previous standardisation initiatives, such as the development of the GSM standard for mobile telephones. If standards are to achieve optimal impact in supporting innovation, it is important that standardisation is started early in the research and development process, to enable the involvement of relevant stakeholders, including National Standards Bodies, and European Standardisation Organisations, and the European Committee for Standardisation (CEN).

Despite the importance of standards, EU funding programmes have been relatively slow to integrate the development of standards into the research and other programmes that they support, a situation noted by the Committee on the Internal Market and Consumer Protection[35] and which the Commission proposes to address[36]. One solution has been proposed by the CEN, which has developed the STAndardisation Innovation and Research (STAIR) framework, to integrate standards with innovation and research. The STAIR working group has identified ways of integrating the STAIR approach into the Common Strategic Framework of the Framework Programmes, and has made a specific recommendation that this be integrated into the EIPs, as part of the process for creating lead markets in key sectors. These proposals should be implemented.

Figure 1 – The Integrated Approach: Standardization at the service of research and innovation (Source: STAIR)

For some KETs, notably Micro and Nano Electronics, international standards more important than EU standards. This is because customers demand products able to function anywhere in the world, and because manufacturers of the final products rely on global supply chains and so need to integrate many components. For example, it has been identified that a modern laptop includes 251 interoperability standards, developed by consortia, established standards setting bodies or individual companies[37]. This does not include related standards including quality, design, environmental or safety standards. In addition to active engagement in in EU standards setting processes, active encouragement should be given to participation in international standards setting processes where this is the most appropriate level for a particular KET. This engagement will also facilitate securing market access for EU manufactured KETs, by influencing the international standards that are adopted for products and ensuring these draw on EU-developed technologies.

Case Study: Promoting Clean Technologies

Sweden introduced regulations charging companies for their Nitrous-Oxide (NOx) emissions in 1992, following the introduction of an economy wide target in the early 80s and subsequent quantitative emission limits for individual facilities. These measures were found to be insufficient to meet economy wide reduction targets and therefore an innovative charging mechanism was introduced, that refunded 100% of the charge back to the companies involved, based on their individual performance. This alongside other measures reduced NOx emissions by 50 per cent between 1992 and 2007. Not only was the charge found to create significant incentives to adopt existing abatement technologies, it also induced a number of new innovations, including patents as well as process innovations.

Regulation and Standards in Lead Markets

Regulation and standards can play a particularly strong role in underpinning the development of lead markets. Long-term regulatory targets can stimulate the private sector to actively develop technologies. Industry agreed standards can then help further define issues as technologies develop including terminology and interoperability, and can help define markets as technologies emerge. Lead markets also emphasise the interaction between regulations and standards and public procurement. These are more likely to be successful if the public sector can act as the first customer for new products and services. Regulations and standards also facilitate the uptake of innovative products, by in effect mandating that only products that achieve certain performance can be procured, which also helps develop markets. Greater use of these standards in this way could have a positive impact on some KETs, for example bio-based products, where the specification of product standards in public sector tendering procedures would drive the use of these products.

The role that regulation and standards can play in developing in lead markets further underlines the importance of strategic policy objectives related to KETs, as these create a framework for the future development of regulations and standards that help create lead markets.

Recommendations

- **The EU should investigate the creation of a future regulatory initiative similar to the US FDA to regulatory science, and seek to integrate this into EU Framework Programmes.**

- **Fully integrate the STAndardisation, Innovation and Research (STAIR) framework, into the Common Strategic Framework of the Framework Programmes, as recommended by the CEN. Consideration should also be given as to how participation in international standards making can be incentivised and encouraged within EU funded innovation projects when these are the most suitable fora.**

EXTERNAL COMPETITIVENESS AND INTELLECTUAL PROPERTY

Introduction

Trade can be a strong catalyst for innovation and for the development of innovative products, including KET-based products, by facilitating access to global markets. Trade policy and negotiations play a crucial role in facilitating market access on Most Favoured Nation (MFN) terms. This is particularly important for key KET-based industries of KETs such as the mechanical and electrical engineering industries, which represent over a third of the manufacturing exports of Europe, and are highly dependent both on technological development and trade conditions. Where barriers are persistent and against the rules of the WTO or a particular FTA, DG TRADE can use trade defence mechanisms and dispute resolution procedures also enable the EU to the EU to target trade-distorting and unfair practices.

Trade Policy – Opening Markets for KETs

DG TRADE works with international partners to set a framework around which international trade can occur and can be further opened. This activity occurs both bilaterally, through country to country market access and free trade agreement (FTA) negotiations, and multilaterally through the WTO. While much of the focus of these efforts has historically been in reducing and removing tariff barriers to market access, more recently attention has turned to non-tariff barriers. This work is pivotal to ensure that KETs and resulting products are able to access markets. For example, technical barriers to trade (technical requirements, product standards, labelling requirements etc.) can serve as barriers to new and innovative technologies being exported to a particular market (see China Indigenous Innovation case study below). The *EC Trade and Investment Barriers: Report 2011*, serves as an important means of communicating these barriers and working towards their removal. Integrating barriers relating to KETs into future editions of this report will be important. Further examples of trade barriers affecting exports of the KET dependent industry can be found in the Electra Report annexes[38] In some markets, encryption policies also block market access for EU companies.

Furthermore, where barriers are persistent and against the rules of the WTO or a particular FTA, DG TRADE can help rectify this type of barrier through formal dispute resolution mechanisms.

Case study – China's Indigenous Innovation Policies
in 2009, China announced its intention to introduce an indigenous innovation policy which would have seen Government procurement favour technology products with IP registered in China. This would have had a large impact on products based on KETs with IP not registered in China and would have proved a strong barrier to trade. DG Trade, Members State, other countries and private companies consulted with the Chinese about the problems with the proposed policy and its potential inconsistency with WTO rules on public procurement (China is still in the process of acceding to the WTO Agreement on Government Procurement). The policy has since been significantly revised and no longer represents a major concern, although careful monitoring continues.

EU Trade Barriers to KET Development

The development of a dynamic market and value chain in the EU in relation to certain KETs is at risk of being impeded by the EU's own trade policies and tariff levels. This is particularly the case in relation to industrial biotechnology, where access to feedstock or raw materials such as bioethanol at world market prices is vital if the EU is to develop the sector further. The tariff barriers to the import of these products that support the Common Agricultural Policy are likely to have a significant effect on the development of this sector in the EU, by making large scale production of some bio-based products uneconomic. The EU should analyse where specific tariff barriers are obstructing the development of KET-based products, and seek to remove these through future multilateral or bilateral trade negotiations, or by creating a new import regime for users of these feedstocks.

Other Aspects of External Competitiveness

[38] Electra report Annex 4 *Opening the internal and export market s of the European electrical engineering industry : challenges in the area of regulation, trade barriers and standards.*

Tax policy, State Aids rules, the competition framework, tariff barriers to the import of certain products and the protection of intellectual property all have a fundamental role in determining the external competitiveness of the EU for KET development and exploitation. However, we do not have a strong set of metrics or an underpinning process that enables comparison of the EU business environment with that of key competitor countries. For these reasons, it would be useful to develop an ongoing framework through which the policies described in this report and their effects on KETs can be analysed within Europe and in a range of key trade partners and competitors in the development of KETs (e.g. US, Japan, Korea, India, Brazil, Singapore etc.). This will help to create a long-term comparison between EU and other efforts to encourage the development of KETs through these policy measures, and help ensure access to global markets for EU businesses.

Intellectual Property

Overview

Innovation is the product of investment in a wide range of complementary assets. Innovation investments by companies are multi-faceted and not limited to R&D, and include intangible assets, underpinned by intellectual property rights. Investments in intangibles can be categorised as: traditional (R&D, design and intellectual property); software development (software and databases); and economic competencies (investments in training, organisational development, managerial capability, product development, marketing and branding). Evidence suggests that broad (intangible) and traditional (R&D and patents) innovation activities are complements rather than substitutes[39].

Mechanisms that protect proprietary intellectual property, including patents, copyright and trademarks, are of vital importance in supporting both the effective operation of the Single Market and the competitive position of EU companies in the Single Market and internationally. For this reason, the EU has been seeking to introduce the EU Patent for over a decade. This would ensure consistent patent rights across the EU. It would also reduce the patenting and enforcement costs to business arising from the present system of European patents (the cost of securing patent protection across all 27 Member States is estimated as being 15 times more expensive than in the US[40], and implementing the European patent would save innovative businesses a estimated €58.5m), and remove distortions in the operation of the Single Market. As many manufacturing technologies are not suitable for patenting, but are part of the tacit knowledge embedded in companies, Europe should establish a system for recognising the inventor as the owner of the IPR, in a manner similar to the copyright system.

EU companies operating internationally, including technology based companies, are at increasing risk from intellectual property infringement, even in sectors such as ICT or biomedical, previously protected from this by the difficulty of replicating a product. An important element of multilateral and bilateral trade negotiations is ensuring that these deliver common enforcement standards and more effective international co-operation. Any international enforcement measures should be effective, appropriate and tailored. It is also important that work to support capacity building in areas such as enforcement in countries like China continues to be undertaken, through European and national authorities.

In areas such as climate protection, there are increasing discussions within the framework of the UNFCCC negotiations that any agreement on limiting carbon emissions must be accompanies by technology transfer to developing countries. Where this happens, it should be where it will make a significant impact on climate change, and where this involves the transfer of proprietary technology, there is a need for fair compensation to the IP rights holder.

Ensuring the Exploitation of IP from Publicly-Funded Projects

Economic benefits flow from the wide adoption of innovations. Therefore, a key objective of EU and other public bodies that fund technology development is to ensure the commercial exploitation and manufacturing of these within the EU, and to ensure that there is a clear route to market for technologies and technology-based products and services developed with public support, and that publicly funded research does not lead to the accumulation of unused intellectual property by research organisations, the public sector or companies. This could be achieved through either a legislative approach at EU level, or through an approach based on changing funding programme rules and best practice sharing.

[39] Battisti and Stoneman (2007)
[40] Commission Communication, *Europe 2020 Flagship Initiative, Innovation Union* COM (2010) 546

The legislative approach could take as a model the approach of the Bayh-Dole Act[41]. Introduced in the US in 1980, this seeks to encourage the exploitation of innovations by transferring ownership of IP generated during Federally-funded research projects to universities or small businesses, provided they fulfil a number of conditions, including: reporting their invention; protecting it; granting the Federal Government a licence to use it; not assign the rights; provide preferential access for the exploitation of IP to US businesses and SMEs; and actively seek to exploit the invention (exploitation is defined as the "*practical application*", i.e. manufacturing). In theory, it also provides the Federal government with a march-in right to allow it to licence the IP to other organisations in the event that no effort is made to commercialise it, although this has never been used. Bayh-Dole also includes an "*exceptional circumstances*" clause that reinforces the exploitation of IP in the US, which has been used by the Department of Energy to develop Solid State Lighting. However, it is difficult to isolate the extent to which the impact of IP exploitation has been driven by Bayh-Dole compared to other factors, such as the proximity of the research expertise and the availability of investment capital.

A mission by DG RTD and DG ENT to the US to consider this issue has recommended the adoption of similar provisions to Bayh-Dole within the EU. Some public funding programmes in the EU include similar rules, including programmes in Denmark and Germany. For example in Germany, BMBF requires that in case of a license from a Public Research Organisation or an industrial company to a non-EU party, that party has following obligations:

- that the funding agency is informed of the proposed transfer and agrees this; and
- the right to license to a non-EU party can lead to a reimbursement to the funding agency of all or part of the funding received for the R&D project

An alternative approach would be to ensure funding programmes within the EU support the development of all elements of the value chain in the EU. It is important that the design of programmes and the selection criteria for consortia encourage the embedding of value chains, from research to manufacturing, in the EU, and prioritise projects that will do this. Consideration should also be given to introducing criteria into the consortium contract that supports the manufacturing of products based on IP developed through EU-funded projects in the EU. Exploitation could include setting up a new company to manufacture products based on the IP, which may seek funding from the European Investment Fund, or one of the funds it has invested in. If the consortium does not intend to exploit the IP, it should be mandatory to first offer of the intellectual property derived from public funded research programmes to companies that would manufacture in the EU, for up to 6 months. If not taken up, then the consortium should be free to exploit their IP with any international partner.

Whilst decisions on ownership of IP should ultimately rest with the funding organisation and consortia members, the principle should be that any IP generated through publicly-funded research must be exploited. Organisations or consortia that receive public funding should have clear plans for commercialisation set out in their application for funding, which can be referred to in the funding contract. Agreement on IP ownership and responsibility for exploitation should also be required as a condition of receiving EU funding. More could be done to share best practice in terms of approaches that will deliver this outcome. The Expert Group the Commission is proposing to set up to consider how IP can best be exploited in the EU, which includes the options of setting up an online brokerage and valorisation tool, should also consider how best to achieve the exploitation of publicly-funded research. It could also consider whether the rules of EU funding programmes should include specific provisions to incentivise exploitation, and to establish a framework for sharing best practice.

Non-Practicing Entities IP licensing and the international IP legal framework

Non-Practicing Entities (NPEs) are organisations which own IP, but do not design, manufacture or distribute products. NPEs seek to gain revenues through licensing IP to companies that develop products based on this. Whilst this is a legitimate business model, it has an impact on the operation of EU companies in key markets such as the US. For example, as it often results in offensive claims to protect IP, contributing to an increase in the level of patent litigation, particularly within the US. Since 2000, the number of patent infringement cases brought in the US has been running at over 2,500 per annum[42]. This has an impact on EU companies trading in the US market; some technology companies report that they have had to put aside 1-2% of turnover to cover US legal fees[43].

[41] University and Small Business Patent Procedures Act, 35 USC § 200 212
[42] *A closer look: Patent litigation trends and the increasing impact of nonpracticing entities*, Pricewaterhouse Coopers, August 2009
[43] Anecdotal evidence, source UK Intellectual Property Office

This problem is largely confined to the US, and is a factor of US commercial and litigation cultures that can be complex and expensive, often giving rise to protracted legal action. By not imposing a cost threshold prior to litigation, which reduces the risk to plaintiffs who want to take action to defend their patent (important as only 29% of NPE cases are successful), and offering high settlements to winners in legal cases (the annual median level of damages awarded ranged from US $2.2 to US $10.6 million 1995-2008; awards for NPEs have been on average double those for practicing entities) litigation in the US can be very difficult. The proposed Patent Reform Act in the US (currently under discussion in the Senate and House of Representatives) could help to resolve these issues, by making it harder to pursue patent infringement claims, building on US Supreme Court decisions in various cases[44].

IP licensing underpins many business models and is an important channel for the commercialisation of technologies, or means by which research institutions or intermediate companies derive an economic return from their investments. However, increased emphasis on formal IP protection mechanisms is likely to generate more litigation. There is a risk that this will draw company and other resources away from innovation. There is also a risk of the US litigation culture spreading to other jurisdictions in Asia, and even Europe (although legal systems in the EU offer some protection against this and strengthen the focus on patent quality). Provisions in EU funding programme rules that incentivise innovation in the EU would make it more difficult for NPEs to acquire IP from EU funded programmes. Whilst seeking to create strong international IP frameworks is a vital interest for the EU, it will also remain important that this is complemented by an active approach to ensure that EU IP frameworks deter speculative litigation, and that the EU continues to lobby in other jurisdictions for similar constraints.

Protecting the innovations of EU companies

A core issue for many companies is that of having the opportunity to recover the investment they have made in innovation. Therefore, the effective protection of IP is increasingly important to business. Improved enforcement of protection of IPR is needed in both the internal market and in export markets, including:

- Continuing to ensure that IP is a central element of both multilateral and bilateral trade negotiations, and especially in countries which have weak IP legislation or poor enforcement capability. The EU should also use dispute resolution procedures to secure protection of IP;
- establishing a close alliance with the U.S.A. and Japan on IPR enforcement issues, including at local level within external markets;
- Targeted market surveillance activities at the borders of the EU and in the internal market;
- A better coordination between customs and market surveillance authorities both in the area of counterfeiting and for goods which are non-compliant with EU regulations;
- Broadening the system of the IPR-helpdesk; and
- Developing a joint IPR strategy common to the European Commission as a whole.

Recommendations

- **We work to communicate barriers to trade in KETs and resulting products through the EU Trade and Investment Barriers report and other mechanisms.**

- **A framework should be developed to compare the impacts of EU policies affecting the external competitiveness of KETs (taxation, State Aids, procurement, IP etc.) with key competitors. The Commission should produce an annual report benchmarking the EU against key competitor countries.**

- **The EU should consider amending the selection criteria and contractual terms of funding programmes to ensure that participating consortia have a clear plan for both the ownership of and exploitation of IP resulting from the project within the EU, and include Bayh-Dole Act like provisions to encourage the exploitation and manufacturing of products based on this IP within the EU.**

- **A system of targeted market surveillance activities at the borders of the EU and in the internal market should be created, to support companies in protecting their intellectual property.**

- **A core element of EU trade negotiations and Market Access strategies should be the promotion of effective, appropriate and tailored IP framework internationally. This should be complemented by**

[44] e.g. US Supreme Court decision in eBay vs Mercexchange, 2006, KSR International vs Teleflex 2007.

market specific approaches to support initiatives that prevent the spread of the US litigation culture in respect of intellectual property.

- **EU to develop a kind of copyright system for KET`s, which allow IPR protection of those areas which are not patented, but still require knowledge protection.**

ANNEX A: A SMART GRID IN THE EU - A STRATEGIC POLICY OBJECTIVE FOR 2030

Objectives

- To implement a comprehensive future energy infrastructure (smart grid) across 27 EU Member States by 2030 and implementing smart metering across 80% of homes and businesses in the EU by 2020.

Impact on Societal Challenges

A smart grid is an upgraded electricity distribution network underpinned by digital infrastructure that enables dynamic monitoring and control. It delivers electricity supplies to consumers through intelligent monitoring and metering systems matching supply to demand, saving energy, reducing costs and increasing reliability. They would contribute to resolving societal challenges by:

- reducing CO_2 emissions from buildings (c30-40% CO_2 emissions) and other sources through intelligent monitoring and control of appliances and facilitating the use of distributed energy generation and micro-generation;

- reducing CO_2 emissions from power generation, by enabling utilisation of clean but intermittent sources of energy (e.g. solar, wind and wave) and reducing the need for standby generating capacity.

- extend the life of electricity infrastructure by protecting high-value capital equipment (e.g. transformers) from fluctuations, maximising efficiency and minimising waste; and

- enabling the storage and release of electricity to meet strong but variable demand from vehicle charging. This is vital to create a market for electric vehicles, another KET-based product.

The Challenge

To implement smart grids, the following challenges need to be overcome:

- developing large scale and cost effective energy storage technologies;

- development of more advanced sensing, control and metering technologies, and data storage of large quantities of information that can be rapidly analysed and utilised in managing network;

- cultural change to empower consumers in energy management decisions and to ensure their acceptance and use of new technologies; and

- ensuring grid interconnectivity for microgeneration and increased integration of on-shore and off-shore renewable energy.

KETs and KET-based Products in Smart Grids

Micro and Nano electronics: semiconductors and chips in control systems enabling intelligent distribution, optimising levels of automation and decision-making throughout the grid.

Advanced Materials: required for new transmission and distribution systems (e.g. superconductors), and will also be required in energy generation technologies that smart grids will enable, and in energy storage technologies.

Industrial Biotechnology: new energy sources, (e.g. biofuels or algae).

Photonics: utilised in digital control systems, and in ultra-efficient lighting.

Delivering Smart Grids in the EU

As the Commission Communication *Smart Grids: from innovation to development*[45], sets out, implementing smart grids across the EU will require co-ordinated action at EU and Member State level. It will also require co-ordination across a range of policy areas spanning the 3-pillar bridge. This could include:

Technology Development

- Ongoing **Framework Programme** support for technology development, building on the European Technology Platform in the Electricity Networks of the future established by DG Research.
- **Structural Funds** should prioritise the implementation of smart grids in less-economically developed regions.
- Create an **EU Innovation Partnership** for future electricity networks to support R&D into key technology challenges such as energy storage and interconnectivity for microgeneration, and to act as a mechanism for coordinating other policy activities.

Tax

- Tax incentives for capital investment (network operators) and for consumers (to install microgeneration technologies) would facilitate more rapid adoption of these.

Regulation

- EU electricity regulators will need to adapt their policies and regulatory frameworks to facilitate the necessary capital investment, and to create incentives for investment in areas such as microgeneration. Regulators will also need to allow new business models, not just those of large incumbents, which enable dynamic pricing.
- Legislation or regulation may also be needed to ensure installation of smart grid and metering technologies on a sufficient scale.

Standardisation

- Interoperability standards for networks and consumer devices (which the USA has, but the EU does not).
- An EU-wide standardisation project has been established to determine performance standards for key metering and grid technologies by end-2012.
- Communications standards for networks and consumers and data security standards for information gathered and stored by meters and grids.

Demonstration

- Public procurement (or use of the Article 107 (3)b mechanism) could be used to support a series of large-scale open access demonstration projects in several regions with different characteristics e.g. high-density urban, low density urban, rural, industrial, to demonstrate and test smart grid technologies in real world “living labs”.

[45] (COM (2011) 202), published 12 April 2011