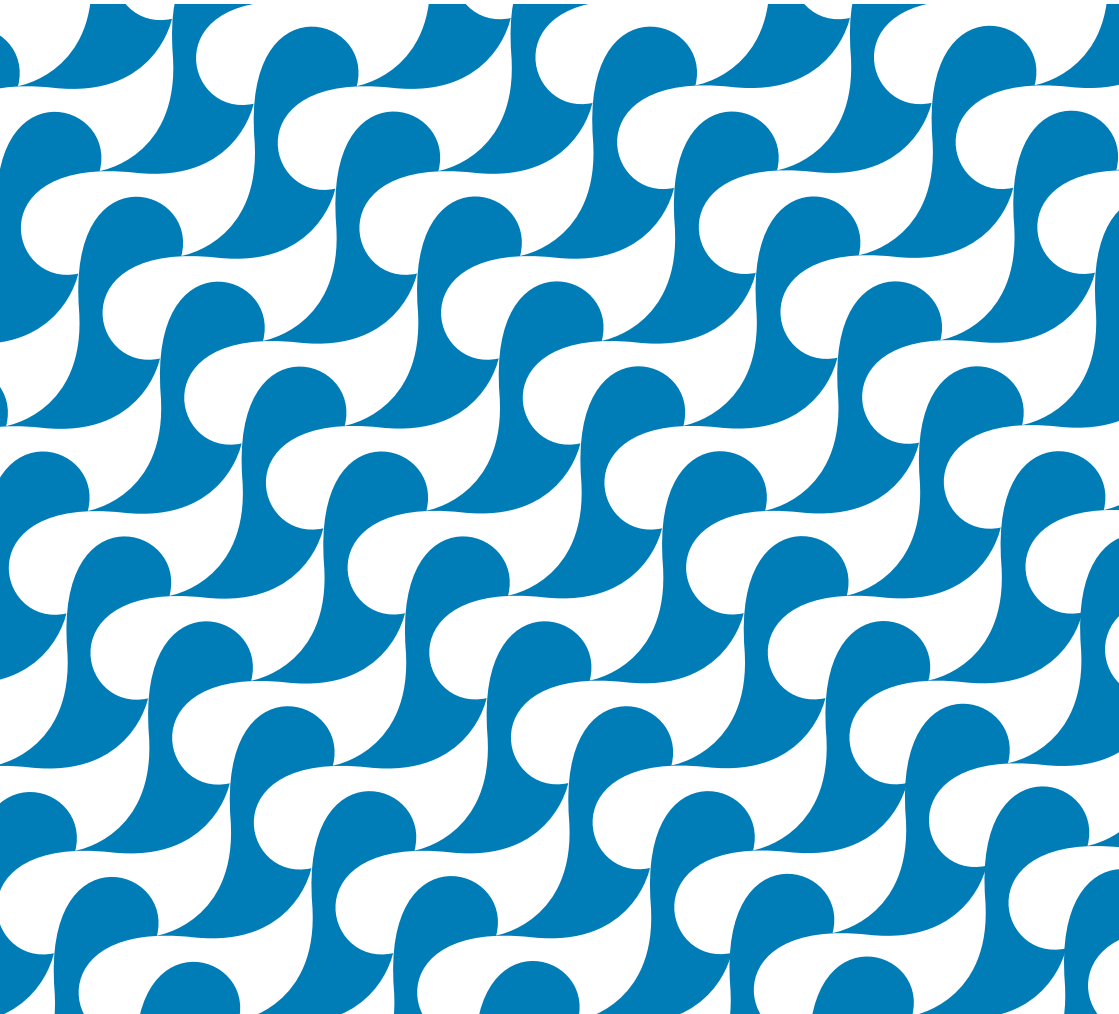
SWENTEC

Swedish strategies and initiatives for promotion of environmental technology

A national roadmap for the implementation of the EU Action Plan for Environmental Technology, ETAP



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FOREWORD

Swentec has been commissioned by the Ministry of Enterprise, Energy and Communications and the Ministry of the Environment to produce this report as part of the implementation of the EU action plan for environmental technology ETAP – Environmental Technology Action Plan. The report will also be used as a basis for reporting to the EU Commission on Swedish strategies, initiatives and measures for national environmental innovations and environmental technology.

The report provides an overview of the Government's initiatives and the national initiatives of the agencies, some illustrative regional and local examples of cooperation over the implementation and development of environmental technology. Sweden's actions with respect to the global community concerning exports of environmental technology and transfer of technology in development cooperation are also covered. The report ends by presenting strategic conclusions and recommendations.

The work of producing the report has been carried out by a working group linked to Swentec. The following have participated in the working group: Ulf E Andersson as convenor – from the Swedish Environmental Protection Agency, Cecilia Ankarstig – Nutek, Andreas Stubelius – the Swedish Energy Agency, Dan Strömberg – Centre for Environment and Sustainability and Lars Wärngård – Vinnova.

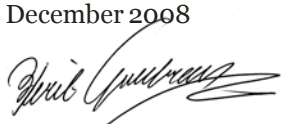
Other agencies and organisations have also contributed to the report, and these include the National Board of Housing, Building and Planning, the Swedish Trade Council, the Royal Swedish Academy of Engineering Sciences, the National Land Survey/Metria, Invest in Sweden Agency, the Swedish National Space Board, Sida and the Swedish Fund for Industrial Cooperation with Developing Countries.

In Sweden we regard the development and use of good environmental technology as an important means of reducing negative environmental impact from our consumption and production, at the same time as competitiveness and industrial growth are promoted. Sweden is an example

showing that it is possible to have both economic growth and at the same time reduce environmental problems.

Our appreciation goes to the working group and particularly to Ulf E Andersson for organising the working group and compiling the material.

December 2008



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1 Background: Goals, analysis and strategies

1.1 ENVIRONMENTAL TECHNOLOGY – SWEDISH STARTING POINTS

By means of environmental technology we can reduce the impact on the environment of our consumption and production, at the same time as the competitiveness and growth of industry is promoted. In many parts of the world, major investments are needed to tackle environmental problems.

In Sweden environmental technology has increasingly become a tool for strengthening Swedish industry and contributing to a reduction in its environmental impact. The Swedish Government considers that environmental challenges should be used to leverage the economy. The international market for environmental technology is undergoing rapid growth, and climate and energy issues are coming increasingly to the fore. Continuing urbanisation means that advanced environmental technology and know-how concerning sustainable city development will increasingly be required in both industrialised and developing countries. Global interest in energy and environmental technology is accelerating at the same time as industrialisation in major growth markets is increasing the need for technology to promote sustainable development. The areas where Sweden is particularly successful are in waste, water and sewage treatment, renewable energy, air purification and increasing energy efficiency. In addition, Swedish expertise in community planning, a holistic view and the adoption of systems approaches which Sweden has taken in this area are often highlighted.

Definition of environmental technology

Environmental technology is all the technology that directly or indirectly contributes to a better environment. Environmental technology covers goods, systems, processes and services which provide clear environmental advantages in relation to existing or alternative solutions viewed from a life-cycle perspective. This involves technologies for reducing the emission of pollutants, producing clean water and air, using energy and natural resources more efficiently, and above all technical systems to reduce or eliminate the negative environmental impact of technology.

Environmental technology covers, for instance, processes and technologies for the production of heat and electricity from renewable fuels, solar cells, wind power, biogas plants, systems for economising on use of energy in housing, renewable materials, technologies for waste management, water purification, fluegas treatment, more efficient engines for vehicles, ships and aeroplanes, as well as processes and technologies for the production of environmentally friendly goods and services. Environmental technology also covers environmentally friendly technologies and processes in agriculture, forestry and fisheries, as well as technologies and processes using organisms for technical purposes, such as microorganisms for treating contaminated ground or wetlands for the treatment of waste water.

The Swedish approach covers not only technology and technical systems per se, but also involves taking a holistic and systemic approach to the whole supply chain for integrated system solutions which also cover recycling or management of waste products, in effect the whole life cycle. This approach to environmental technology is entirely consistent with the definition of environmental technology used by both the EU and the OECD.

In national terms Sweden has a high adoption of environmental technologies. This is an important contributory factor as to why Sweden has succeeded in decoupling the connection between economic growth and the production of greenhouse gases. During the period 1999–2006 Swedish emissions remained under the 1990 level by on average 4.5 percent. At the same time its GDP has grown by an average of 3 percent a year. Sweden's emissions of greenhouse gases are amongst the lowest in the OECD countries on a per capita basis. This shows that it is possible to combine economic growth with an improved environment.

1.2 SWEDISH NATIONAL INITIATIVES IN ENVIRONMENTAL TECHNOLOGY AND ENVIRONMENTAL TECHNOLOGY COMPANIES

Development and use of environmental technology is a priority area for the Government during its mandate period of 2007–2010. It is important to take advantage of the business and export opportunities that small and medium-sized companies have. It is also a major challenge to achieve sustainable road and air transport by developing new, more environmentally friendly technologies. Research, development and demonstration of new vehicle technologies is thus an important part of the Government's initiatives in the development of environmental technologies.

A key proportion of Government initiatives for measures with regard to climate involve the development and use of good environmental technology. In the climate area, the Government has earlier allocated the "climate billion", and it decided in September 2008 on an additional package of SEK 3 billion for climate and energy solutions, where about a third of the funding would be used to develop second-generation biofuels. The commercialisation and dissemination of new energy technologies is also an important part of this initiative.

As regards international cooperation, the Government is allocating funds for a special initiative for climate aid of about SEK 4 billion. This will contribute to sustainable development, transfer of environmental technology, and strengthen international cooperation on climate issues.

The Government in its research and innovation bill for 2008 proposes that support for research and innovation increase by a total of SEK 5 billion for the period 2009–2012. Strategic research areas in technology are to be strengthened by SEK 650 million and within environmental and climate research by slightly more than SEK 500 million. In addition substantial

increases have been allocated to i.a. research councils, Vinnova and research institutes. A number of close-to-market research and development programmes, particularly those for production solutions involving more efficient use of resources, renewable materials, transport, logistics, information and communications technologies, as well as developing the "Green Car" contribute to the development of new environmental technologies. A large part of the Swedish Energy Agency's R&D budget of SEK 800 million promotes the development of environmental technology in the energy area.

Increased demand and supply, and increased use of good environmental technology is promoted by a number of measures and steering instruments. Investments in energy efficiency during the period 2008–2010 of SEK 310 million concern inter alia procurement of technology and market introduction of energy efficient technologies, requirements for energy certificates for buildings, climate guidance for consumers and companies, as well as the development of climate labelling for products and services. The appropriation for solar energy will be increased, in order to stimulate the adoption of solar heating in residential buildings. For the years 2007–2010, SEK 36 million will be allocated for this purpose.

Many other more general steering instruments such as the application of the Environment Code, environmental taxes, environmental labelling systems, green procurement and the introduction of environmental management systems in private and public sectors are driving forces in the development of demand for good environmental technologies (see section 3).

Strategic development, often in the form of commissions to agencies, is another area where the Government has taken a number of initiatives to promote the development of environmental technologies. The commissions not only involve strengthening the institutional structures for the development and adoption of environmental technologies, but also cover investigations that identify strategic opportunities, success factors and obstacles, as well as strategic research initiatives.

The Government decided in June 2007 on a major investment in *R&D* for *environmentally friendly vehicle technologies*. The aim of the initiative is to create an environmentally friendly transport sector in Sweden, increase employment in the Swedish vehicles industry as well as strengthen Sweden's global position in the area. The focus is on the development of technology, more energy efficient vehicles and the use of renewable fuels. Of the SEK 245 million set aside for the period 2007-2010, about SEK 125 million is intended in the first instance for financing joint projects with the USA for the development of more efficient heavy vehicles, as well as their adaptation for biofuels. The Swedish Energy Agency will be responsible for implementation.

Work of the agencies in thematic areas. Within the framework of the national strategy for regional competitiveness, entrepreneurship and employment 2007–2013, three thematic agency groups have been working since autumn 2007 on priorities for the strategy, and two of the groups on issues related to environmental technologies. The aim is that the agencies will strengthen their inter-sectoral cooperation for sustainable regional growth. The group "Innovation and Renewal" consists of Nutek (coordinator), Vinnova, Invest in Sweden Agency, the Swedish Arts Council, the Swedish National Heritage Board, the National Archives, the Swedish Environmental Protection Agency, and the Swedish Energy Agency. The group has identified the following areas of cooperation: Bioenergy, Environmental technology/Cleantech, Natural and cultural values and Creative industries.

Also the group of agencies working with accessibility, made up of the Swedish Road Administration (coordinator), the Swedish Rail Administration, the National Public Transport Agency, the Swedish Institute for Transport and Communications Analysis, the Swedish Post and Telecom Agency, the Swedish National Rural Development Agency, the Swedish Consumer Agency, have identified cooperation areas connected to environmental technology such as accessibility to public transport and other types of accessibility.

The Government decided in October 2007 to grant the Swedish Trade Council SEK 30 million during the period 2007–2009 for an industry

specific commission to support *internationalisation and new export business for Swedish environmental technology companies*, with a focus on small and medium-sized companies. In its commission to the Swedish Trade Council, the Government puts great focus on demand driven coordination. The Swedish Trade Council has together with the business sector set up a steering group for the Council's environmental technology export programme. The steering group has the aim of coordinating and focusing initiatives in environmental technology in order to attain success.

The Swedish Energy Agency was commissioned by the Government in December 2007 to create a national *network for the use of wind power*. The aim of the network is to disseminate knowledge on wind as a natural resource, ensure access to information in order to facilitate the expansion of wind power, as well as provide support for regional initiatives of national importance. The Swedish Energy Agency is the hub of the network. A crucial focus of the network is to strengthen existing initiatives and contribute to the formation of new regional nodes in the area of wind power. Another important task is to coordinate the work of other agencies in the use of wind power.

In 2008 the Government gave the Swedish Energy Agency the task of mapping and analysing *the preconditions for growth for companies producing services or products for renewable energy*. The agency identifies obstacles to growth faced by companies, and also provides proposals for measures to eliminate them. This work will be completed by 31 March 2009.

As a part of the promotion of Swedish exports of environmental technology, the Swedish Trade Council was commissioned by the Government together with companies in the industry to develop the marketing concept SymbioCity (www.symbiocity.org). *SymbioCity* is a Swedish trademark and communications platform for marketing Swedish products and services within the framework of Swedish traditions and experiences gained from sustainable economic development and efficient use of resources. The trademark, web site and materials have been developed to support the marketing of Swedish companies in an international trading forum. SymbioCity is managed by the Swedish Trade Council and can be used by all Swedish players active in the area of sustainable city development and environmental technology. The concept is used in a large number of markets around the world.

Swentec, the Swedish Environmental Technology Council, was transformed on 1 April 2008 into a delegation attached to the Ministry of Enterprise, Energy and Communications and was commissioned by the Government to develop an *overarching and effective structure for strengthening Swedish environmental technology*. Swentec will draw up material for Government initiatives in the environmental technology area and work for their coordination. The delegation also mediates knowledge and highlights good examples and also identifies concepts for systems solutions and initiates new business models. Swentec has analysed a number of Swedish areas of strength in environmental technology and leading edge Swedish companies.

ISA, the Invest in Sweden Agency, received in June 2008 a commission from the Government to implement an initiative *for promoting investment in the environmental technology area*. The investment covers SEK 10 million during the period 2008 up to 2010. The task focuses on promoting foreign companies' investments in the environmental technology area in Sweden, in order to contribute to the development of the business sector, increase technological development and create more jobs in Sweden.

The lead market initiative – Renewable Energy, is one part of the EU's innovation strategy and aims at facilitating the market introduction of innovative products and services. In June 2008 The Swedish Energy Agency was commissioned by the Government to draw up proposals in conjunction with the Swedish Environmental Protection Agency and the Swedish Government Agency for Innovation Systems for the implementation of the lead market initiative concerning renewable energy.

The lead market initiative – recycling and bio-based products. In June 2008 Vinnova was commissioned by the Government to draw up proposals on how the EU's lead market initiative concerning recycling and bio-based products is to be implemented in Sweden.

The Delegation for Sustainable Cities was established in September

2008. The initiative is an investment in sustainable cities to stimulate urban construction projects which contribute to an improved environment and have a reduced impact on climate, and at the same time facilitate Swedish exports of environmental technology. The ambition is that Sweden should be in the forefront internationally for sustainable city development. New Swedish "shop windows" showing attractive and environmentally good housing are needed. These should be areas showing the very latest leading-edge solutions in construction and the realisation of visions in local areas or districts. The Government is setting aside SEK 340 million for 2009 and 2010 to mobilise the business sector. Amongst other things, the task of the delegation is to support the development, use and export of environmental technology, collect and disseminate information on good examples, as well as promote the development of knowledge and cooperation.

The Swedish Trade Council through a commission from the Government has started a special *promotion programme in India*. The programme runs for three years from October 2008, and focuses on providing support to Swedish companies actively working the market and doing business in energy and environmental technology.

The research is linked to the development of environmental technology which also exists in a number of the Government's prioritised areas in the research bill *A Boost for Research and Innovation* from September 2008. R&D issues are handled in greater detail in section 2.

The Government has decided to extend *support for the market introduction of wind power* and has set aside a further SEK 350 million for the period 2008–2012 for market introduction, technological development and building up knowledge on outcomes from earlier investments. The funds are intended to support establishment in situations where technically difficult preconditions exist, primarily related to marine and mountain areas in order to gain experiences that could be used for new establishment and thus create better conditions for renewable electricity production in the future.

In November 2008 the Government decided on new *support for farm-based biogas*. The funds will be used to start manure-based biogas production. The initiative in biogas is one step towards reaching the goal that green industry should be self-sufficient in energy. The Government decision is to provide about SEK 40 million per year during the period 2009–2013 as investment support for biogas plants within the framework of the rural development programme. Climatic benefits from biogas production can be roughly estimated as amounting to approximately 150,000 tonnes of CO_2 annual equivalences for the production of 0.3 TWh.

The Government decided in December 2008 to give Nutek the task of implementing a programme for *Environment Driven Business Development*. The aim of the programme is to strengthen the competitiveness of small and medium-sized companies in environmentally driven markets, both internationally, as well as nationally and regionally, by means of environmentally driven business development. New business opportunities are created as a result of climate changes and in the reorientation to sustainable energy systems. The programme covers SEK 35 million over the years 2008-2010. The programme primarily focuses on providing support in the commercialisation phase. Investments will take place in the areas of "Advanced consultancy for companies with goods and/or services in the commercialisation phase" and also "Coordination of procurement, and packaging for system solutions".

R&D investment in environmental technology. In December 2008 Vinnova was commissioned by the Government to carry out such an initiative, covering SEK 40 million during 2008–2010 in the areas of *IT and environmental technology* as well as research on sustainable city development, with links to the SymbioCity concept.

The positive environmental impact arising from IT should be made transparent. The initiative will be run in the form of demonstration projects, where the focus should be on transparency and greater awareness of the environmental impact of daily decisions. Pilot initiatives will be implemented where small companies in the area of sustainable construction – supported by active research – should be able to get assistance from larger companies to test or develop technologies at an early stage.

Knowledge of measures efficient in the use of resources in existing buildings will be documented, in order to assess outcomes and market potential. Design and architectural aspects are to be given special prominence in implementation. The development of incubators in environmental technology, in conjunction with Innovationsbron AB focuses on business development of long-term sustainable solutions in renewable and efficient energy technologies, the water-sanitation and transport sectors, as well as waste treatment and material handling.

1.3 ANALYSES AND STRATEGIES OF AGENCIES AND ORGANISATIONS

Agencies and organisations have, either through commissions from the Government or on their own initiative, drawn up analyses and strategies which either directly involve the environmental technology area or provide the essential prerequisites for the development of environmental technology.

The Swedish Private Equity & Venture Capital Association and Nutek have since 2001 jointly investigated the Swedish market for risk capital. Since autumn 2006, Innovationsbron has also been a cooperation partner. The report from the first quarter of 2008 shows i.a. that 56 percent of venture capital players consider that "cleantech" is the most interesting industry for risk capital investments in the immediate future.

The green knowledge society is a programme document which the Royal Swedish Academy of Agriculture and Forestry (KSLA) issued in December 2007. Sweden more than many other countries is dependent on R&D development in green industries, since forestry and food account for about 15 percent of exports. In many cases Sweden has good technical application of biomolecular and ecological knowledge of systems, for example, as regards biometry, advanced construction of wooden houses, processes for bioenergy, as well as improved crops and different types of trees. The academy proposes an initiative for the development of knowledge in green industries through advanced, needs-based and interdisciplinary research, as well as better contact between R&D and the rest of society.

Nutek published in spring 2008 the study *Framgångsrika miljöinnovationer – en studie av 113 svenska innovationer från tävlingen Miljöinnovation (Successful environmental innovation – a study of 113 Swedish innovations from the competition "Environmental innovation"*) which identifies the factors related to commercial success. 113 finalists in the national competition "Environmental innovation" were studied. Results show amongst other things that access to business contacts and equity capital at early stages as well as knowledge of customer needs is of great importance for commercial success at early stages of development.

The Swedish Environmental Protection Agency has evaluated how knowledge, experiences and results from local investment programmes were disseminated, and the extent to which project results have been used and led to the implementation of similar projects. The evaluation *Lokala miljöinvesteringar ger globala avtryck (Local environmental investments have a global impact)* from February 2008 shows that dissemination has clearly been good since 17 of the 21 case studies have either been successful or satisfactory from a dissemination perspective. The evaluation also shows that LIP (Local Investment Programmes) financed projects in many cases have been an inspiration for sustainable city development in other countries, and served as a means of support for Swedish companies selling environmental technology to countries such as China, the EU and Canada. The evaluations also draw conclusions on critical factors covering how dissemination of LIP and similar projects can be improved, for example by creating awareness of the potential outcomes environmentally and commercially, coordination between players, focus on holistic solutions and the need to have "shop windows" to highlight good results.

The Swedish Energy Agency on a Government commission has investigated the scope for promoting exports of Swedish technology for increasing energy efficiency and renewable energy production through the flexible mechanisms (CDM and JI). *Swedish exports of technology*

through the flexible mechanisms from April 2007 show that a number of Swedish companies exporting technology provide the technologies and services that are in demand or will be in demand in CDM and JI projects. Examples that can be mentioned are technical solutions for steam and gas turbines, heat exchangers, biogas production, and efficiency in the use of electricity.

Increased knowledge of CDM and JI as well as better contact networks between Swedish export promoters, project developers and purchasers of emission credits would facilitate the exports of Swedish energy and environmental technology companies to increase their exports through the flexible mechanisms. Companies exporting technology and export promoters see the potential in using CDM/JI to strengthen exports.

In April 2008 Nutek published the study *Vad menas med cleantech? (What do we mean by Cleantech?)* which shows how different players on the risk capital market regard and define the concept of cleantech. The study shows that there are major variations in how different players view the concept. It is important to be aware that different players have different views when using the concepts of cleantech and environmental technology, and that the concepts may themselves have different value connotations. The analysis also shows that we can lose business by applying too narrow a definition of cleantech when allocating financial resources.

Vinnova's *Strategy for research and innovation* for sustainable growth was published in January 2008 and covers the period 2009–2012. It identifies environmental and energy technologies as one of four areas with great potential for growth.

In February 2008, IVA, the Royal Swedish Academy of Engineering Sciences, published its main study Drivkrafter f*ör miljöproblemens marknadsvärde (Driving forces for transforming environmental problems into market opportunities)* within the framework of its project *New arenas for environmental work*.

The driving forces for development are mainly directed to market development, which makes trade policy important for environmental issues. The enlargement of the EU and China's rapid economic growth

contribute to the redrawing of the map on environmental work. Other factors such as international standardisation, consumer demands, shaping public opinion and increased demands from the finance and insurance industries are also driving forces. So far there is no indication that the market on its own will find solutions to the problems. For this reason the state fulfils an important function in the development of new arenas for environmental work. Central government by means of steering instruments and incentives can contribute to giving environmental issues a clearly defined market value. Incentives promoting development in a sustainable direction are necessary. The areas which the study considers that Sweden should give special emphasis to in its initiatives are:

- Distribution of electricity, power transmission, storage of energy, increasing energy efficiency
- Biomass/bioenergy
- The build-up of long-term sustainable infrastructure and system solutions

The study proposes measures in leadership and distribution of responsibility – within the Government and the Riksdag, and in industry and the agencies, as well as measures for increasing supply and demand.

The publication produced by Forma and Vinnova *Forskningsstrategi för miljöteknik (Research strategy for environmental technology)* was submitted to the Government in February 2007. Six areas of strength were identified in the strategy, sustainable development of society, sustainable transport, environmental protection technology, biological resources, simple and advanced materials, and energy. Sweden can create advantages through focusing on system innovation and system solutions. In order to promote the development of environmental technology, the authorities propose greater focus on environmental technology in research, and initiatives in areas where Sweden is strong as well as greater cooperation between agencies, research funders and industry for research into environmental technology.

In June 2008 Nutek held a *hearing on environmentally driven markets*.

The aim was to develop thinking and views in order to specify needs and on the basis of this provide proposals for activities. The participants highlighted in particular the following proposals as areas for activity:

- Network activities for companies in environmentally driven markets with customers or private funders – particularly business angels or risk capital providers. For example, network activities for companies, meeting fora between companies and risk capital providers, coaching in companies, and matching of buyers and sellers.
- Competence raising activities for companies in environmentally driven markets in e.g. marketing, how to develop and present offers, as well as the packaging of system solutions.
- Creation of one or more functions which coordinate supply and demand in environmentally driven markets, such as scanning national and international markets for relevant public procurements, bringing together relevant companies in public procurement, leveraging experiences within the area of public procurement, increasing opportunities for using existing demonstration facilities for business purposes, as well as better policy monitoring of the surrounding world, and market analyses to increase opportunities for the export of system solutions.

ITPS, the Swedish Institute for Growth Policy Studies, in June 2008 has in conjunction with the Globalisation Council and its partner agencies published the report *Swedish environmental technology – a survey of players, markets and competitors)*. Some of the conclusions from the report are that environmental technology companies are widely distributed throughout industry and make up a highly heterogeneous group covering a wide range from knowledge and research intensive service companies to more traditional industrial companies. General steering instruments, such as the carbon dioxide tax, create driving forces for sustainability, but are also important for development in the environmental technology area. At the same time differences between environmental technology companies mean that it is difficult to measure the precision of general measures. If specific technology areas need to be given support, the measures used should be targeted. A combination of these strategies would be the most successful route to pursue.

Export potential in the area is very large. The demand for water treatment, waste management, sustainable infrastructure and sustainable housing increases dramatically as environmental problems grow in many parts of the world. China and India are both interesting markets for the export of Swedish environmental technology, but significant trade barriers mean that market potential today cannot be fully exploited. The analysis also shows that it is important to emphasise environmental technology in Sweden, including foreign direct investment in the environmental technology area. Swedish areas identified as strong are renewable sources of energy (particularly bioenergy), sustainable building and planning, sustainable transport, environmental protection technologies, as well as system solutions to complex environmental problems where there is a need to coordinate knowledge and competence.

The earlier mentioned report from the Swedish Energy Agency *Pionjärmarknadsinititativet – Förnybar energi (The lead market initiative – renewable energy)* from October 2008 took up inter alia the following strategic proposals:

- Creating a virtual incubator. Bring together energy competence and competence from the national incubator program into a virtual incubator, as a means of providing support for company development in renewable energy sectors.
- Reviewing EU financing. Implementing a review of possible measures to take advantage of support from EU programmes to a higher degree than currently occurring.
- Creating a Fund of Funds for renewable energy. Setting up a fund for early investments in renewable energy with funds from EIF and private capital. Competence, networks and market knowledge in the energy area can be provided to the fund by the Swedish Energy Agency.

Vinnova's earlier mentioned corresponding commission resulted in the report *Pionjärmarknadsinitiativet – biobaserade produkter och*

återvinning (The lead market initiative - bio-based products and recycling), October 2008. Vinnova states that policy measures to develop pioneer markets has great potential in generating important driving forces for innovation and sustainable growth. Around 10 areas were identified for policy measures. However, further analysis is required to develop a more detailed policy.

In November 2008, Swentec analysed how the competence of municipalities could be taken advantage of in the environmental technology area, particularly with regard to the development of infrastructure. Three main challenges were identified, which reduce the scope for municipal companies to export. Ideological views on whether exporting can be a part of the role of municipalities. Difficulties in finding internally employees willing to work abroad. Municipal companies often lack organisational competence when it comes to creating intellectual property from technical solutions. It is interesting to note that both exporting and non-exporting municipalities see a number of advantages in exporting municipal knowledge, from strengthening the region to improving the municipality as an attractive employer, as well as internally developing competence and creating new sources of income.

1.4 STRATEGIC WORK OF THE SWEDISH ENVIRONMENTAL TECHNOLOGY COUNCIL

In August 2008 the Swedish Environmental Technology Council, Swentec, organised a strategy meeting for Swedish environmental technology where around a hundred key persons from organisations, agencies, trade associations and the research community participated. The work was guided by the vision: "Sweden has a driving role and supplies world class solutions for a sustainable future".

The work mentioned earlier, carried out by agencies and organisations on strategies in the environmental technology area have been an important foundation for this work. The goal was to create a consensus on how the vision could be achieved, where cooperation and coordination are fundamental.

In the work, five overall strategic areas were identified for achieving the vision. The starting point for Swentec's work on strategy has been to integrate strategies and investigations formulated earlier, and transform these into a coherent, overarching strategic document and an action plan. The strategic areas identified by Swentec are: *Policy steering, Competence for sustainable development, Cooperation, Commercialisation* and *Business models*.

As regards *policy steering* it was stated that Sweden needs robust rules over mandate periods, powerful market incentives and a clear distribution of roles in the public sector. The demand for good environmental technology should be stimulated through inter alia standards, procurement of innovation, aggressive use of public financing, and the creation of demonstration facilities.

Sweden has a major advantage from its good environmental work and high competence in the area of sustainable development. However, this needs to be maintained and developed. Systems and resources for competence development in innovation, new technologies, entrepreneurship and systems thinking are all needed. An important part of this is identifying and highlighting competence in important areas (such as process technologies and integrated systems solutions). Sweden can benefit from the technology and project results that have already been obtained and these can be transformed into products and business. The competence of municipalities should also be used strategically for procurement of innovation and technology and its commercialisation.

Cooperation is needed by raising efficiency and mobilisation in order to find powerful concepts. Commercialisation is based on the fact that Sweden has great potential to generate business from investments in R&D in both the academic and business worlds. A critical factor for success is creating better conditions and financing by investing in needs-based research, and support for lead markets in conjunction with industry and society. Another factor critical for success is to support companies so that

they can obtain sufficient financing to bridge the gap between product development and stable sales (the "death valley") and package and market goods or services in such a way that the market will view them as attractive.

Business models, where Sweden needs to tailor business models in order to manage opportunities on different markets. Sweden can develop business models based on our unique Swedish cooperation between industry, agencies and higher education, but these must be better adapted to small companies. Consortia need to be formed between small companies over products, services and systems, platforms for commercialisation, as well as cooperation with strong commercial players that can provide the driving force for increasing systems sales. In this context measures are needed to make Swedish environmental competence visible, inter alia via creating "shop windows" for demonstration facilities in the forefront of technology.

1.5 CONCLUSIONS BASED ON GOVERNMENT INITIATIVES AND ANALYSES OF AGENCIES

Some general conclusions can be drawn from the overall experiences gained from Government initiatives, and the strategic analyses and investigations carried out by agencies, as presented above.

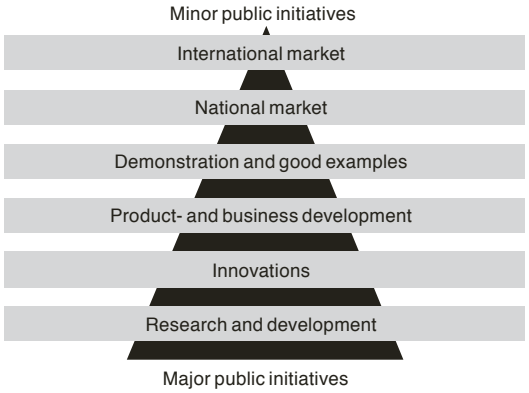
1. Environmental technology makes it possible to combine economic growth with a good environment.
2. Environmental technology is both a sector in itself, but also part of the general driving force for companies and organisations to improve their environmental performance. This applies not least to large industrial companies.
3. There is broad consensus amongst most players on what the Swedish areas of strength are, the importance of cooperation between industry, agencies and higher education, as well as the most important strategic efforts to be made in the near future.
4. Sweden has strengths in integrated system solutions and in its overall approach to good environmental solutions. This strength should be developed and reinforced.
5. It is important to both increase the demand for and the supply of good environmental technology. Continuing technological development and the exploitation of new research is also needed in the area of environmental technology.
6. The demand for good environmental technology should be stimulated. Central government has a vital role to play in development. Central government through steering instruments and incentives can contribute to giving environmental issues clearer market value through, inter alia, standards, environmental requirements in public procurement, development of procurement for technology and innovation, aggressive use of public financing to strengthen the domestic Swedish market, and not least by creating more demonstration and reference facilities. The state and its agencies should themselves be good environmental role models.
7. Co-operation solutions and new business models should also be developed in the future, where cooperation between industry, the public sector and the R&D sector is an important factor. Initiatives and stimuli to encourage cooperation between companies and other players should be promoted so that the pre-requisites for establishing export markets are increased.
8. The competence of municipalities should also be used strategically for procurement of innovation and technology, as well as its commercialisation.
9. It is also important to emphasise the importance of implementing foreign environmental technology in Sweden, including foreign direct investment in the environmental technology area.

2 Moving from research to markets

Today there are a number of government and other players providing different types of support to companies in the environmental technology sector. The measures focus on different parts of the product value chains (see Figure 1 below). From the earlier mentioned report on Swedish environmental technology produced by ITPS in 2008, the conclusion can be drawn that many of the state actors in the first instance focus on providing support in the early stages of product value chains, while support in the commercialisation phase is not provided as frequently.

Relatively large investments are being made by a number of players providing support for research and development, and to some extent for innovation as well as product and business development. Whilst investments in demonstration facilities and market introduction are significantly less with fewer players involved. ITPS also points out that investments to increase demand in environmentally driven markets are not particularly frequent in Sweden. State support for purchase of new environmental cars as well as experiences from other countries show, however, that such types of measures can have a major impact.

Figure 1 Product value chains in environmentally driven markets



Source: Nutek, 2004

2.1 RESEARCH, TECHNICAL DEMONSTRATION AND DISSEMINATION OF KNOWLEDGE – INCREASED AND MORE FOCUSED INITIATIVES

2.1.1 Research programmes related to environmental technology

The Government bill on research 2008

Through the research and innovation bill, *A boost for research and innovation* (Bill. 2008/09:50), put forward by the Government, research of importance for the environment and climate will receive additional resources. The Government proposes in the bill that support for research and innovation be increased by a total of SEK 5 billion for the period 2009–2012.

Strategic research areas in technology are to be strengthened by SEK 650 million and within environmental and climate research by slightly more than SEK 500 million. In addition substantial increases have been allocated to i.a. research councils, Vinnova and research institutes.

In the Bill the Government identifies some 20 strategic research areas where research of high-quality that can satisfy the needs of society and strengthen Swedish industry, is being carried out. The strategic research areas of greatest importance for sustainable development are technology, energy, sustainable use of natural resources, and research into marine environments.

The Swedish Energy Agency

The Swedish Energy Agency accounts for the largest part of research appropriations in the Energy area, and funds a broad spectrum of different research programmes. In total SEK 57.5 million will be allocated to 22 different projects in energy oriented basic research.

SEK 35 million for research on the impact of wind power on people, society, the environment and animal life in the programme *Vindval (Choosing wind)* for the period 2008–2012. The goals of the programme are to facilitate the expansion of wind power by developing knowledge for

use in environmental impact assessments, and processes for planning and granting permits for establishing wind power facilities. Funds are also provided for communication measures to disseminate the results to active players, and the general public.

The fuel programme runs from 2007 to 2010 and has an annual budget of SEK 40 million. The programme covers research into the supply and cultivation of biomass for energy purposes. Activities cover both basic research, as well as industrially driven development projects.

Consortium for material technologies and thermal energy processes has a programme running over a four-year period 2006–2009 which is financed by the Swedish Energy Agency (39 percent) and industry (61 percent). The consortium was formed to promote the industrial development of thermal energy processes and aims at developing technological solutions for materials for better performance, life length, accessibility and function, through e.g. the incineration of domestic renewable fuels.

The programme *Small-scale heat provision from biofuels* (2007–2010, SEK 10 million per year). The programme aims at reducing obstacles from converting oil and electricity heating to bioenergy heating through the further development of competitive small-scale bioenergy technology. In addition, system solutions where biofuel is combined with solar heat, and heat storage should be further developed.

The research programme *Turbo energy* (2007–2010) aims at a coordinated initiative to increase efficiency of thermal turbo machines, which are of great importance for large-scale electricity production.

The programme *the Centre for Energy and Resource Efficient Construction and Facilities management*, CERBOF, (2007–2009, total SEK 130 million) is Sweden's largest research initiative for reducing energy use and the impact of building on climate. The work will be carried out in close cooperation with representatives from the building and property management industry, various agencies, higher education and research institutes.

More efficient refrigeration and heat pump systems is an applied research and development programme in this area, with a budget totalling SEK 70 million during the period 2006–2010. The programme is jointly financed by the industries involved. The aim of the programme is to develop more efficient heat pump and refrigeration technologies to reduce the use of electricity and other energy, and reduce output peaks in the power system.

The research programme *General energy systems studies* (2006–2010, about SEK 40 million per year) aims at explaining how the energy system functions and how it influences and is influenced by people, technology, the economy and the environment.

The Swedish Energy Agency initiated in 2001 a *climate policy research programme*. During the current programme period (2006–2010) the budget amounts to SEK 50 million. The programme has the overall goal of expanding Sweden's international contact networks in the climate policy area, of contributing knowledge that can help to bring forward the international climate policy process and build up internationally competitive research groups in the area.

The SolEl (Sun Electricity) programme is an applied, national development programme over the period 2008–2010 for solar cell systems, and is jointly financed by the Swedish Energy Agency and industry. The programme has an annual budget of SEK 4 million.

The programme *Ethanol from cellulose* (2007–2010) aims at promoting the cost-effective introduction of cellulose-based ethanol on the Swedish market for fuels. The overall goal of the programme is to create research results of such a quality that a demonstration project based on enzymatc hydrolysis can be started at the end of the programme.

Energy systems in road vehicles (2007–2010, total SEK 82 million) is a coordinating programme for the Swedish Energy Agency's research projects in increasing energy efficiency of road vehicles. This programme carries out a large proportion of more long-term vehicle research carried out in Sweden. Examples of projects are; cheaper lithium-ion batteries, different types of hybrid systems, methods for transforming diesel into hydrogen, but also more long-term research concerning the steering, regulation and development of combustion engines.

Formas

Formas, together with Vinnova annually awards funds for environmental technology research in the following six areas of Swedish strength: Sustainable building, Sustainable transport, Environmental protection technologies, Use of biological natural resources, Simple and advanced materials and Energy. Applications are welcome in the following – system oriented and interdisciplinary areas which deal with social science aspects, as well as projects linked to demonstration projects. Joint financing from industry (50 percent) is required.

Vinnova

Vinnova takes a broad approach to investing in environmental and energy technologies, and work takes place in interaction with other competence areas in Vinnova, and a number of other agencies. Environmental technology projects are welcome in the following areas:

- Industrial biotechnology,
- The industry research programme for forestry and the timber industry (Product development),
- Sustainable and energy efficient transport systems (Transport),
- Eureka (promoting cooperation between companies and researchers in Europe),
- Vinn-Verification (verifying research results of commercial potential),
- Vinn now (support for R&D-based companies to prepare commercially interesting development projects),
- Research&Grow (strengthening and stimulating R&D in small and medium-sized companies) as well as
- Euro stars (support for close to market R&D projects with players from at least two affiliated countries).

Pure profits is a programme that aims at demonstrating opportunities in environmental and energy technology industries. A part of the programme is directed to the high-tech interface between nanotechnology and the environment through the programme Green Nano. During 2008–2009 an investment was made into Climate smart solutions for industrial applications. In addition, smaller pilot investments were made, such as:

- Small companies testing and demonstrating environmental applications
- New business models, business logic and steering methods from a life-cycle perspective, for example, “functional sales”.
- Green procurement

Initiatives in environmental and energy technologies are to be built up gradually over the period 2008–2012, and contain new initiatives of about SEK 100 million per year.

Vinnova supports a number of different approaches to strengthening research and innovation environments in the programmes *Vinn Excellence Center*, *Vinnväxt* and others. A number of the centres financed in these programmes have environmental and energy technology relevance:

- BiMaC Innovation (KTH) focuses on the development of new, unique bionanocomposites and on a number of technical problems never resolved at the central level, which have held back the development of the forestry sector.
- SUS – Centre for Sustainable Communications (KTH) will i.a. develop methods and “mediating” services such as real alternatives to travel and physical transport.
- Chase – Chalmers Antenna Systems Excellence center (Chalmers) covers the following research areas – aerials, signal processing, mobile communications, computational science, biomedical engineering and biological effects of electromagnetic radiation.
- GigaHertz Centrum (Chalmers) covers wireless communications and sensing systems based on high frequency technologies, for example, mobile telecommunications and radar technology.
- Mobile Life Centre (Stockholm university) covers R&D into mobile services and IT in everyday life.
- iPack Center - Ubiquitous Intelligence in Paper and Packaging (KTH)

is a multidisciplinary research platform for establishing cooperation between forestry, electronic and biomedical industries in the areas of intelligent paper and packaging for biomedical applications.
- Next Generation Innovative Logistics – NGIL (Lund University).
- Centre for ECO_2 Vehicle Design (KTH).
- Samot – Service and Market Oriented Transport Research Group (Karlstad University) will develop public transport through a specific initiative in service development.

Mistra

ProEnviro is an initiative in innovative research ideas for the development of environmentally friendly products and for strengthening competitiveness of small and medium-sized companies. The projects are run in cooperation between industry and higher education, universities and research institutes. ProEnviro has a total of SEK 60 million and will run until 2010. Mistra finances major research programmes in the environmental area with annual grants of SEK 5 to 10 million. There are currently 10 programmes with a focus on new environmental technology solutions, such as new methods for antifouling boat hulls, domestication of useful microorganisms, and different aspects of bio refining.

Mistra through the programme *Urban future* wants to establish a leading world centre for sustainable city development. According to plans, a future Mistra Center for Urban Future will be started in January 2010, with financing of about SEK 15 million per year for the first two years, whilst annual financing for the following two 4 year periods may amount to SEK 15 million.

Projects in Mistra's program *Idéstöd (Idea support)* will contribute to realising innovative research projects of great potential for a better environment. An IdeaSupport project should have strong elements of boldness, originality and creativity. Even though these criteria do not exclusively deal with environmental technology, such projects have occurred frequently. A current example is the development of a remote-controlled micro-U-boat which could go down to virtually inaccessible places such as Lake Vostok in the ice masses of the Antarctic or otherwise inaccessible cave systems.

The Swedish Environmental Protection Agency

The Swedish Environmental Protection Agency finances research programmes in the environmental area (with an annual budget of about SEK 80 million), which affect or provide the preconditions for the development of environmental technology. The agency's R&D initiatives are usually interdisciplinary, and oriented to steering systems. Ongoing programmes of greatest relevance to environmental technology are:
- The life-cycle view in integrated product policy (2005–2008). The research programme Preconditions for a life-cycle view in integrated product policy (FLIPP) show how laws, taxes and environmental labelling affect different groups of people. The programme also aims at developing sustainable systems for production and consumption of goods favouring both companies and the environment.
- Climatools (2006–2009). The research programme Climatools provides the players involved with better foundations for developing adaptation strategies in ongoing climate change.
- Environmental strategic tools (2003–2008). The research programme Environmental strategic tools (MIST) focuses on different ways of achieving environmental quality targets, and studying how environmental assessments of the agencies can be made more effective and powerful.
- Sustainable waste management (2006–2009). The research programme identifies steering instruments and other strategic decisions, which make facilitate development towards more sustainable waste management.
- Sustainable remediation (2004–2008). The knowledge programme Sustainable remediation is a part of the work of the Swedish Environmental Protection Agency for achieving the environmental quality target of a toxic free environment. The programme has provided agencies, researchers and companies with grants for different activities to

strengthen the development and dissemination of knowledge in the post-treatment of polluted areas. Assessment of technical methods for remediation has taken place in the programme.

2.1.2 Demonstration facilities and good examples

The creation and dissemination of knowledge from existing demonstration projects with good environmental technology is an important measure, which strengthens both the supply of and demand for good environmental solutions. Demonstration projects can function as good examples, showing the technologies and practical solutions available, and their respective positive environmental and financial outcomes. Without access to demonstration facilities in the domestic market, environmental technology companies find it difficult to make a breakthrough internationally.

Dissemination of information on existing demonstration projects and good examples is an area in which Sweden has noteworthy experience. Many agencies and organisations representing industries are currently working in these areas. The Government continues to support this development during 2008 by giving the Delegation for Sustainable Cities the task of identifying and disseminating knowledge of good examples in this area.

Swentec has received a commission from the Government to organise a national map of demonstration and reference facilities in environmental technology. This national initiative will be a platform for developing cooperation between all Swedish players in Swedish environmental technology. The map will cover all environmental technology and have both a system and product focus. The main focus will be on achieving business, and the goal is that the sales organisations of companies should be involved in visiting the reference facilities. The concept is based on coordination and cooperation with other players such as the regions for the exchange of information and practical management of visits.

New pilot and demonstration facilities must also be created. Pilot and demonstration projects are in the middle of the value chain from R&D investments to full-scale market uptake, and thus provide a bridge between innovation initiatives and large-scale implementation of good environmental technology. The Government finances a number of strategic measures aimed at creating demonstrations of new environmental technologies, mainly in the areas of energy and vehicle technology, renewable energy support, second generation biofuels, new sustainable urban centres and innovative product development. These initiatives are described in more detail in other parts of sections 2–4.

2.2 TECHNOLOGY PLATFORMS AND TECHNOLOGICAL DEVELOPMENT

2.2.1 Technology platforms

Technology platforms bring together researchers, industry, financial institutes, decision-makers and other parties involved in creating a long-term vision of research needs and future market developments. In European research policy, technology platforms play today an important role in the adaptation of research to the requirements of industry, thereby enabling the commercialisation of technologies with a high degree of industrial relevance. There are more than 30 technology platforms, the majority of which are closely linked to the environmental technology area; forestry technology, fuel cells, solar cells, water supply and sanitation technologies, amongst others. Sweden is represented in slightly more than half of all these platforms, and has substantial representation in, amongst others, the Forest based sector TP (Forestry) and European Biofuels TP (Biofuels).

Sweden played a prominent role when the Forest-based Sector Technology Platform was established in 2004. Today there are 27 countries participating, and together they have developed a strategic research agenda for the forestry sector. The platform has its own organisation, and arranges conferences and seminars annually.

European cooperation in the form of a JTI, Joint Technology Initiative,

for research and demonstration in hydrogen and fuel cell technologies was launched in October 2008. JTI is managed by European industry, but universities and representatives from regions and Member States have influence. The goal is that hydrogen and fuel cell technology should become commercial in Europe 2010–2020.

2.2.2 Verification of environmental technology

The principle behind verification of environmental technology (ETV) is to provide users of environmental technology with reliable information on how new environmental technologies operate and their possible impact on the environment. The idea is that this will help to accelerate market acceptance and thus the introduction of environmental friendly technologies. The ETV system can increase security of customers by providing third-party security. It is positive that methods and technologies are checked and evaluated with respect to environmental performance. However, there is a risk that the introduction of ETV (Environmental Technology Verification) systems at the European level creates obstacles to entry for new technologies and new companies.

Sweden takes part via the Swedish Environmental Research Institute (IVL) as an active partner in the ETV project TRITECH. The project runs over the period 2006–2009, and is financed by the LIFE program in the EU. The project aims at developing methods for involving different companies and other players in testing and verifying environmental technology, and also the testing of 15–20 technologies within three areas: remediation of polluted ground, energy and waste water processing.

2.2.3 Technical Research Institute

SP Technical Research Institute of Sweden

SP is a group of research institutes for the application of technological research. SP has many initiative areas linked to environmental technology. SP supports the development of sustainable energy systems, for example through research and evaluation, where the purpose is to increase energy efficiency in buildings and industries. SP also participates in the development of more efficient and climate neutral future energy solutions, through the conversion of energy, energy from waste products and renewable energy. Important competence areas are:

- *The cluster Waste Refinery* aims at systematically evaluating, developing, demonstrating and integrating different technologies to increase energy efficiency and extraction of resources from waste. The focus is on systems analysis, as well as technological development of thermal and biological conversion of waste into energy and material products.
- SP Energiteknik is responsible for the *Heat Pump Centre (HPC)*, an international information centre for promoting the development of heat pump technologies. Members from 11 countries, including the USA and Japan, are involved in the programme. The task of HPC is to circulate information in order to initiate research and accelerate the technological development of heat pumps and refrigeration technologies.
- *Certification of products and management systems*. The SP Group provides comprehensive certification covering many industries, products and areas of technology. SP Certification issues certificates in accordance with many standards. SITAC is a certification body for products and persons in Sweden in the building, installation and construction areas, and is able to assist companies not only in Sweden but also in the rest of Europe.

IVL The Swedish Environmental Research Institute

IVL, The Swedish Environmental Research Institute, is an independent non-profit research institute which since 1966 has been working on solutions to environmental problems in society and companies. IVL has a board with joint representation from industry and the Government. IVL has about 170 employees, of which 26 percent have postgraduate qualifications and 63 percent have an engineering or other academic qualification. IVL works with climate and energy, sustainable building, air and transport, sustainable production, products and waste, and also water.

IVL runs a project financed by the EU Commission *The EU-China*

CDM Facilitation Project which is the EU's largest capacity construction project in China. The project is run over the period 2007–2010 in cooperation with China's leading research institutes and central agencies in the climate area, as well as prominent CDM experts in Europe.

2.2.4 Environmental technology from high-tech industries of the future: IT, bio, space- and nano technologies

Common to all these industries is that they are knowledge intensive, and Sweden and other Member States are investing in them nationally and regionally. Generally, they are also enabling technologies, which have already, but could to a greater extent lead to significant environmental benefits in many societal sectors. Sweden has a leading position in these areas and they are important parts of Swedish industry and employment.

IT technologies including telecom solutions can create important tools for reducing the environmental burden and creating environmental benefits in other sectors. There are many innovative IT and telecom solutions which reduce impact on the environment in a number of areas in society. Solutions which can replace physical travel, make transport and meetings more efficient and optimal, better steer and regulate processes in industry and save energy and other resources in housing and construction. Environmental technology in the IT industry also deals with making the IT industry more environmentally friendly by reducing the environmental impact of its products by working on reducing energy consumption. Recycling IT products is another area where initiatives are being taken. National pre-studies carried out by the Government Offices on IT for the environment from 2008 submitted proposals for the use of IT in the public sector, intelligent transport, and IT as a part of sustainable cities.

The Swedish IT and telecom industry has started at the industry level the joint project Green IT, which amongst other things will develop a tool on how Green IT can be incorporated into a company's own activities. The Swedish Energy Agency works on improving energy statistics, where the use of energy for IT equipment is an important element. KTH's *Centre of Excellence for Sustainable Communications* will develop innovative applications in media and communications technologies to contribute to sustainable development with new user based services, products, environments, business models, methods and tools to facilitate and make possible cooperation between people located in different places. The Swedish EMAS Council is currently developing procurement criteria for IT products. Work is proceeding on creating criteria for telecom products. Vinnova has recently received a Government commission on Green IT, see section 1.

Biotechnology is a broad group of technologies based on using organisms, parts of organisms or biochemical products such as enzymes for technical purposes. Sweden currently has the fourth largest biotechnology industry in Europe (ninth place globally) and has more companies per capita in the area than any other country. In total the pharmaceutical and biotech industry employ about 50,000 persons in Sweden. Biotech can be used directly for environmental purposes (environmental biotechnology), for instance in the use of methods for treating emissions or decontaminating polluted land. In industries such as paper and pulp, food, feed, textiles and pharmaceuticals, biotechnology can increase process exchange, reduce energy consumption and waste production.

The Government has the goal that *Sweden should be one of the five leading biotech countries in the world*, by strengthening intellectual property, better linkage between research and risk capital, and stronger cooperation between research, industry, higher education and health and medical care, as well as more comprehensive participation in international programmes. The linkage between biotechnology – environmental technology exists in a number of areas, for example, remediation of polluted land by means of microorganisms, water purification through biological methods, application of biotechnology for more environmentally friendly industrial production processes, biotechnology for the production of renewable fuels and energy carriers. A number of applied research programmes exist, financed by Mistra, Formas and Vinnova.

Space technology can also contribute to promoting and creating good environmental technology. Without satellite data we would have a significantly poorer view of the status of climate and the environment.

Sweden is far ahead when it comes to the development of remote sensing applications, and also contributes data through Odin, the Swedish environmental satellite. Large-scale environmental problems require new methods of monitoring, and that is the reason that satellite-based systems such as GMES - Global Monitoring for the Environment and Security are important. During 2008 Saccess, a unique satellite imagery database was launched providing satellite images of Sweden which are updated with new images covering the whole country. Saccess can be used to study changes in the landscape in e.g. agriculture and forestry, environmental analysis and planning. Information is easily accessible via the Internet. Saccess is expected to lead to new technologies, areas of use and new companies. A number of Swedish environmental agencies make operational use of satellite data. Since the beginning of the new millennium, the Swedish Forest Agency has annually used satellite pictures to monitor clear-felled forest areas which has made follow up significantly more efficient and received international recognition. The Swedish Environmental Protection Agency maps all protected forests by means of satellite images and uses a standardised description of content.

Another example of major environmental benefits from remote analysis is the use of satellite images for Swedish ice breaking services. Photographs show the current ice situation and thus the best route for icebreakers. By means of this technology, icebreakers have been able to reduce fuel consumption by 10–20 percent, fuel costs by SEK 1.1–2.0 million, emissions of NO_2 by 30–70 tonnes and the emission of SO_2 by 1.2–2.5 tonnes. All vessels which benefit from ice breaking services reduce their fuel consumption correspondingly.

In the space sphere, new technological solutions are being developed for energy, materials and sensors, which in many cases are of environmental relevance. Swedish companies are also working on making space activities more environmentally friendly, for example, by developing environmentally friendly fuel for steering satellites and rockets. A number of countries have shown interest in green fuel.

Another aspect to the linkage between space and environmental technology is the development under way for manned space vehicles and permanent settlements in space. This involves work on “life support” processes (access to air, water and food). This covers, for example, recycling with closed systems where e.g. water is an expensive resource that must be recycled. This is a technology which will also be of benefit for work on sustainable cities throughout the world. The project *HabLab* at Chalmers University College of Technology will also develop local ecologically friendly water-sanitation solutions, self repairing walls and new technologies for regulating entry of daylight into buildings, all these are environmental technology spin-offs from space technology.

Nanotechnology – creating structures on a nanometric scale – is not as highly developed an area of technology as the three above. Swedish nanoscience and nanotechnology research, however, maintains a high international level in a number of areas. The Swedish innovation system concerning nanotechnology applications is still in its build-up phase. Today there is already great potential in the environmental area where nanotechnology can create new opportunities. Some examples that can be mentioned are renewable and sustainable energy supply from the sun, wind and bioenergy, purification of air and water emissions, remediation of land, reduction in energy consumption in different applications and reduced emissions from combustion engines. Nanotechnology – in particular the use of particles in the nanometric area - can, however, in certain cases have a negative impact on environment and health – these interlinked problems are monitored in Sweden by the National Chemicals Inspectorate.

Earlier Vinnova has financed R&D in the nano area in a number of programmes, such as BioNanoIT and Micro- and nanosystems. Nanotechnology has also been a part of initiatives taken by Vinnova such as Designed material and Vinn Excellence Center. In May 2008 Vinnova started providing funding in the area of *Green Nano* – Nanotechnology for the environmental area.

2.3 COMMERCIALISATION AND MARKET ADOPTION

This involves both helping and further developing the ideas themselves, whether they involve product development or the development of broader environmental technology solutions, and also providing support for financing company development and expansion. These two processes are closely related to each other.

2.3.1 The public support structure

There are a large number of public players providing financing in seeding, start up and growth phases for environmental technology companies, in a number of different ways. The main ones are Almi Företagspartner, the Swedish Industrial Development Fund, Innovationsbron, Nutek and Vinnova. The support provided by these players and their roles are described in greater detail in section 3.2.1 Public financing in early phases. A part of the early financing is also channelled in a natural way via incubators.

2.3.2 Capturing ideas and starting companies

A majority of Swedish incubators are linked to universities and university colleges. Innovationsbron is a very important player in the incubator area in Sweden, and supports/runs 19 incubators in the national incubator program. So far most incubators have not had a specific focus on environmental technology, but more recently, specific profiles in environmental technology are becoming increasingly common. There are slightly more than 40 incubators in Sweden, of which 13 stated that they are focusing on the environment and environmental issues, one example being Swedish Cleantech Incubators. A number of Swedish agencies have funds for incubators:

- Nutek has about SEK 10 million during 2009, to support the initiatives of private company incubators, as a supplement to public incubators.
- Since 2003 Vinnova has carried out a programme to support the development of high-quality incubators in Sweden, in amongst others the programme, Vinnkubator, and in recent years it has had a budget of SEK 150 million. The programme has been evaluated on a number of occasions by international experts and received high ratings.
- Another initiative for the further development of Swedish incubators is the Nyckelaktörs programme (Key players programme), which was started during 2006 with an annual budget of SEK 25 million. The programme aims at developing competence, methods, processes and structures to make key players in the Swedish innovation system more professional in their roles concerning coordination between players in the research sphere, companies and other players in surrounding society, as well as using knowledge and commercialisation of research findings.

The Government has set aside SEK 75 million to seven universities and university colleges which will start *Innovation Offices* where researchers can receive assistance for registering patents and obtaining risk capital.

2.3.3 Competitions in environmental technology

Venture Cup is a business competition started in 1998. Since its start 8,605 business ideas have participated. The Swedish Energy Agency is a national partner in the Venture Cup. About 5 percent of the ideas in the Venture Cup are relevant to energy.

Environmental innovation was arranged for the tenth time in spring 2008, and is run by the Halland region, with financial support from amongst others Nutek, Vinnova, the Swedish Energy Agency and Swentec. The competition is open to all with a commercially viable environmental innovation that reduces the burden on the environment. Out of the total grant of SEK 350,000 per year, those who make it to the finals, some 10 to 15 of the best, receive a development award of SEK 10,000. A large proportion of environmental innovations taking part in the competition are related to energy.

2.3.4 Networks of business angels

A business angel can be defined as a private person investing capital in and providing business knowledge to unlisted growth companies with which they do not have a family connection. Some of the business angels in Sweden participate in one or more of the business angel networks that exist in Sweden. According to the study *Business angel network activities* 2007 from SVCA, networks play an increasingly important role in the work of matching entrepreneurs looking for capital with business angels looking for interesting projects to invest in. The study also shows that 54 percent of business angels are interested in Cleantech as an investment area.

2.4 CONCLUSIONS AND RECOMMENDATIONS

Integrated support and financing systems for the whole value chain/ product development chain

The Swedish innovation system for environmental technology today is in a state of imbalance arising from the difficulties for companies to obtain financing in the middle or later phases of the value chain. This is not just a Swedish phenomenon.

One conclusion that can be drawn from both Swedish and other European experiences is that better forms of financing and other support structures are needed to create financing for activities in the middle of the value chain/product development chain – in the interface between R&D investments in large-scale international commercialisation. Support and financing are needed to create pilot and demonstration facilities, and also for introducing to the market environmentally friendly goods and services. Increased support is also needed to increase demand in environmentally driven markets and create meeting fora and arenas for contacts between companies, customers and funders of different kinds.

Another conclusion is that the development of support and financing systems, both at national and community level should be guided by the possibility of creating a system where the whole of the support and financing chain is coherent without difficult gaps and discrepancies, so that R&D financing is followed by the financing of demonstration facilities in the middle of the value chain, and followed by other financing and support forms for national and global commercialisation.

The third conclusion is that the multiplicity of players, support initiatives and forms of financing make it difficult to get a clear picture of, particularly for small and medium-sized companies. In addition, measures are needed for information, education and training, and new forms of cooperation between those supporting companies in order to achieve streamlined routes or simple entry points into the systems ("No wrong door", see conclusions and recommendations in section 3.

Demonstration facilities and "best-practice" in environmental technology

There is a need to increase the visibility of different demonstration facilities of environmental technology that already exist and those that are close to realisation in the near future in Sweden, in order to increase interest and accessibility for both foreign and domestic interests. The Swedish Environmental Protection Agency works with the dissemination of good project outcomes and activities from LIFE, national investment programmes and good environmental solutions. The Delegation for Sustainable Urban areas will work with good examples concerning sustainability of city areas. Swentec has received a commission from the Government to organise a national map of demonstration and reference facilities in the environmental technology area. Increased access and visibility of environmental technology solutions in a practical context would improve the exchange of information between Member States, increase awareness in industry, and those in the public sector running procurements, the general public about the potential of environmental technology, as well as support the dissemination of Swedish environmental technology internationally.

Web-based tools could relatively easily with minimum resources provide information about sustainable technology solutions to environmental problems. This would attract the attention of many target groups and

also create good references for companies and other players. What Swentec and other players do to give prominence to demonstration facilities and good examples would enrich European knowledge and information sources, particularly web sites connected to the EU, databases and knowledge compendia. In this context, it is important that information is easy to find, and clearly located in a structured context, available in computer systems and user-friendly.

System for environmental technology verification
It is a positive factor that methods and technologies are examined and evaluated with respect to environmental performance. However, there is a risk that the introduction of ETV systems at the European level creates obstacles to entry for new technologies and new companies. This applies particularly to small and medium-sized companies, even though the ETV system is a voluntary commitment. Nor is it self-evident what positive impact could be contributed by a European ETV system, in addition to what is already being contributed by similar systems, such as the EPD system. The value added of a European ETV system, in addition to that provided by existing systems, and its effects on smaller companies should be carefully analysed.

New environmental technology from high-tech industries of the future: IT, bio-, space- and nano technologies
There are a number of factors arguing for ensuring that development from these knowledge intensive new technology areas can not only contribute to creating new environmental technologies, but also make existing environmental technologies more widely known. One possibility would be to carry out a pre-study on how "environmental spin-offs" from these industries of the future can be promoted. Another step to support the proposal could be arranging an ETAP Forum in Sweden, under the theme of "What can advanced technology solutions from other areas provide in the environmental technology area".

3 Improved conditions and pre-requisites for environmental technology markets

Creating better preconditions for the development of environmental technology markets requires measures in a number of areas. Environmental technology development is mainly driven by demand, which in its turn can be increased through a number of different steering instruments, both financial and other types. Policy goals and environmental performance targets for goods, processes and services are also an important driving force. To promote the development of the market and environmental technology companies, financing is also needed for all parts of the value chain. Co-operation between groups of companies, and between companies, agencies and higher education can also create good preconditions for promoting entrepreneurship in environmental technology and increase the supply of good environmental technology.

3.1 PERFORMANCE TARGETS

3.1.1 Definition of performance targets as a concept

Environmental performance targets are an important instrument of environmental policy, which also leads to the development of technology. Sweden has participated in the work of defining the concept of performance targets from an ETAP perspective. The universities of Chalmers and Göteborg hosted an introductory workshop in October 2004, and since then have participated in two EU projects, PT-PRO (on Performance targets for processes) and PT-PILOT (developed by 2 pilot-PTs).

3.1.2 Programme for increasing energy efficiency (PFE)

Manufacturing industry, which earlier had a zero tax rating for electricity used in manufacturing processes, can avoid an additional electricity tax of 0.5 öre/kWh, if they participate in PFE, which is a five-year programme for increasing energy efficiency. Companies undertake during the first two years to introduce an energy management system and carry out a survey to analyse the company's potential to take measures to increase their energy efficiency. Companies also undertake during the programme period to implement measures to improve efficiency in their use of electricity by focusing on repayment periods shorter than three years. In January 2007, 117 companies participated in the programme. In total the companies use about 30 TWh electricity annually in their manufacturing processes, and this means that through the programme they will be able to reduce their taxes by a total of about SEK 150 million annually. There is scope for more companies to join this scheme up to year 2009.

Evaluations that have been carried out forecast a total gain in efficiency of slightly less than 1 TWh of electricity per year for a total investment cost of approx. SEK 1 billion. Approximately half of the efficiency gain comes from production processes and the other half from auxiliary systems such as plants, fans and other motor driven devices. The measures often have a very short repayment period. In addition to the measures described above, PFE companies should also take into account life-cycle costs (LCC) when purchasing equipment with high consumption of electricity and for projects, when making changes and renovations. This will lead to further efficiency gains during the remaining three years of the programme.

3.1.3 The Ecodesign Directive

The Ecodesign Directive was adopted by the EU in 2005 and covers products requiring energy to function. The directive is a framework directive and means that manufacturers of energy intensive products during the product development process must take measures to reduce the product's energy consumption and impact on the environment. Some specific requirements or overall goals for energy saving for individual products have not yet been drawn up, but the focus is on products' energy use and other environmental impact factors during the whole life cycle from extraction of raw materials to scrapping. It is estimated that 80 percent

of products' total environmental impact is determined during the product development phase.

In Sweden the Act on Ecodesign came into force 1 May 2008. Work is underway in the EU on drawing up product requirements and Sweden is represented by the Swedish Energy Agency which collects views on proposals for product requirements, both from other agencies and trade organisations, industrial companies, importers and other parties affected. The act is an incentive for producers to invest in increasing energy efficiency and aims at accelerating the introduction of new technology and efficient use of energy.

3.1.4 Environmentally friendly construction

The Ecocycle Council for the Building Sector and the Swedish EMAS Council have started cooperation on developing a programme with national guidelines for environmentally friendly construction. In the programme a minimum environmental level will be established stipulating what demands different players can impose on each other and what consumers can expect in terms of environmental adaptation. Central to the programme will be proposals for environmental requirements that can be set up for procurements involving residential construction. These will be circulated for official comment in the procurement work of the Swedish Environmental Management Council.

Swedish Construction Sector Innovation Centre – BIC

BIC is an organisation working on developing the building sector by creating conditions for and driving innovation processes. This involves the creation of new products, processes, services and systems that are crucial in a market exposed to competition. The work takes place not only through basic but also applied research and development, as well as through implementation in the form of pilot projects, information, education, standardisation, recommendations, ongoing improvements etc. Members are from building contractors, administrators, project leaders, entrepreneurs and suppliers as well as research units and agencies. About one third of the activities are related to environmental technology, and these are mainly connected to energy issues.

Best practices: Hammarby Sjöstad

The new district of Hammarby Sjöstad in Stockholm has shown how an area can be built with a significantly lower environmental impact than is usually the case for new construction. The way in which this district was planned is unique, and this was the key to its success. When the district was being built, Stockholm city council encouraged the building contractors to find their own solutions within common frameworks, where recycling principles, low energy consumption and production of their own energy were all elements.

The result was an area with many parks and green areas. These aimed at creating fast and attractive public transport, car pools and attractive cycle tracks. Renewable fuel was used wherever possible. In order to reduce heating costs, investments were made in increasing energy efficiency and the reuse of heat from waste water. New technology was used to save water and treat waste and provide effective waste recycling systems in order to recycle as much material and energy as possible.

- The environmental burden is 30–40 percent lower than a typical urban district from the 90s.
- The use of cars is 14 percent less than in comparable districts in Stockholm.
- The use of water amounts to 150 l per person per day, compared with a figure of 200 l in other parts of Stockholm.
- When Hammarby Sjöstad is complete, it will produce half its own energy.

Hammarby Sjöstad has aroused a great deal of international attention and is visited annually by more than 12,000 industry representatives and decision-makers from the whole world. Sjöstaden has also functioned as a "shop window" and demonstration facility for Swedish environmental technology, and has been important in supporting the environmental sales of a number of companies.

3.1.5 Bygga-bo-dialogen

Bygga-bo-dialogen (Building-Living Dialogue), is a unique cooperation between companies, municipalities, agencies and the Government. Through voluntary undertakings in the Bygga-bo-dialogen, the players in industry wish to achieve more than is stipulated in various laws and rules. The common goal prior to 2025 – within a generation – is to achieve a sustainable building and property sector primarily within three prioritised areas; healthy internal environment, efficiency in the use of energy and resources. The 44 players today participating in the Bygga-bo-dialogen are companies and agencies in the building and property sector, companies which in different ways are connected to the sector (e.g. credit providers, insurance companies and other suppliers of services or products to the sector) as well as municipalities.

The seven Bygga Bo goals concern increased proportion of renewable energy by 2015, reduction in the use of energy by 2025, creation of information on dangerous substances in building materials, environmental classification concerning health and impact on the environment of buildings, phasing out of dangerous substances in building materials, reduction in deposits of building waste and a reduction in the extraction of gravel. Methods used in the dialogue cover:

- Voluntary undertakings from participating players
- Work on good examples
- Environmental classification system of buildings in conjunction with energy certification systems
- Dialogue concerning social planning
- In-service training.

One prioritised area is the development of effective IT solutions for optimising energy use in buildings, in a dialogue between different players in the building sector. Within the framework of the programme, voluntary undertakings can be made more explicit in the future and will be supplemented by more active follow-up of supplied quality. There are ideas for introducing financial incentives, for example in the form of tax relief, for those players implementing ambitious voluntary commitments, but this needs to be further investigated.

3.1.6 The programme Environmentally driven markets

In May 2008, Nutek launched the programme *Environmentally driven markets (Miljödrivna marknader)* which during 2008 will amount to SEK 10 million. In the programme small and medium-sized companies in Sweden can increase their competitiveness, develop their business and sell their goods and services in environmentally driven markets. The programme supports growing companies which through networks can develop their business. There may also be a number of companies that work together on system solutions in order to demonstrate or supply goods or services, preferably in conjunction with customers. Another focus of the programme deals with driving forces and obstacles to environmentally driven growth. In this context the project provides support for increasing knowledge on measures needed to facilitate processes for smaller companies to succeed in environmentally driven markets.

3.2 MOBILISATION OF FINANCIAL RESOURCES

Access to financing is a fundamental prerequisite for starting and further developing companies not only in the environmental technology sector, but also in other sectors. A favourable company climate and clear playing rules are other important positive preconditions. Financing remains a common problem, especially in the early phases of a company's development.

Increased resources have been made available through the whole value chain, from research and development through to pilot and demonstration projects for local and global commercialisation. Today these measures are given clearer focus through support for development and commercialisation of products and services that can create sustainability – particularly in the climate and energy area – and also contribute to economic

growth. Financing of development and maintenance of buildings, facilities and infrastructure is increasingly determined by aiming at positive environmental effects and reducing consumption of energy and resources and the emission of greenhouse gases.

3.2.1 Public financing in the early phases

There are a large number of public players providing financing in seeding, start up and growth phases for environmental technology companies, in a number of different ways. One part of early financing is channelled in a natural way through incubators.

The Swedish Industrial Development Fund was formed by the Government in 1979 and oversees a total of SEK 3.1 billion, of which SEK 1.6 billion is invested. The investments are in small and medium-sized Swedish companies with growth potential on the international market. The Swedish Industrial Development Fund has a special initiative in Cleantech and in the last 10 years has invested about SEK 400 million in some 30 companies in this industry, and aims to invest a further SEK 300 million in the near future.

Vinnova is a government agency under the Ministry of Industry, Employment and Communications and provides support in the early phases of development. *Forska & Väx (Research and grow)* was started by Vinnova in 2005 with the aim of providing financial support to small and medium-sized companies which, independently or jointly, wish to invest in innovative R&D. The programme focuses on reaching companies with the capacity and desire to grow but which earlier have not actively invested in raising their innovative capacity through acquisition of new knowledge. The idea is to strengthen company competitiveness on the global market through increased knowledge in products and services, as well as developing cooperation and building up networks. Applications from companies in environment and energy areas have increased steadily. During the autumn application period, the area of environment and energy was the second-largest following biotechnology, and about SEK 25–30 million is allocated annually in the environmental technology area. The volume of applications is very large, approximately 10 times as large as fund availability.

Vinnväxt is an open competition for regions. The aim of the programme since 2001, has been to promote sustainable growth in regions by developing internationally competitive research and innovation environments in specific growth areas. Those regions that win receive 10 years of financing of up to SEK 10 million per year. The goal is that the winners should over a 10-year period become internationally competitive in their respective areas.

Vinn nu is intended for newly started companies basing their activities on results from research and development. Vinn nu started in 2002 and is run by Vinnova and the Swedish Energy Agency. Each company receives funds amounting to SEK 300,000, and around 5 companies are in the environmental technology area (including energy).

Vinnova's *strategy for increasing innovation in small and medium-sized companies* emphasises the need to get more companies to participate early in the development of new products and processes through international business cooperation. There is a clear relationship between growth/exports and company investment in R&D. At the pilot level, studies are carried out into how Vinnova in conjunction with the Swedish Trade Council and other players through follow-up funding of an R&D project can make it possible for a number of small and medium-sized companies to focus on international markets early on during the development phase. Many companies lack access to competence when it comes to using intellectual assets. Vinnova has thus created a follow-up financing package to provide companies with a strategic understanding of how they should protect and make use of their intellectual assets.

Nutek is Sweden's central business policy agency and works with financing, information and guidance. The agency also works with support for *programs and processes to strengthen the conditions for growth in industry and regions*, and is also responsible for the EU's regional structural funds which are mainly directed to company expansion phases. Within the framework of the structural funds, a number of incubators

have been partly financed, and Nutek has also been commissioned to support private incubators. Company networks can obtain support for business development and commercialisation through the programme *Environmentally driven markets*. Nutek also has a programme for product development, which includes financing for the development of "environmental technology products".

Almi Företagspartner works regionally and can provide support *for all types of companies* irrespective of industry, interest in growth or level of technology. Almi makes loans available (inter alia loans for innovation) and grants (including pre-study funding) and above all advisory and consultancy services.

Innovationsbron is 84 percent owned by the state and 16 percent by the Swedish Industrial Development Fund. Innovationsbron *supports researchers, innovators and entrepreneurs in transforming ideas into businesses*. Innovationsbron supplements the market and focuses on projects and companies in very early stages of the development process. The main instrument Innovationsbron has is providing support and running incubators, as well as contributing seed capital (grants, conditional loans and equity capital). Innovationsbron operates both on a national and local basis. Innovationsbron in its work has a broad profile, and so far has not focused specifically on environmental technology, even though there are many successful projects in this sector.

The Swedish Energy Agency provides *financing in the form of grants and conditional loans*, in order to assist seed companies to get products out on to the market and become commercially viable. Financial support is often a precondition for a company to be able to attract the additional capital required. This requires at least 50 percent matching financing from industry.

Support is given to companies which have a good business idea and fulfil a number of criteria in terms of technical uniqueness, major relevance to energy, as well as a good team backing the idea. The work of the Swedish Energy Agency is based on decades of experience from goal oriented long-term work on renewable energy. This long-term work has generated knowledge in the Swedish Energy Agency and is today used to support the future growth industry, CleanTech Energy. A wide range of ideas from companies is presented to the Swedish Energy Agency which has as a result developed good routines and the ability to assess different business proposals.

3.2.2 Financing via the Climate billion

The Climate billion (Klimatmiljarden) is a part of the Government's Budget Bill for 2007, and will provide a total investment in the climate area of an additional SEK 1 billion during the period 2008 to 2010. This initiative contains major investments related to environmental technology.

Distribution of measures, period 2008–2010

- Energy efficiency: Increase energy efficiency through procurement of technology and market introduction of energy efficient technology, requirements for energy certificates for buildings, advisory services to consumers and companies on climate issues, information and training measures on more efficient use of energy. SEK 310 million (+420 million from other initiatives).
- Pilot and demonstration projects for second generation biofuels: Strengthen Sweden's position as a leading nation in the work of developing second-generation biofuels SEK 150 million.
- Networks for wind power: Creation of a national network for wind in order to strengthen existing initiatives and contribute to regional nodes for developing wind power
- The Swedish Energy Agency as a coordinator, strengthen existing initiatives and contribute to new regional nodes in the area. SEK 40 million
- Sustainable extraction of bioenergy from agriculture and forestry: Increase production and improve sustainability in the extraction of biomass from forestry and agriculture. SEK 40 million
- Climate investments in other countries: Disseminate environmentally friendly and energy-efficient technology to poor countries in particular. SEK 96 million

- Programme for sustainable cities: Stimulate urban construction projects which contribute to an improved environment and reduced climate impact and facilitate the export of Swedish environmental technology. SEK 340 million
- Climate research: Climate research in Rossby Centre at SMHI. SEK 24 million

3.2.3 Financing via the climate investment programmes

The Swedish Environmental Protection Agency runs under a Government commission the programmes *The climate investment programmes (Klimatinvesteringsprogrammen) (Klimp) and Local investment programmes (Lokala Investeringsprogrammen) (LIP)*. The intention of these two programmes is to promote investments contributing to sustainable development at local and regional levels throughout the whole of the environmental area, but with a focus on measures which also stimulate employment and economic growth. LIP, which was completed in 2002, covered investments totalling SEK 6.2 billion for projects to create good housing environments, treatment of air and water emissions, as well as increasing biological diversity. The 211 programmes given grants cover around 1,800 measures and were co-financed by the municipalities.

Klimp is similar to LIP, but with a more explicit focus on measures to reduce climate impact. Since 2003 the Swedish Environmental Protection Agency has allocated SEK 1.5 billion to 95 climate investment programmes in municipalities, county councils and companies around Sweden. Today the programme covers approximately 720 measures and an investment volume totalling SEK 6.6 billion. Implementation of the programmes will continue until 2012. These programmes have been important for developing Swedish areas of strength in biogas and bioenergy amongst others. They have also contributed to the creation of new sustainable urban areas, such as Hammarby Sjöstad in Stockholm and Västra Hamnen in Malmö. Environmental solutions in these urban areas have been important references for Swedish companies in their exports of environmental technology. The Swedish Environmental Protection Agency continuously evaluates project outcomes in order to create learning processes and circulate good demonstration projects and best practices.

3.2.4 Financing via investment support for energy conversion

The Swedish Energy Agency deals with a number of different types of investment support for energy conversion.

Investment support for solar heating
The aim is to promote the use of solar heating technology for heating single and multi-family dwellings and certain kinds of premises. Support is provided for the installation of solar heating facilities for tap water heating and heating. The project has been in operation since 2000.

Support for conversion of heating systems
The aim is not only to reduce dependency on oil, but also promote effective environmentally adapted use of energy and a reduction in the use of electricity for residential heating. Support is also provided for changing direct electricity heating systems to district heating, heat pumps (air/ground/ rock) or bio fuel. Support for conversion from direct electricity started 2006 and will continue until 2010. Up until 2007 support could also be obtained for replacing oil heating, and this option was used by around 50,000 home owners.

Support for energy efficient windows or biofuel facilities in houses.
A person building a new house can obtain support for biofuel installation, such as pellet fuelled boilers, as the primary source of heat. Owners of single or multi-family dwellings can obtain support for window replacement with a U-value of a maximum of 1.2.

Support for increasing energy efficiency and conversion in public premises
The aim of support is that the public sector should act as a standard setter in energy areas. Owners of premises used for public activities can also

apply for support for conversion from electricity or fossil fuels to biofuels, district heating or rock/ground/lake heat pumps. Support is also given to investments in more efficient use of energy and the installation of solar cells in public buildings.

3.2.5 Financing via EU programmes

The EU programme Life+

The Swedish Environmental Protection Agency is the national node for the EU programme, Life+, which amongst other things, supports demonstration projects in environmental technology. The programme started in June 2007 with a budget of Euro 2.1 billion up to year 2013. By financing innovative projects that demonstrate the technological and financial driving forces of environmental technologies, the programme contributes to filling the gap between research financing and risk capital.

Sweden has been granted a total of SEK 120 million for applications in 2007, and this means that Sweden is one of the most active countries in Life+. However, the financing component to be contributed by project owners means that about SEK 250 million is invested in environmental projects in Sweden in connection with the first application round of Life+.

Competitiveness and Innovation Programme (CIP)

National responsibility for CIP is shared between Nutek and the Swedish Energy Agency, where the latter is responsible for Intelligent Energy for Europe, and Nutek for the remaining parts. Both agencies run active outreach activities to help bring more Swedish players into the programmes.

Structural funds

The structural funds promote sustainable economic growth. The main focus in the projects are measures to promote growth in industrial development, research and development, as well as higher education. Growth industries, clusters and the environment are themes that can be supported in the programme.

Within the framework of the structural funds, priority in Sweden is put into investments in the areas of innovation and renewal. For all structural fund projects, there are horizontal requirements on environment, integration and gender equality to be taken into account. Nutek and the Swedish Environmental Protection Agency have together produced a manual on how environmental, and environmental technology aspects are to be considered when assessing applications and work in the programme. The proportion of projects with a positive environmental impact and related to environmental technology is expected to increase in many regions. In two of the eight regional structural fund programmes (Western Sweden and Mid- Norrland) special initiatives are taken in the areas *Sustainable urban development and Energy and environmentally driven development.*

Jeremie

Jeremie (Joint European Resources for Micro to Medium Enterprises), is an initiative from the EU Commission and the European Investment Fund, EIF. The aim is to provide market supplementing financial instruments within the framework of the structural funds programmes. At the beginning of April 2008, it was clear that the applicable legislation was technically too complicated to proceed further with a Jeremie Fond in Sweden. The main reason for this is the Act on Public Procurement.

Nutek and Almi have with support from the European Regional Fund financed eight regional needs analyses, one for each programme area. In order to enable the programme to solve the need for capital on the part of companies and also give players who can act as co-financiers in these investments the opportunity of coordinating their efforts, Nutek proposed a joint call for capital support solutions. As a result of the needs analyses, regional calls have been directed to financing players active in the programme areas implemented during the autumn and winter 2008–2009.

3.2.6 Private risk capital

Risk capital can be divided into two main categories: Venture (start-up and expansion) and buy-out. Venture capital helps companies to develop

in the early seed phases, start-up and growth, whilst buy-out enables risk capital companies to partner or purchase the whole or parts of a company.

Risk capital players active in the sector of Cleantech Energy can be divided into general investors, who do not have any specific sector focus but invest in a number of sectors, and specialist investors who have a specific Cleantech focus. More recently a number of players have positioned themselves to target the Cleantech area. The risk capital situation in the environmental technology area has clearly improved in the last two years. Examples of this are the following:

- Sustainable Technologies Fund, which invests in companies in renewable energy, efficient use of energy, renewable materials and chemicals, as well as recycling and treatment technologies, have together brought in investment capital of slightly more than SEK 0.5 billion from Swedish and foreign investors. These include both the Sixth AP Fund and the Third AP Fund.
- Ikea has started a subsidiary, Ikea GreenTech AB, which will invest about SEK 500 million in environmental technology over the next few years. The funds will be invested in five areas: solar panels, alternative lighting, energy saving, water-saving and new product materials. The idea is that Ikea GreenTech will identify companies which through interesting new environmental technologies can develop products, which can both be installed in Ikea related facilities and which can as quickly as possible be sold through self-service Ikea stores.
- Volvo Technology Transfer also creates financing support for new environmental technology companies. A precondition is that the companies in question have activities or products of relevance for Volvo. Volvo Technology Transfer has supported new environmental technology companies such as Chemrec, Chromogenics, EL-Forest and EFF Power.
- The Seventh AP Fund announced in December 2007 that over three years they will invest SEK 3 billion in unlisted environmental technology companies, and that about half will be invested in Nordic companies, and the other half outside the Nordic area. The investments will be made in sectors such as alternative sources of energy, water production and recycling.

- Provider Venture Partners AB (Swedish risk capital company) and Sitra (Finnish Innovation Fund) launched during 2007 a new risk capital fund for environmental technology, Cleantech Venture Capital Fund, which has its head offices in Finland and Sweden. The fund has about Euro 100–160 million to be invested in Nordic companies.
- The Nordic Investment Bank will be able to lend slightly more than SEK 14 billion for projects to reduce dangerous emissions and mitigate the effects of climate change. Initiatives will also be taken for measures which will lead to the introduction of renewable energy sources, and also energy-saving and adaptation to the consequences of ongoing climate change.

3.2.7 Capital for environmental technology in developing countries and Eastern Europe

Swedfund provides risk capital and competence for investments in Africa, Asia, Latin America, as well as Eastern Europe (non-EU countries). Swedfund invests together with strategic partners. In the first instance these are Swedish companies wishing to establish themselves on a new market or expand their business in existing markets. Swedfund provides risk capital in the form of share capital, loans, guarantees and partial financing for leasing agreements. Swedfund International AB is owned by the Swedish state.

Swedfund has environmental technology as a focus area, and over a number of years has worked with investments in environmental technology and energy, such as the financing of the south-western waste plant in St. Petersburg, Russia, manufacturing of water purification chemicals, Egypt and Poland, and the manufacture of insulation material, Poland. Swedfund works actively to invest together with both Swedish and international companies in energy and the environment with a focus on poor countries in Asia, Africa, Latin America and Eastern Europe (non-EU) facing major environmental problems. Swedfund tries to mobilise Swedish resources, one instance being demonstration facilities.

EBRD – The European Bank for Reconstruction and Development

finances projects and activities in central and eastern Europe, as well as in countries in the former Soviet Union. In the environmental area, primarily municipal technical projects are financed in waste and water-sanitation, infrastructural development and reusable energy. Sweden is one of the larger donor countries.

3.2.8 Financing guides

Swentec's financing guide. Swentec has produced a web-based guide to financing for small and medium-sized environmental technology companies to facilitate contact with the different bodies available for financing.

The guide takes as its starting point the position in which the company finds itself, and covers the whole value chain from start-up to exports. The content is partly produced together with the group for financing environmental technology exports, and consists of Swedfund, EKN, SEK, the Swedish Energy Agency, Sida, Swedish Trade Council, Almi and Swentec.

The internationalisation guide (http://www.internationaliseringsguiden.se) was developed as a result of cooperation between Almi Företagspartner, the Swedish Trade Council, the Swedish Export Credits Guarantee Board, the Swedish Export Credit Corporation and Swedfund. The guide is a portal assisting all Swedish companies wishing to find the right player to obtain guidance/help concerning their needs in different phases of a company's internationalisation process. The portal links to different players behind the guide and provides a short cut to information/guidance and expert knowledge concerning business development, foreign investment, financing, risk capital and protection against risk of non-payment – through the whole value chain.

3.2.9 "No wrong door" for small and medium-sized environmental technology companies

Swentec, the Swedish Environmental Technology Council developed during 2008 together with regional and local players web-based support for small companies to find the right support and financing solutions.

Today there are many players with products and services for small and medium-sized companies both in Sweden and at the EU level. But with the great range of organisations, agencies and investors supporting smaller companies, it difficult to get a clear overview and identify the opportunities that exist. Support systems could be made more effective, if companies interested in developing in the environmental technology area, could more simply and easily obtain comprehensive guidance services to other national or EU-based players and programmes.

3.3 MARKET-BASED STEERING INSTRUMENTS

By steering instruments, we are referring to those tools the central government has at its disposal to create good preconditions for development or to accelerate change in a desired direction. Steering instruments are needed both to increase supply and demand for environmental technology. This largely involves applying and developing financial steering instruments such as, for example, environmentally adapted public procurement, but also the use of different types of steering instruments to set out requirements for "best available technology" when assessing permits, increase environmental aspects in product standards, develop environmental management systems in both public and private sectors, improve environmental reporting from companies and other organisations, increase the use of systematic environmental methods such as lifecycle analyses, increase the proportion and demand for environmentally labelled products, as well as increase the use of strategic environmental assessments.

3.3.1 Review of economic and other steering instruments in the environmental area

Steering instruments which primarily have environmental policy objectives can in many cases also help to accelerate change in the development of environmental technology, not least to increase the demand for good environmental technology. The Swedish Environmental Protection Agency

and the Swedish Energy Agency analysed in 2006 virtually all financial steering instruments in environmental policy in their joint report *Financial steering instruments in environmental policy (Ekonomiska styrmedel i miljöpolitiken)*. A number of Swedish financial steering instruments (taxes, fees, tax relief and grants) have been shown to have a good environmental impact and good dynamic effects in society, for instance by promoting the development of technology. The agencies consider that general non-sectoral taxes, such as the carbon dioxide tax, are the steering instruments which generally have the best conditions to bring about long term effective environmental steering in society. Renewable biofuels are today exempt from both energy and carbon dioxide taxes. This helps to strengthen the position of these fuels on the market.

Evaluations have shown that a number of different steering instruments are also effective in the long-term, based on criteria such as cost efficiency (cheapest measures taken first), dynamic efficiency (the instrument helps to generate technological development and over time leads to the most cost-effective solutions) as well as goal attainment (extent to which a steering instrument leads to the attainment of goals). The steering instruments which are considered to be efficient in this sense are the energy and carbon dioxide taxes, tax on sulphur, NO_2 fee, fuel tax, environmental classification of fuels and tax differentiation, tax on cadmium used in fertilisers, congestion charges (Stockholm) and also the tax on deposits. This analysis also points out the need to geographically differentiate certain steering instruments, for example those that can be related to the national environmental quality target of *No eutrophication*.

The electricity certification system and EU tradable emission rights, work together primarily with other financial steering instruments to attain climate goals. From a player's perspective, the system of steering instruments works together with the energy production system and energy intensive industry. Market-based steering instruments affect steering, as well as the preconditions for what other steering instruments should be combined with these systems.

Steering instruments other than financial must also be considered in a final overall strategy. In order to assess whether a financial steering instrument is the most effective, comparison should be made with other steering instruments. In addition, steering instruments often interact, for example the NO_x system interacts with assessment of permits, or financial support for solar energy with information steering instruments directed to the target groups on the importance of solar energy installations. In order to both evaluate the effect and assess potential, all applied and possible steering instruments should be analysed parallel.

3.3.2 Electricity certificates

The Riksdagen has decided that support for electricity production from renewable energy sources and peat should come from the electricity certification system. The electricity certification system was introduced in May 2003 to attain EU goals for the production of electricity from renewable energy sources and will continue until 2030. This is a market-based support system which by creating competition between different types of electricity production will reduce production costs and strengthen the development of new production in the future. The aim of the system is to increase the quantity of electricity from renewable sources from the 2002 level of 17 TWh by 2016, and contribute to a more ecologically sustainable energy system in Sweden. An electricity certificate is awarded to electricity producers for each megawatt hour of electricity generated from renewable energy sources or peat, produced in an approved plant. Sales of these give producers financial resources to expand the production of electricity from renewable sources.

3.3.3 Economic incentives for starting the market for environmental vehicles

There are a number of different types of steering instruments that have an impact on the transport sector. Energy and carbon dioxide taxes on fuels are indexed annually in relation to price changes (KPI). The aim of the energy tax is primarily fiscal, whilst the carbon dioxide tax aims at reducing emissions of carbon dioxide from fossil fuels. Biofuels are exempted from both the energy and carbon dioxide taxes. The aim of tax

exemption is to promote the introduction of new fuels and contribute to the energy policy goal of supply security by supporting the use and domestic production of biofuels. The act requiring larger petrol stations to sell at least one renewable fuel since 1 April 2006 has an impact on development in the biofuel area. The act mainly encourages the sale of ethanol.

Vehicle taxes have primarily a fiscal purpose, but since October 2006 have been changed to increase steering in the direction of more energy/fuel effective vehicles and vehicles using alternative fuels. The tax is based on emissions of carbon dioxide from vehicles instead of as before the weight of a vehicle. During 2006 the tax on vehicles was reduced by a total of SEK 6,000 for diesel powered private cars with particulate filters. The tax reduction for particulate filters ceased at the end of 2007, as it was thought that the majority of new private cars with diesel engines would be supplied with particulate filters.

As of 1 April 2007 private persons buying an environmentally approved car receive an environmental green premium of SEK 10,000. The premium which is time-limited, is intended to encourage the purchase of fuel efficient cars and cars powered by alternative fuels.

On 1 August 2007 a congestion charge was introduced for Stockholm. The aim of this is to improve transport conditions and the environment in Stockholm, and also contribute to financing investments in the road network in the Stockholm region. There are also a number of other steering instruments in the area, such as tax on benefits concerning free cars and free fuels, subsidised public transport, as well as road charges for certain heavy vehicles.

3.3.4 Green procurement

The work on promoting Green procurement has been ongoing in Sweden and the rest of Europe over a number of years now. Criteria have been developed, good examples exist in most areas of technology, and increasing numbers of public players are applying Green procurement. Green procurement processes are increasingly integrated with other support methods such as Life Cycle Costing (LCC), EPD – Environmental Product Declarations and Environmental Management Systems. The Swedish Environmental Protection Agency, however, has determined in an evaluation that there still remains much to be done before it can be concluded that a breakthrough on a wide front has been achieved.

3.3.5 Procurement of technology

Procurement of technology is a steering instrument to promote the development of new energy efficient technologies. Since procurement takes place in a tendering process, this means that there is some kind of competition between different manufacturers. When tenders are received, they are tested and evaluated by an independent party, and one or more winners are selected. The winners receive help to introduce their product to the market and are guaranteed an initial volume of orders for the new product. In addition, the state contributes information to purchasing groups in order to circulate the winning technology more widely.

Procurement of technology is a steering instrument for initiating a market reorientation and for disseminating new efficient technologies (new products, systems and processes). It is also implemented mainly in the areas of heat and regulation, hot water and sanitation, ventilation, white goods, lighting and industry. The Swedish Energy Agency has compiled a listing of all technology procurements in the energy area which it and its predecessors have carried out. Since 1990, 56 different technology procurements have been carried out in this area and received partial financing. Ongoing technology procurements include needs-steered ventilation in new multi-family dwellings, steering and monitoring systems for property, climate integrated systems for solar shading and regulating entry of daylight, standardised industry information in the sawmill industry and pellets as fuel for home heating.

3.3.6 Innovation procurement

Public procurement of technology has been used successfully to bring about new products. In Sweden this has mainly taken place not only through cooperation between large public players and private companies

(Televerket – LM Ericsson, Vattenfall – ASEA/ABB, SJ – ASEA/ABB), but also in the defence sector and through special assignments to the Swedish Energy Agency and its representatives (STU, Nutek). Since an increasingly large part of public activities are procured from external providers, the need for innovation in the service sphere is increasing. Process innovators in the manufacture of goods are interesting to support, not least from an environmental perspective. Vinnova in its initiative to promote innovation through public procurement, has chosen to broaden the concept of technological procurement to incorporate innovation procurement.

Today there is no institutional infrastructure for public innovation procurement, but in Vinnova initiatives have been taken to solve this, amongst others, through a pilot programme.

3.3.7 Eco labelling and environmental management systems

Both environmental labelling and the introduction of environmental management systems contribute to creating positive driving forces for the development of environmental technology. In Sweden there are a number of different types of environmental labels on the market:

- What is referred to as third party certification: Examples of environmental labels in this category are the Nordic Swan. The Swedish Society for Nature Conservation's "Bra Miljöval" (Good environment choice) and KRAV for ecological products, and of course the EU Flower.
- The environmental product declarations had the aim of providing comparable information about the impact of products and services on the environment. They are used in the first instance to provide information between companies. The Swedish EMAS Council registers certified environmental declarations (EPD, Environmental Product Declaration).
- Energy labelling of white goods, air-conditioning equipment and air-air heat pumps, make it easier for consumers to make choices to economise on energy. The Swedish Energy Agency is a supervisory agency.

The introduction of an environmental management system is also a steering instrument based on voluntary undertakings. Within industry the most common environmental management system is ISO14001, but EMAS is also fairly widespread. Simplified environmental management systems mainly for small and medium-sized companies are also relatively common. Environmental management systems create a large quantity of competence enhancing activities, and encourage companies to set up environmental goals and purchasing criteria, which in their turn encourage increasing use of environmental technology. Sweden is one of the countries where penetration of these systems has progressed furthest, and the number of companies with environmental management systems is steadily increasing. In Sweden the Swedish EMAS Council is responsible for the application of the EMAS system.

Swedish agencies have since 1996 been commissioned by the Government to introduce and work with environmental management systems based on the principles laid down in ISO14001 and EMAS. Today nearly all agencies, numbering some 220, have been given the task of introducing environmental management systems. Some 50 smaller agencies have received simplified variants, which means that in the first instance they should work with environmental impact in their own administration.

3.3.8 Improving market information

The Swedish Energy Agency issues annually the market review *Investing in Cleantech*. This publication takes up trends and statistics in Cleantech markets and provides information on steering instruments and policy incentives that may be of importance for investors in the sector. The aim of the review is to provide information on the Cleantech market to stimulate additional investments in the sector. The main target group for the publication is investors in Sweden, but it has also been recognized by entrepreneurs and innovators in the sector, as well as politicians and other players in the innovation system in Sweden.

Swentec's reviews of the Swedish environmental technology sector are published annually with statistics on the number of companies, distribu-

tion between industries and financial performance, including exports, and studies of specific industries are also published. So far Swentec has published reviews of the water and ventilation industry, waste management and bioenergy.

Vinnova has a wide ranging international contact network covering methods for promoting future processes. The focus is mainly on possible trends in the future in research, technology and policy, as well as a dialogue to bring about a joint development strategy for Vinnova and other players with an appropriate agenda for research and innovation.

As a complement to this, in the last year of the project Framsyn och tillväxtområden i svensk exportindustri (*Emerging business opportunities in the Swedish export industry*) a method was developed that will have an impact on growth areas in Swedish export industry. This means that prominent company leaders contribute to identifying possible markets of the future in new areas where Sweden appears to have good potential. In cooperation with the Blue Institute, with its origins in the Market Technical Center, the first two reports in a series of 12 in-depth studies into growth areas in Swedish export industry have been published. These are Vedbaserat bioraffinaderi (Wood based biorefineries) and Förnybara energikällor (Renewable energy sources).

The report *Vedbaserat bioraffinaderi (Wood-based biorefineries)* is also one of a number of source materials used in the work of developing a common strategy for biorefining together with the Swedish Energy Agency. The report *Förnybara energikällor (Renewable energy sources)* is a compilation of three in-depth studies into wind power, solar energy, and wave power. These reports are also a result of cooperation with the Swedish Energy Agency which was commissioned by the Government to identify growth potential and the preconditions for the renewable energy sector.

In order to shorten the lead time for export business for Swedish environmental technology companies, the Swedish Trade Council has developed *priorities for the markets in bioenergy, water, waste treatment and management* where the most interesting international markets have been identified. Market priorities are based on company surveys, market data and interviews with experts. The majority of companies in the industry are small and medium-sized, and the establishment of priorities has been done to facilitate companies' choices of export markets. These priorities are a consequence of the survey carried out by Swentec of leading edge companies in the environmental technology industry and are part of the Swedish Trade Council's assignment in the environmental technology area from the Ministry of Enterprise, Energy and Communications.

In addition, market studies have been carried out on specific markets, for example in the USA in cooperation with the Swedish Energy Agency, where the focus has been on business opportunities in biogas, ethanol and waste incineration with extraction of energy.

3.4 AWARENESS RAISING MEASURES AND TARGETED TRAINING

In this area a large number of fairly dissimilar activities are carried out, many of these are initiated and implemented at local or regional levels. Some good examples of such local initiatives and initiatives from industry, include the work of environmental managers in industry in giving prominence to environmental technology companies, or science centres where new environmental technology solutions are being exhibited. A complete report is of course not possible in this context, however, a selection of examples is given below.

3.4.1 Energy advice and energy information

The Swedish Energy Agency works in many different ways in raising knowledge and awareness of energy questions among companies/organisations and individual consumers. Energy labelling of white goods is one successful example. This also involves supporting local energy advisory activities, for example through providing further training for energy advisers. The Swedish Energy Agency is active in the ManagEnergy

initiative. High-quality web sites with useful information on energy support this activity.

3.4.2 Sustainable municipalities

On the initiative of the Swedish Energy Agency, a pilot project was implemented *Sustainable municipalities* 2003–2007 together with the municipalities of Borås, Solna, Ulricehamn, Vingåker and Örnsköldsvik, amongst others, with the purpose of developing the working methods of local players and broadening their knowledge in the energy area. The lessons learned from the pilot project provide the basis for future activities that bring together national and local opportunities to influence and combine the expert competence of national agencies in the energy area with that of the municipalities at the local level.

The programme *Sustainable municipalities* 2008–2011 – with energy as the springboard was implemented by the Swedish Energy Agency on a commission from the Government and aims at stimulating local activities contributing to sustainable use of energy in an energy system that is secure, cost-effective and has low negative impact on health, the environment and climate.

The programme *Sustainable municipalities* helps municipal employees and decision-makers to get access to knowledge, good examples and results, and also contributes to an in-depth dialogue in municipalities, between municipalities, and between municipalities and national experts. By having an open and inspirational climate for cooperation, conditions are created to think along new tracks, to develop existing forms of cooperation, and expand system perspectives etc. With knowledge of how different subsystems in the geographical area operate, for example transport flows and technical municipal support, important local activities can be implemented to improve energy efficiency.

3.4.3 Promotion of LCC approaches

The Swedish Energy Agency, the Swedish EMAS Council and the Swedish Consumer Agency, amongst others, have all taken initiatives in developing net-based tools to enable potential customers and other users to make their own calculations. Information campaigns have also been implemented to obtain greater recognition. In particular, it can be mentioned that the Swedish EMAS Council has developed a calculation tool for calculating LCC analysis for private cars. This tool is intended to be a support both for purchasing and analysing needs.

3.4.4 Dissemination of results from larger project oriented programmes

The Swedish Environmental Protection Agency works on the dissemination of results from the investment programmes, Klimp and LIP, by identifying activities and facilities with good environmental and financial outcomes, and using these as good examples. Ways of working and methods are based on work which the Swedish Environmental Protection Agency and Nutek did for the Commission on identifying good results from the LIFE programmes, and making these accessible. This process is currently a permanent feature of the Commission's work.

3.4.5 Dissemination of results from company oriented programmes in the environmental area

Over more than 10 years Nutek has supported around 1500 small and medium-sized companies in environmental work through co-financing of development projects. The coverage has been broad, involving not only eco design, but also business development and export of environmental technology. Experiences from research and practical work on sustainable development in small and medium-sized companies is presented in a database of all completed projects, containing detailed descriptions and contact data. The results, analyses and reports developed in the framework of Nutek's environmental programmes can all be accessed. Nutek also regularly runs seminars for different target groups to disseminate the results of current projects in sustainable growth areas.

3.4.6 Arrangement of the ETAP Forum in Vienna

Within the framework of the Commission's work on implementing ETAP, Sweden together with Austria launched an initiative in Awareness raising and Targeted training. A preparatory workshop was held during Autumn 2005. Together with the Commission, the fourth ETAP Forum was arranged in Vienna at the end of January 2008 on the theme of Unlocking global market opportunities. Industry and public players from all member countries had the opportunity of discussing how European environmental technology could maintain and develop its place in the global environmental technology arena in a context of increasing competition. During the meeting, modern meeting technologies were used such as the "mentometer" system, which made it possible to effectively share ideas and views from all the different types of players represented at the Forum. The Commission is working on the views expressed at this conference.

3.5 COORDINATION BETWEEN COMPANIES AND FORMATION OF CLUSTERS

Primarily Nutek, together with Vinnova, ISA and the Swedish Energy Agency finance cluster formations of companies and other players, which together develop and apply environmental technology. Some examples are the Biobränsleregionerna (Biofuel regions), Bioenergy in Småland, Sustainable Business Regions, Cluster formation over quality of indoor air, Eco-Design clusters and others. A number of cluster programmes of the Swedish Energy Agency and Vinnova related to R&D are presented in section 2.

Nutek's cluster programme

Nutek's cluster programme finances during the period 2005–2010, in the first instance cluster initiatives which are in a mature phase, and which will strengthen international competitiveness. The programme also targets relatively new cluster initiatives at an early stage, with a focus on future growth areas.

The environmental aspect is regarded as a possible and important competition factor, and the idea is that the regional cluster programme in an integrated and concrete way will work to increase knowledge on how environmental factors can become an important competitive instrument for the cluster initiatives.

Of the 10 cluster initiatives which Nutek's programme is working actively and financially with in 2008, there is one that focuses on environmental technology, whilst the others focus on competence areas in packaging, marine technologies, animation and experiences, heavy vehicles, biotechnology, mining and minerals, and geographical information systems.

Best practices: Sustainable Sweden Southeast

Sustainable Sweden Southeast is an initiative in South East Sweden focusing on Kalmar (Blekinge, Kronoberg) and covers 32 active players, of which 22 are small companies in environmental technology, 10 municipal limited liability companies, as well as higher education in Kalmar, Blekinge, and Växjö University and IVL. The Regional Development Council in Kalmar County and the Swedish Trade Council are important cooperation partners. Synergies should strengthen international preconditions by broadening the network in the first instance to Jönköping, Halland and the Region Västra Götaland.

The aim is to strengthen international competitiveness of South West Sweden through exports and cooperation in the environmental area, via renewal and market development in small and medium-sized companies. The goal is to be the active partner for environmental technology by working out a policy, and an approach to "sustainable entrepreneurship".

During the year the initiative has developed six business systems with different orientations, but works on the basis of players' needs, cooperating with university colleges and universities (Växjö University and the University colleges of Kalmar and Blekinge, and also Beijing Technology University). The business systems provide a platform for joint activities at the same time as knowledge of international work is a learning process

involving increasing factual knowledge and organisational development for the companies.

Best practices: The Paper Province in Värmland
The Paper Province is an economic association which coordinates and develops technological cooperation between players in the pulp and paper industry in Värmland, northern Dalsland and the county of Örebro. It focuses on marketing, project development, supply of competence, growth and development cooperation with industry, schools, universities and the public sphere – regionally, nationally and internationally.

Local proximity to raw materials, modern infrastructure and a central location in northern Europe, all combine to make the region one of the leading areas in the world for this industry. There is a unique combination of competencies concerning pulp, paper and the packaging industry with more than 250 companies and around 12,500 employees in the industry. During 2007 the Paper Province was identified as one of Europe's 16 "Top European clusters in high innovative regions" by the European cluster observatory. The cluster is financed by the county administrative board and the region in Värmland, as well as four municipalities in the county.

Best practices: Passivhuscentrum (Passive house centre)
In the municipality of Alingsås successful cooperation has been developed between the municipality and industry over energy efficient renovation of run-down multi-family dwellings from the 1960s and 1970s. The municipal housing company, Alingsåshem AB, has entered into a unique multi-year agreement with the private building contractor, Skanska AB, for the renovation of 300 flats in the Brogården district. By applying Passivhusteknik (Passive House technology), it is estimated that the use of energy can be more than halved in the 300 flats after renovation, and that if the technology were applied to many of the one million flats of the same standard that exist throughout Sweden, the outcome would be highly rewarding. In the long-lasting agreement Skanska is responsible for developing competence for this type of renovation, competence which can also be used by other housing companies.

To assist this process, the Municipality of Alingsås has together with Region Västra Götaland started an information centre, called Passivhuscentrum, which disseminates knowledge about energy efficiency in the building sector through training and study visits. The centre also has national expertise linked to it to support and accelerate development of energy efficiency in the building industry.

This private-public cooperation has made a major breakthrough, both nationally and internationally. In April 2009 they will act as hosts for Enbo09, the largest international energy and housing exhibition in the Nordic area, as part of the European Interregional project Rebecee (Renewable Energy and Building Exhibitions in Cities of the Enlarged Europe).

3.6 PRIVATE-PUBLIC COOPERATION

Players in the industrial sector have an important role when it comes to disseminating environmental technology. Private-public cooperation (PPC) is a very important component if ETAP is to be successful. In fact the whole of ETAP could be viewed as an area for such cooperation. ETAP, essentially is support provided by public players to private players producing and selling environmental technology solutions.

Today in Sweden there are a large number of PPCs. Many examples can be mentioned, such as numerous Swedish companies and public institutions taking part in research and development projects within the framework of IEE, CIP and Life+. Another area is the work of Teknologiplattform (Technology platforms) and a third is the cooperation brought about by the comprehensive Klimp programme (see 3.2.3). Small and medium-sized companies are involved to a large extent through local and regional players, and sometimes in conjunction with the national level. The energy efficiency programme of the Swedish Energy Agency, see 3.1.2,

features such cooperation as an important element. All these initiatives are described elsewhere in this document. The interface between cluster formations and PPCs is also blurred, since the former often has significant elements of cooperation with public players and/or public financing.

The Delegation for Sustainable Cities
The work of the earlier mentioned delegation builds very much on cooperation. The delegation should co-operate with the municipalities, players on the market and other parties. The delegation will implement measures that contribute to improving conditions for the development of sustainable cities, which improve the conditions for exports of environmental technology and expertise, which in overall terms will provide a national arena for sustainable city development. This work is linked both to Byggabo-dialogen and the Swedish Trade Council's initiative in SymbioCity.

Swedish Clean Water Partnership
This is an interesting example from an environmental technology perspective. SymbioCity CleanWater Offer is the result of the mobilisation project, Swedish CleanWater Partnership – a platform and natural bridge between customers and Swedish knowledge and products in the water sector for increasing Swedish exports of water-sanitation technology and competence.

The concept is based on a total solution for the customer and this covers parts of the knowledge concerning integration of systems in municipalities, as well as proposals on how customers can solve financing.

It is based on cooperation between Swentec, Varim (water sanitation trade organisation for suppliers and consultants) and the organisation, Svenskt Vatten, which has suppliers from municipal water entities as members.

3.6.1 Local and regional initiatives

Many PPC projects are initiated and carried out at the regional or local level, sometimes also within an EU financed programme or EU network.

It is impossible in this document to show the full range of initiatives existing in Sweden. There are many different organisational solutions to support business in the environmental technology sector, including different types of incubators.

Other examples are the three PPC projects in the environmental area for vehicles, which have been run in the three largest cities in Sweden, partly with support from the EU (Civitas), which have also been highly successful. The projects significantly accelerated the rapid introduction of environmental cars (see 3.3.3). This involved raising awareness and making it easier for different kinds of potential customers to obtain the new technology, as well as effectively linking together supply and demand.

These examples have often been initiated by national or regional players in the public sector. But there are also examples where initiatives have come from the business sector, such as KNEG, Climate neutral freight transport.

Best practices: Industrial ecology
Industrial ecology is a branch of environmental technology where society and its environmental impact are studied from a systems perspective. The systems perspective is expressed in terms of two main branches, one of which is referred to as industrial symbiosis.

Industrial symbiosis deals primarily with the flow of waste products between companies. The optimal approach is that human society functions essentially in the same way as nature's own eco systems.

At Händelö in Norrköping, there is an interlinked system for the exchange of energy, products and waste products with many companies involved. In total the system consists of 23 exchanges between the 14 companies involved in the system. The fact that this has become an interlinked system was not originally an overall goal of any player, but rather the result of different exchanges in the system developing more or less independently of each other. Norrköping's industrial eco system has grown over the last three decades. The system has been self-organising

since there has been no underlying plan guiding its creation and development. Instead development has been powered by economic factors. Each exchange is thus planned separately.

Best practices: KNEG
Climate neutral road freight transport. The transport sector faces major challenges – the emission of greenhouse gases must be substantially reduced. In 2007 some of the major players in the freight goods transport sector in Sweden took a co-ordinated initiative where the reduction of greenhouse gases from Swedish freight transport was at the very top of the agenda – KNEG. Schenker, Volvo Lastvagnar, Preem, the Swedish Road Administration and Chalmers jointly set up the goal of halving greenhouse gas emissions from Swedish road freight transport by 2020.

Each partner in KNEG makes three to five commitments to reduce emissions from their own activities. These undertakings are divided into four areas: more efficient transport, more efficient fuel production, more efficient vehicles, and also greater use of renewable fuels. Some of the undertakings concerned initiatives for training in driving economically, optimisation of logistics, mixing alternative fuels or use of hybrid technologies.

During the cooperation a number of new projects have been started with participants co-operating over e.g. specific flows of goods. This type of project shows the strength of private-public cooperation where new solutions requiring new technology, knowledge and changes in legislation are to be tested. It may involve the use of longer and heavier vehicles where new lorries are needed, changes in permits, and knowledge to calculate fuel savings and reduction of greenhouse gas emissions.

The cooperation has been highly successful and received much attention outside Sweden's borders from both players in industry and politicians in the EU. A number of players are involved, and this increases the potential for disseminating new technologies and new solutions for climate neutral freight transport.

Best practices: Fossil fuel free region – Kalmar.
The County of Kalmar, a region in South West Sweden, is taking the initiative of becoming a fossil-free fuel region by 2030. This will be achieved by:

- More efficient use of energy to reduce consumption.
- Conversion from fossil to renewable fuels.
- Producing renewable energy to bring about corresponding reductions in the use of fossil fuels in and outside the county.

Special measures will be taken inter alia by more efficient use of energy in different forms, wind power, bioenergy/biogas, reduction of different greenhouse gases in the agricultural sector, and climate smart travel and transport. Both public and private players will be involved, for example farmers concerning climate smart animal husbandry, biogas production and cultivation of biocrops, energy and the pulp industry to extend the use of backpressure power and waste heat, the tourist industry for energy efficient transport, property owners for efficient use of energy in housing and premises, and similar. An important part of the work is also that the County Administrative Boards intend to function as models in their own activities, by implementing comprehensive programmes for increasing energy efficiency, changing energy to renewable energy sources, and working to make their own transport "climate smart" by such means as environmental vehicles, car pools, telephone conferences, and other methods.

3.7 CONCLUSIONS AND REFLECTIONS FOR FURTHER WORK

Improved statistics and follow-up
There is a need to discuss more efficient follow-up mechanisms nationally and at the EU level. There is also a need to follow up national innovation systems and their output, environmentally friendly procurement (both green procurement and technology/innovation procurement), and also how Member State initiatives can be incorporated in joint EU activities such as the building of infrastructure in new Member States.

Dissemination of what has been learnt and development of knowledge from large project oriented programmes
It should be possible to put greater emphasis on knowledge development and the dissemination of good examples from larger project oriented programmes, particularly those with substantial elements of EU funding, as well as other relevant national programmes. Working approaches and methods to achieve this need to be developed, particularly as regards good programme implementation, but also for successful project outcomes and company cooperation brought about by the programmes. Active exchange of experience between Member States thus needs to be encouraged.

In such work experiences from developing and renewing infrastructure, as well as measures aimed at achieving sustainable districts and cities should be given particular emphasis, especially programmes and programme outcomes that can be assumed to be relevant for the newest Member States of the Union.

Initiative on targeted training for key groups.
Many agencies have within their sector one or more professional groups, which play key roles in bringing about increased market share for environmental technology. Examples of such key groups are purchasers, environmental auditors and managers responsible for environmental management systems, sales personnel, risk capital specialists, incubator supervisors and so on. Targeted training for these groups should be very efficient, and in ETAP comes under Provision of targeted training. A comprehensive review should be made of those agencies and players that could be commissioned to draw up inventories, plan and take initiatives for in-service activities, which aim at raising competence concerning the preconditions and opportunities for environmental technology.

Use of energy in public premises
Within the framework of the Bygga-bo-dialogen (Building-Living Dialogue), voluntary undertakings can be made more explicit, and be reinforced through more active follow-up of delivered results. A special area which has been shown to be appropriate for this type of commitment, is the Use of energy in public premises, which has had a relatively short payback period for funds invested. Ideas for developing broader approaches could be obtained from the PFE programme described above, including the use of financial incentives, by such means as tax reductions.

Environmental adaptation in freight transport and logistics
There are grounds for determining whether the initiative on environmental vehicles could be succeeded by similar activities in freight transport and the logistics sector, and in such case, using the region as a basis. Similar to the initiative on the environmental car, this involves raising awareness and making it easier for potential customers of different kinds to demand new environmental technology solutions that exist on the market or are "close to market" launch, as well as linking supply and demand more effectively.

Procurement: Green procurement, technology procurement, innovation procurement
It is important that initiatives are taken that lead to green procurement becoming a part of public procurement, and that a significant majority of all public procurement covers ambitious environmental requirements, which themselves drive technology forward. This could be implemented not only by further development work by central government, with the goal of stimulating offensive voluntary undertakings, but also by creating clear follow-up systems. At the Community level there needs to be working material in the form of criteria for different product groups, which is based on the experiences from Member States that have progressed furthest in this work.

Technological and innovation procurement also needs to be further developed. Resources need to be set aside so that the rate of development can be increased, and clearer ambitions and goals formulated. These procurement instruments – for creating new environmental technology solutions, could be developed together with the research community, and small and medium-sized companies.

Other initiatives are needed in the European context, and Sweden is in a good position to be able to contribute from the national experiences she has gained.

"No wrong door" in a support system for environmental technology and environmental entrepreneurship

Today there are many players with products and services for small and medium-sized companies both in Sweden and at the EU level. But the picture of all organisations, agencies and investors promoting smaller companies is difficult to overview, and companies find it difficult to identify the opportunities that actually exist. Different players should co-operate in accordance with the principle of "No wrong door" – all entry points are correct. Independently of where companies make their initial point of contact, they should receive good information on the opportunities provided in Sweden and the EU.

Support systems could be made more effective, if companies interested in developing in the environmental technology area, could more simply and easily obtain comprehensive guidance to other national or EU-based players and programmes they might need. Examples of this are guidance through the funding support systems, personal guidance on new business ideas, or development of new environmental technology solutions or export assistance.

Work in Sweden on developing and streamlining companies' searching processes and contacts between company promoters and companies, should be supplemented and coordinated with corresponding initiatives at the European level.

4 Acting globally

The international dimension of Sweden's promotion of environmental technology exists in a number of different investment areas: in export promotion, promotion of Sweden, promotion of foreign investments in Sweden, and not least in international aid contexts.

Co-operation agreements have been developed with a number of countries outside the EU, in some cases with significant elements of cooperation concerning environmental technology.

4.1 PROMOTION OF EXPORTS

Export promotion takes place both in Sweden and abroad, through the Ministry for Foreign Affairs and foreign representatives (embassies and consulates) as well as the Swedish Trade Council. One of the tasks of foreign representatives is cooperation with Swedish companies that are active or wish to become active in international markets. There are specialists in the geographical units of the Ministry for Foreign Affairs for promoting industry.

Export loans are for companies in need of capital to support their exports and can be provided both in Swedish and foreign currency. Export loans of up to 90 percent of total capital needs can be financed and there is no maximum limit. Loans are only provided to Swedish companies with activities in Sweden, and this includes environmental technology companies. Export loans are a result of cooperation between ALMI, Swedish Export Credit Corporation. the Swedish Export Credits Guarantee Board, the Swedish Trade Council and Swedfund.

4.1.1 Project exports

The tasks of the Swedish Trade Council is to stimulate exports and facilitate the international expansion of small and medium-sized companies. It focuses on basic export services, competence development for companies, targeted measures for international business promotion and consultancy activities. The Swedish Trade Council has some 60 offices in 52 countries.

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Initiatives in Swedish energy and environmental technology companies in India

The Swedish Trade Council has been commissioned by the Government to start a special promotion programme in India. The programme runs for three years from October 2008, and focuses on providing support to Swedish companies actively working in the market and doing business in energy and environmental technology. India with an average annual growth of about 8 percent is today one of the fastest-growing economies in the world. Rapid growth imposes major demands on the environment and the market for environmental technology is considered to be worth about SEK 35 billion. Of this about 45 percent, which corresponds to about SEK 15 billion, is imported. In some of the key segments, such as bioenergy and water purification, annual growth is estimated at about 15 percent. Special funds have been set aside in the programme to provide support to Swedish companies for business initiatives in energy and environmental technology in India. Up to 50 percent of the costs of a project can be funded with a ceiling of SEK 60,000. The programme can also help companies in applying for financial support for promoting business in India through Sida, such as Demo Miljo, Start Syd or the local Miljöfaciliteten (Environment facility) in Sida in New Delhi.

Personal export advisory services
Small companies with little or no experience of exports can receive assistance from representatives of the Swedish Trade Council in each county in Sweden. Regional export advisers also have contacts with county bodies and representatives of the Trade Council in Sweden and abroad. Personal export services from Småföretag is a cost-free service for Swedish companies in all industries, including those in environmental technology with a maximum of 50 employees, and a max of Euros 10 million in annual turnover.

Monitoring international markets
Increasing numbers of companies understand the importance of monitoring and analysing changes in the surrounding world to make well-based decisions. Information specialists from the Swedish Trade Council carry out cost-free research and gather market information in a number of areas:

- general information on countries (population, GDP, industrial structure, economic development)
- company information (both Swedish and foreign companies)
- current statistics and forecasts (e.g. trade statistics and labour market statistics)
- market and industry reports

The SymbioCity initiative also has close linkages to Government initiatives in sustainable city development, which inter alia, are channelled through the Delegation for sustainable cities. The aim of the delegation is to stimulate urban construction projects contributing to a better environment and reducing climate impact, which support the exports of Swedish environmental technology. This initiative is described in greater detail in section 1.

4.2 PROMOTING SWEDEN

Issues connected with promotion involve increasing interest in Sweden, circulating information and knowledge about what Sweden is good at, for instance environmental technology. This may involve capturing and disseminating information about new business opportunities and finding forms of cooperation between the foreign market and Swedish companies. This aims at developing the interest of foreign investors in Sweden as an attractive country for their investments. Another task is to support Swedish companies tendering in internationally financed procurements, through for example the World Bank, the UN and the EU.

The Government has started an initiative for foreign representation to contribute to increased growth in Sweden. The initiative is intended to promote trade and investments to and from countries that are considered to be of long-term importance for Swedish industry. The Ministry for Foreign Affairs has been strengthened by around 30 positions located in strategic places around the world. Embassies and consulates have been reinforced with new promoters, particularly in the USA and China.

A growing proportion of these positions in embassies and consulates concern cooperation involving environmental technology. For instance, the Swedish Embassy in Washington, USA will make climate and energy issues one of its most important priorities during 2009. Activities in political, industrial and cultural spheres will be promoted with a focus on sustainable cities, green architecture and energy smart technology in the form of low energy buildings, heat pumps, solar cells and renewable sources of heat – areas where Sweden is at the very leading edge in terms of knowledge and technology.

4.3 CO-OPERATION AGREEMENTS WITH THE USA AND BRIC COUNTRIES

The Government has also initiated cooperation with countries outside the EU, principally the USA and BRIC countries (Brazil, Russia, India and China) concerning environmental technology of different kinds.

Co-operation with the USA over environmental vehicles
In June 2007 a MoU was signed to increase cooperation in the energy area between Sweden (Ministry of Enterprise, Energy and Communications) and the USA (DOE). The USA and Sweden together with Volvo and Mack are investing Dollars 12 million to develop more environmentally friendly heavy vehicles. The agreement is regarded as a model for future energy projects which bring together state and private capital. The goal of the project is to develop more energy efficient and environmentally friendly lorries and other heavy vehicles by the use of biofuels and new technology which amongst other things aims at increasing the efficiency of energy combustion. The agreement was broadened in July 2008 with the addition of a joint initiative to develop an electricity car with more efficient batteries and thus a greater driving range using clean electricity than earlier models. Charging stations have been set with the assistance of the American Department of Energy whilst the car itself is manufactured by Volvo.

In June 2006 an agreement was signed between the state of California and Sweden in the area of renewable energy. A number of cooperation areas were identified, covering various legal issues as well as the exchange of good examples in this area.

Sino-Swedish environmental technology cooperation
During the Prime Minister's visit to China in April 2008 (together with the Minister for the Environment and Minister for Trade) a MoU was signed on Sino-Swedish cooperation in the energy and environmental technology area. In addition a LOI was signed on sustainable city development and on the eco city of Caofeidan. In June 2008 the Government appointed a special coordinator for the implementation of the Sino-Swedish environmental technology cooperation.

4.4 PROMOTION OF FOREIGN INVESTMENT IN SWEDEN

Sweden is a small country. For this reason it is particularly important that Sweden capitalises on advantages provided by the increased flows of goods, capital, services and labour. Foreign investments create new business opportunities, open up new markets, contribute new competence and increase the exchange of technology and technological expertise.

The Invest in Sweden Agency (ISA) is the body that has the task of helping to increase foreign investment in Sweden. ISA primarily helps small and medium-sized companies abroad to establish new activities in Sweden and make cooperation agreements with Swedish companies. The majority of the investments take place within the service sector, IT and biotechnology.

One third of the investments take place outside large urban areas, such as when the municipality of Härjedalen in northern Sweden, together with Miljöbränsle AB (HMAB) and the Chinese company National Bio Energy Co Ltd (NBE) and Dragon Power Co Ltd. in 2006 formed the jointly owned company in the bioenergy area. The aim of the jointly owned company, NBE Sweden AB, is to create a biofuel complex in Härjedalen.

The Government has given ISA the task of carrying out an initiative for the promotion of investment in the environmental technology area. The investment covers SEK 10 million during the period 2008 up to 2010. For 2009 the agency has identified 10 areas where Sweden is strong, bioenergy, biofuels, green chemistry, wind power, sustainable construction, water, waste, recycling, management of natural resources, heating, ventilation and refrigeration, as well as innovative technologies.

The agency has also, together with Nutek started a project with regions with strong competence in environmental technology such as the Business

Region Göteborg, Region Skåne, Skellefteå municipality/Piteå municipality and the Stockholm Business Region to promote foreign investments in environmental technology in these regions. The activities run over the period 2008-2011, and focus primarily on markets in Japan, India, China and the USA.

4.5 ENVIRONMENTAL TECHNOLOGY, CLIMATE AID AND DEVELOPMENT COOPERATION

Government initiatives in development and the dissemination of new technology go hand in hand with increased international responsibility for the transfer and adaptation of technology. It is important that developing countries have access to energy efficient and climate friendly technologies for their development in order to avoid increased use of coal and oil. By means of climate initiatives in other countries, energy efficient technology that already exists in Sweden and in process of development can be transferred to developing countries.

The threat of climate change must be met at the global level. The Government has high ambitions in its work on climate change. The aim is that Sweden should become a leader both in the implementation of effective measures domestically and in developing international cooperation. Development and dissemination of new technology is a prerequisite for reducing climate impact without limiting conditions for growth and living standards. Investments to reduce emissions abroad provide greater reductions in emissions for each unit of investment compared with their implementation in Sweden, and are important if all countries are to be able to reduce their emissions sufficiently. The investments will be credited to Sweden in accordance with the rules on so-called project-based mechanisms under the Kyoto Protocol. A total of SEK 670 million could be used for international climate investments.

Climate aid is also crucial since the environmental impact and climate change affects development in poor countries and the poorest people the most. The Government wishes to actively contribute to long-term measures for adapting to climate change in the poorest countries. Climate aid should also be used to support the measures taken by developing countries to limit the amount of greenhouse gases. Grants should principally be channelled through existing multilateral initiatives, as well as via bilateral cooperation where primary focus is on Africa. In total this means that the Government within the framework of development cooperation will be allocating SEK 4,055 million for climate initiatives during 2009–2011.

The Swedish Government has also taken the initiative in launching an international commission for climate change and development.

Government initiative within the framework of development cooperation
As mentioned above, during 2009-2011 the Government will take a special initiative concerning climate change totalling more than SEK 4 billion in development cooperation.

In total the Government is allocating SEK 1,560 million during 2009–2011 for support to the Adaptation Fund under the Kyoto Protocol, the Convention on Climate Change's aid financed fund for Adaptation, as well as support for the World Bank's International Development Association (IDA) to support its climate initiative focusing on adaptation measures, as well as clean energy and efficient use of energy.

The Government is allocating SEK 1,000 million during 2009–2011 to the financial mechanism in the Climate Convention, the Global Environment Facility (GEF) and to the Clean Technology Fund (CTF) in the World Bank primarily to limit emissions.

The Government is allocating SEK 150 million during 2009–2011 for ground and agricultural issues to the organisations IFAD, FAO and WFP. Funds have been set aside for additional grants in the disaster prevention area, e.g. through support for implementation of the Hyogo Framework for Action, amounting to SEK 195 million.

Within the framework of bilateral development cooperation, a further SEK 1 150 million will be channelled through Sida during 2009–2011 for adaptation measures in certain countries, particularly in Africa. Where

the cooperating countries have developed national adaptation programmes (NAPA) under the Climate Convention, these should be eligible for funding.

In total this means that the Government is allocating SEK 4 055 million in new funds for climate initiatives during 2009-2011 within the framework of development cooperation.

Climate and energy initiatives in the 2009 Budget Bill (MSEK)

Initiative	Year 2009	Year 2010	Year 2011
Commercialisation of new energy technology	145	380	350
Climate investments in other countries	230	230	210
Dissemination of new energy technology	100	122	117
Efficient use of energy	0	60	260
Electricity production from renewable sources	60	70	20
Support for energy efficient windows in single-family dwellings	80		
Premium for environmentally approved cars	325		
Impact of the food chain on climate	6	3	3
Adaptation measures	174	205	205
Total	**1,120**	**1,070**	**1,165**

4.6 SIDA'S WORK WITH LINKS TO ENVIRONMENTAL TECHNOLOGY

Sida has an important role to play in a number of areas prioritised by the Government in development cooperation linked to environmental technology. Sida also has responsibility for the following activities in the environmental technology area.

4.6.1 DemoMiljö

DemoMiljö (Demo Environment) enables testing of new technologies by agencies, municipalities, institutions and companies in around 40 of the countries with which Sida co-operates. Small and medium-sized companies are offered support for pre-studies and project development. Sida has commissioned Nutek together with Swentec to carry out the project DemoMiljö. The initiative supports environmental technology investments in the area of sustainable city and renewable energy. Support is directed to countries in Africa, Asia, Latin America, as well as Eastern and Central Europe. DemoMiljö provides grant based support for modern environmental technology solutions in sustainable city development and renewable energy.

DemoMiljö provides recipient countries with the possibility of testing modern technology solutions in the environmental area and companies with the opportunity of demonstrating their expertise and products. Sectors eligible for support cover the air environment, water and sanitation, energy-saving waste management, renewable energy, land contamination, noise and urban transport. DemoMiljö provides two types of support, for the implementation of demonstration projects as well as pre-studies for project development and project identification.

4.6.2 Twinning projects

The EU's twinning programme is an instrument for strengthening the public sector in new Member States and candidate countries. Twinning is based on cooperation between agencies in the Member States of the EU and their counterparts in co-operating countries. Swedish twinning cooperation is managed by Sida. Since 2002 EU twinning has also been used in the Western Balkans, in Eastern Europe and Central Asia.

A number of projects linked to environmental technology have been implemented, mainly in water-sanitation, waste management and the application of BAT (Best Available Technology within the framework of the IPPC Directive (Integrated Pollution Prevention and Control).

4.6.3 Sustainable city development in developing countries

Sida has developed a tool for providing support for environmentally sustainable city development in developing countries. Rapid urbanisation in

many towns and cities is intimately connected with environmental degradation and health risks. By means of town and country planning, and management of our cities and society, now and in the future – life quality can be improved for inhabitants at the same time as the impact of urbanisation on the environment and climate can be minimised. There is an enormous need to improve city management and national planning, including system solutions for the environment.

In this context a Swedish initiative on sustainable city development was launched in Johannesburg in 2002. Based on this Sida has developed a manual as a starting point for further development of methods and tools aimed at sustainable city development in developing countries and countries in transition. The manual will be tested during 2008 in pilot cities of different types, thereafter the concept will be reviewed and published.

5 The way forward

5.1 GOALS OF THE SWEDISH GOVERNMENT

The Government has taken a number of initiatives to strengthen and develop environmental technology, and considers that it is strategically important to:

Develop a focus on the market - in Sweden, in the EU and globally, in order to:

- Contribute to solving environmental problems in the world community.
- Support exports of Swedish environmental technology and Swedish environmental expertise.
- Create positive cooperation between Swedish and European activities in the area of environmental technology.
- Strengthen the demand for good environmental technology.

Develop a focus on business and entrepreneurship, which:

- Builds on Swedish areas of strength, where there are Swedish companies, company owners and products which are or could become world leaders.
- Is supported by research, training and support activities from agencies and higher education.
- Builds on broad cooperation between companies, higher education and the public sector.

Develops a focus on leveraging the opportunities inherent in new trends and development, so that:

- Technology areas with high potential for development will also contribute to environmental improvements. For instance, rapid development and new technology breakthroughs in IT, and bio-, space- and nanotechnologies could create new systems which improve the state of the environment, protect nature and make better use of energy and other resources.
- Researchers, product developers and innovators are encouraged to recognize the need to develop new technology solutions with good environmental performance. Strengthening cooperation between higher education, industry and agencies is a key factor in achieving this.
- Sweden can satisfy the increase in demand for better environmental technology systems created by globalisation and urbanisation.

Strategically promote development of environmental technology by strengthening a number of processes at the same time, primarily through:

- Viewing good environmental performance as a driving force in all industries and sectors, not least in large companies.
- Promote the development of new knowledge intensive companies, which develop innovations in environmental technology.
- Contribute to technological changes in industries and sectors that have a high impact on the environment, such as energy production, transport, agriculture, construction and certain industrial sectors.
- Develop both the supply and demand for good environmental technology.
- Strengthen cooperation between companies, higher education and the public sector.

5.2 PROBLEMS AND DEVELOPMENT AREAS THAT THE COMMISSION AND MEMBER STATES SHOULD GIVE ATTENTION TO

In addition to the strategic orientations above, the following areas should also be considered in European cooperation, and they can also be a part of the review and further development of work in ETAP that should be implemented by the Commission.

More important is the further development of a sustainable European industrial policy. This is one of the priorities Sweden has for its presidency in autumn 2009. A new industrial policy must be developed which builds on new technology, and the promotion of new business solutions. Smarter consumption, better products, and resource efficient production are all interlinked, and are important in global markets.

During the Swedish presidency a conference on the theme of sustainable industry is planned. The aim is to mobilise Europe across a broad front in order to develop a sustainable industrial policy and to demonstrate through good examples, how European industry can confront the threat of climate change and strengthen its competitiveness.

Moving from research to market

Integrated support and financing systems for the whole value/product development chain. One conclusion that can be drawn from both Swedish and other European experiences is that the following are needed:

- Better forms of financing and other support structures to create financing for activities that are in the middle of the value/product development chain - in the interface between R&D investments and large-scale international commercialisation. Support financing is needed to create pilot and demonstration facilities. Increased support is also needed to increase demand in environmentally driven markets.
- The whole support and financing chain would be better integrated without troublesome gaps and discrepancies, so that financing of R&D is followed by financing of demonstration facilities in the middle of the value chain, and other financing and support forms for national and global commercialisation.
- The range of players, support measures and forms of financing are less than transparent. In addition, measures are needed for information, education and training, and new forms of cooperation between those supporting companies in order to achieve streamlined paths or simple entry points into the system ("No wrong door").

Demonstration facilities and "best-practice examples" in environmental technology

There is a need to make more visible different demonstration facilities of environmental technology that already exist and are close to realisation in the near future in Sweden in order to increase interest and accessibility for both foreign and domestic interests.

What Swentec and other players do to give prominence to demonstration facilities and good examples should enrich European knowledge and information sources, particularly web sites connected to the EU, databases and knowledge compendia.

System for environmental technology verification

It is only good factor that methods and technologies are examined and evaluated with respect to environmental performance. However, there is a risk that the introduction of ETV systems at the European level may create obstacles to entry for new technologies and new companies. This applies particularly to small and medium-sized companies, even though the ETV system is a voluntary commitment. The value added of a European ETV system, in addition to that provided by existing systems, and its effects on smaller companies should be carefully analysed.

New environmental technology from high-tech industries of the future: IT, bio-, space and nano technologies

There are a number of factors for ensuring that development from these knowledge intensive new technology areas not only can contribute to creating new environmental technologies, but also for making existing environmental technologies more widely known. One possibility would be to carry out a pre-study on how "environmental spin-offs" from these industries of the future can be promoted. Another step to support the proposal could be arranging an ETAP Forum in Sweden, under the theme of "What can advanced technology solutions from other areas provide in the environmental technology area".

Improved conditions and pre-requisites for the environmental technology market

Improved statistics and follow-up

There is a need to discuss more efficient follow-up mechanisms nationally and at the EU level. There is also a need to follow up national innovation systems and their output, environmentally friendly procurement (both green procurement and technology/innovation procurement), as well as how Member State initiatives can be incorporated into joint EU activities such as the building of infrastructure in new Member States.

Knowledge transfer from larger programmes

Dissemination of what has been learnt and development of knowledge from large project oriented programmes. It should be possible to put greater emphasis on knowledge development and the dissemination of experiences from larger project oriented programmes, particularly those with significant elements of EU funding, as well as from other relevant national programmes. In particular demonstration facilities for new environmental technology of project outcomes showing "best practice" should be made visible.

Experiences from developing and renewing infrastructure, as well as measures aimed at achieving sustainable districts and cities should be given particular emphasis, especially programmes and programme outcomes that can be assumed to be relevant for the newest Member States of the Union.

Initiative on targeted training for key groups

Many agencies have within their sector one or more professional groups, which play key roles in bringing about increased market share for environmental technology. Targeted in-service training for these groups could be highly effective. A comprehensive review should be made of those agencies and players that could be commissioned to draw up inventories, plan and take initiatives for in-service activities that aim at raising competence concerning the preconditions and opportunities for environmental technology.

Use of energy in public premises

Voluntary undertakings can be made more explicit and supplemented by more active follow-up of delivered results. A special area which is highly appropriate for this type of undertaking, is the "Use of energy in public premises", where there is a relatively short payback period from funds invested. Ideas for drawing up broader initiatives could be leveraged from the Swedish PFE programme.

Environmental adaptation in freight transport and logistics

The successful initiatives for environmental vehicles could be followed by similar activities in freight transport and the logistics sector, using the region as a basis. Such initiatives should, of course, treat all commercial players in an equivalent manner, independently of national origins. This was also the case in the environmental car projects run earlier.

Procurement: Green procurement, technology procurement, innovation procurement

It is important that initiatives taken lead to green procurement becoming an integral part of public procurement and that a significant majority of all public procurement involves ambitious environmental ambitions, which will themselves drive technology forward. At the Community level there needs to be working material in the form of criteria for different product groups, based on the experiences from member states which have progressed furthest in this work.

Technology and innovation procurement also needs to be further developed. Other initiatives are needed in the European context, and Sweden is willing to contribute from the experiences she has gained.

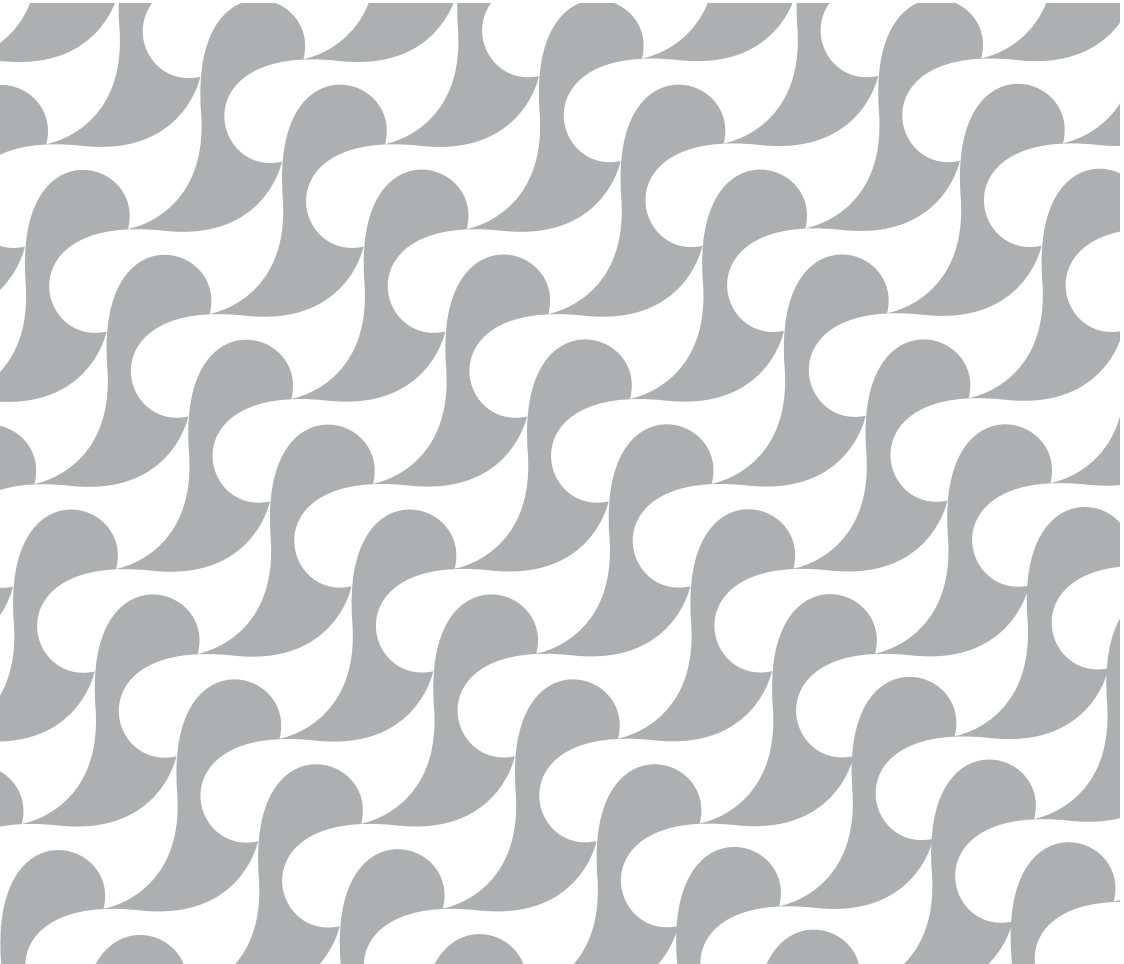
"No wrong door" in support systems for environmental technology and environmental entrepreneurship

Today there are many players with products and services for small and medium-sized companies both in Sweden and at the EU level. Support systems could be made more effective, if companies interested in develop-

ing the environmental technology area, could more simply and easily obtain comprehensive guidance to other national or EU-based players and programmes they might need. Those promoting company development and environmental technology should co-operate in terms of the principle of "No wrong door" – all entry points are correct. Independently of where companies make their initial point of contact, they should receive good information on the opportunities provided in Sweden and the EU.

Work in Sweden on developing and streamlining companies' searching processes, and contacts between company promoters and companies, should be supplemented and coordinated with corresponding initiatives at the European level.

APPENDIX 1 Swedish players in environmental technology



Almi Företagspartner
Avfall Sverige, Swedish Waste Management (Trade Organisation)
Bioenergy Småland
Byggsektorns InnovationsCentrum (BIC), Swedish Construction Sector Innovation Centre
Byggsektorns kretsloppsråd, The Ecocycle Council for the Building Sector
Chalmers tekniska högskola, Chalmers University of Technology
Delegationen för hållbara städer, Delegation for Sustainable Cities
EBRD – The European Bank for Reconstruction and Development
Energimyndigheten, The Swedish Energy Agency
Exportkreditnämnden, Swedish Export Credits Guarantee Board
Exportrådet, Swedish Trade Council
Formas – forskningsrådet för miljö, areella näringar och samhällsbyggande, The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
Föreningen KRAV (Association Krav)
Industrifonden, Swedish Industrial Development Fund
Ingenjörsvetenskapsakademin, The Royal Swedish Academy of Engineering Sciences
Innovationsbron (Innovation Bridge)
Institutet för tillväxtpolitiska studier (ITPS), The Swedish Institute for Growth Policy Studies
Invest in Sweden Agency (ISA)
Kemikalieinspektionen, Swedish Chemicals Agency
Konsumentverket, The Swedish Consumer Agency
Kungl. Skogs- och Lantbruksakademien (KSLA), The Royal Swedish Academyof Agriculture and Forestry
Kungliga tekniska högskolan (KTH), Royal Institute of Technology
Miljöstyrningsrådet (MSR), The Swedish Environmental Management Council
Mistra – Stiftelsen för miljöstrategisk forskning, The Foundation for Strategic Environmental Research
Naturskyddsföreningen, The Swedish Society for Nature Conservation

Naturvårdsverket, The Swedish Environmental Protection Agency
Nordiska Investeringsbanken, Nordic Investment Bank
Nutek, The Swedish Business Development Agency
Näringslivets miljöchefer (NMC), Swedish Association of Environmental Managers
Provider Venture Partners AB
Rymdstyrelsen, The Swedish National Space Board
Sida, The Swedish International Development Cooperation Agency
Sjunde AP-fonden, The Seventh Swedish Pension Fund
SP Sveriges Tekniska Forskningsinstitut, SP Technical Research Institute of Sweden
Sustainable Business Regionerna, Sustainable Business Regions
Sustainable Technologies Fund
Svensk Exportkredit, The Swedish Export Credit Corporation
Svenska Miljöinstitutet (IVL), Swedish Environmental Research Institute
Svenska Riskkapitalföreningen, The Swedish Private Equity & Venture Capital Association
Svenskt Näringsliv, The Confederation of Swedish Enterprise
Svenskt Vatten, The Swedish Water & Wastewater Association
Swedfund
Swedish Cleantech Incubators
The Swedish Clean Water Partnership
The Swedish Venture Capital Association
Swentec, Sveriges miljöteknikråd, The Swedish Environmental Technology Council
Universitet och högskolor, Universities and University Colleges
Varim (Trade Association – The Swedish Association of Suppliers of Effluent and Water)
Vinnova (Swedish Governmental Agency for Innovation Systems)
Regionala miljöteknikaktörer, Regional Environmental Technology Actors

For the reader's convenience, names of players are also provided in English. Names in brackets represent descriptive translations, otherwise the names are those used officially on their respective web sites.

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Often there are no English translations of these documents, hence a descriptive translation is given so the reader can obtain some of the content of the document.

SWENTEC

Swedish Environmental Technology Council

www.swentec.se