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The Austrian Environmental Industry

Summary of Results

Angela Köppl

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Research Study by the Austrian Institute of Economic Research commissioned by the Federal Ministry for Agriculture and Forestry, Environment and Water Management and the Austrian Economic Chamber, supported by the Umbrella Organization Energy – Climate Protection and the Federal Ministry for Economic Affairs and Labour

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Content

0 Executive Summary[1]

- ***Specialisation, structure and core production in the Austrian environmental technology industry[2]***

Viewed across time, the environmental technology industry in Austria, including energy technologies, is characterised by growing specialisation. The proportion of enterprises that concentrate exclusively on environmental technologies is increasing. Broken down by environmental activities, the Austrian environmental technology industry has moved away from its focus on end-of-pipe technologies, the core of environmental industry, and towards integrated technologies. In both 1993 and 1997, end-of-pipe technologies made up 44 percent of turnover; however their contribution was down to a third by 2003. Integrated technologies now contribute 54 percent to turnover, whereas 11 percent of the turnover derives from measurement and control technology and environmental monitoring (in the following: M&C technologies). In the integrated technologies segment, energy technologies have assumed a leading position. The company sample shows 47 percent of the turnover obtained through clean energy technologies, with cogeneration plants and systems engineering (plant optimisation) in top position.

- ***Growth of the environmental technology industry in 2000 to 2003***

In the period from 2000 to 2003, turnover in the environmental technology industry grew by an average of 7.7 percent p.a. (compared to 2 percent in annual average growth achieved by total manufacturing during this period).[3] Average annual exports rose by 7.5 percent, i.e. at double the rate of total manufacturing growth. At 10 percent annually, the turnover and export growth rates were particularly high in the clean technologies sector.

- ***Foreign direct investment by Austrian environmental technology producers***

For Austrian enterprises, foreign direct investment (FDI) is becoming a key strategy for internationalisation. The most common activity by far pursued by foreign subsidiaries of Austrian environmental technology producers is distribution, followed by production at foreign subsidiaries. Procurement and other activities have been named much more rarely as motives for FDI. This reply structure leads to the conclusion that FDI should not be primarily interpreted as

[1] The results presented in the following summary are based on the study "Österreichische Umweltechnikindustrie, Wien 2005" ("The Austrian Environmental Technology Industry, Vienna 2005") carried out by Angela Köppl. The long version of the study can be obtained at the Austrian Institute of Economic Research.

[2] The terms "environmental technology industry" and "environmental industry" are interchangeable. The same holds true for "clean technologies" and "integrated technologies".

[3] *Statistics Austria*, "Leistungs- und Strukturerhebung" 2000, 2003, Austrian Trade Statistics.

a substitute for Austrian exports, as companies investing abroad also show a higher export rate. It thus appears that there is a complementary relationship between exports and FDI.

- ***Markets for Austrian environmental technologies***

In the mid 1990s, about half the turnover of environmental technologies was achieved on the Austrian market, and half in exports. By 1997, exports had reached 60 percent of environmental technology turnover. The current company sample showed another increase in exports to about 65 percent. In total, the companies in our sample exported technologies amounting to € 1.6 billion. Forty percent of turnover of the Austrian environmental technology industry is generated in the EU15. The German market alone accounted for 22 percent of the turnover by Austrian environmental technology producers. The share of turnover in the Central and Southeastern Europe countries (CEECs) remained fairly stable from 1997 (9.2 percent) to 2003 (9.5 percent). As important markets for environmental technologies worldwide, the US and Canada comprise 4.7 percent of our sample's turnover. China's share has declined (to 1.5 percent) compared to earlier surveys, which may, however, be due to distortions in the sample. Turnover figures for Southeast Asia are at approximately the same level as those for China.

The findings of earlier studies showed that clean technologies were more dependent on the domestic market. This has since changed. In 2003, less than 30 percent of the turnover of clean technologies was obtained on the Austrian market. Accordingly, producers of clean technologies focus less on the domestic market than the rest of Austria's environmental technology industry. Almost half of the clean technology turnover covered by the sample is generated by exports into the EU15 countries. Other key export markets for clean technologies are the CEECs, whereas, based on the current sample, there is no demand for such technologies in China, Southeast Asia and Russia. The importance of the domestic market varies greatly by environmental sector. Almost 70 percent of turnover achieved in water technologies is generated in Austria, while this is true for only a quarter of energy technologies. One third of the turnover of air technologies is made in Austria, as is 45 percent of the turnover of waste disposal technologies. The CEECs account for 12 percent of turnover in Austrian energy technologies, making them an important market for this sector.

- ***Export barriers***

It is more difficult for small enterprises to enter export markets. One out of three companies argues that foreign markets are covered by other affiliates within their group. 14 percent of non-exporting companies report that they have not (yet) become active on foreign markets because they have only recently entered the environmental technology field. Ten percent of the companies say the legal framework presents a barrier to exports. The economic literature similarly specifies the differences in national legal frameworks as an important non-tariff trade barrier, especially when technologies must be certified abroad or where specific technical standards are prescribed. This may give rise to considerable trade barriers, in particular for

producers of clean technologies. Eight percent of the responding companies report that they have reached the limits of their production capacity with sales on the domestic market.

- ***Expected employment growth***

Fewer than 70 percent of the companies surveyed reported that they expect to see a rise in the number of employees in their operations in the next three years. This was true for nearly 75 percent of enterprises producing energy technologies. Among producers of end-of-pipe technologies, 60 percent expect to increase their work force, and slightly over a third believes that employment in their company will remain constant.

- ***Market entry and motives for entering the environmental technology market***

One out of four companies entered the environmental market between the mid 1970s and the mid 1980s; one fifth entered the market in the second half of the 1980s, and one third in the 1990s. Not quite 10 percent only recently became active in the environmental technology market, i.e. since 2001. Enterprises offering clean technologies are on average relatively recent entries to the market. Two thirds have been active on the environmental market since the mid 1980s and 13 percent since 2001.

As in former studies, companies (in this case 45 percent) named market expectations in the environmental field as a clearly dominant motive for market entry. One out of four enterprises named environmental protection as a decisive criterion. Competitive strategy was the dominant motive for almost 13 percent of the respondents. Legislation and internal environmental problems were less frequently cited as motives for entering the market. Compared to earlier surveys, the most striking result is the importance attributed to the environmental argument, i.e. the conscious decision to offer solutions for environmental problems. Next to market expectations, this was one of the strongest motives for market entry among producers of clean technologies (32 percent) and was named in 21 percent of the responses by producers of end-of-pipe technologies.

- ***Diffusion of environmental management systems among environmental technology producers***

Thirty-one percent of the environmental technology producers in the current sample have implemented an environmental management system and 17 percent plan to do so. Among those companies having already introduced such a system, the majority (54 percent) operates in the end-of-pipe technology sector and slightly over a third produce clean technologies, while the remaining 10 percent provide M&C technologies. The proportions are reversed when it comes to plans to introduce environmental management systems. Here, almost 60 percent of the firms produce clean technologies, not quite 30 percent supply end-of-pipe technologies and slightly over 10 percent supply M&C technologies.

- ***Determinants of demand***

The study confirms the important role played by legislation as a demand stimulus for environmental technologies, and it finds that subsidies have gained in importance compared to previous studies. According to the 2005 survey, producers of environmental technologies consider subsidies for environmental investments to be the key demand-generating factor. In 2000, this element had only ranked fourth in importance. In the current survey, EU legislation ranks second, followed by domestic legislation. The legal regulations in the EU and in Austria have similar weight. EU legislation affects demand through two channels: First, the EU countries are a major market, and second, the Austrian legal framework is significantly influenced by EU law. In 2000, domestic legislation was still considered the main determinant for demand among environmental technologies. This assessment could be interpreted as weak evidence for the great importance of legislation to the growth prospects of the environmental technology industry (Porter hypothesis).

- ***Market structure and development of the market position***

As already demonstrated in past findings, there are differences between Austrian and foreign market structures. While the domestic market is characterised by an oligopolistic or even, for a smaller part of the firms (13 percent), monopolistic structure, the majority of enterprises operating in the European market must compete against a few major and many small producers. Almost a quarter of the Austrian companies questioned face a large number of competitors when operating in the EU15 markets, a share that is even larger in the other European countries. Broken down by environmental sectors, the greatest market concentration in Austria can be found in the domain of waste disposal and air technologies. This was already true in the past for the former, whereas it applies to air technologies for the first time in the current sample. Between 56 and 62 percent of the firms in the sample (depending on the submarkets) have managed to improve their market position over the past three years. The greatest improvement achieved by Austrian companies was in the EU15. Fewer than 10 percent said their market position had deteriorated. The percentage of companies that strengthened their market position is clearly higher in the clean technologies sector (by almost 20 percentage points domestically) than it is in the end-of-pipe technology sector.

- ***Growth expectations for the environmental technology market***

Almost 50 percent of respondents expect their turnover in the EU15 to increase significantly over the next years. Expectations for other European states are even greater, totalling 60 percent. Analysing the development of markets by activity, the proportion of enterprises expecting their turnover to decline over the next few years is almost double among producers of end-of-pipe technologies than among producers of clean technologies.

- ***Research and innovation activities in the Austrian environmental technology sector***

Environmental technology producers (including non environmental production sectors) covered in the current sample achieved R&D spending (as proportion of turnover) of 3.5 percent for 2003 (compared to an R&D spending of 2.0 percent for manufacturing in 2002, based on figures provided by *Statistics Austria*). Taking into account only the production of environmental technologies, markedly higher R&D expenditures of 5.6 percent resulted for 2003. Differentiating by activities, the average R&D spending for producers of end-of-pipe technologies (4.0 percent) is slightly above the average for producers of clean technologies (3.7 percent). Broken down by environmental sectors, companies producing waste disposal technologies are shown to be very research-intensive (achieving R&D spending of 6.7 percent). Second in the sample is the air sector, which has R&D expenditures of 4.3 percent.

In general, it can be said that smaller companies in the clean technologies sector are more inclined to undertake R&D activities than larger ones. In companies of up to 9 employees (6.6 percent) and 10 to 19 employees (6.0 percent) R&D spending is significantly higher than the average of the environmental technology industry (5.6 percent). In the category of 10 to 19 employees, companies producing clean technologies stand out with particularly high R&D spending (9.2 percent). In total, 83 percent of the producers of environmental technologies report having introduced innovations to their product range between 2000 and 2003. Innovative activities are most frequent among companies producing waste disposal technologies, whereas those offering air technologies have the lowest innovation percentage in the sample.

A total of 46 percent of innovating companies received monetary support from public authorities, with waste disposal technologies benefiting most from public funds (60 percent of innovating companies), followed by energy technologies (47 percent). Compared to the environmental technology industry, 38 percent of innovating companies in total manufacturing received subsidies for their innovation activities (between 1998 and 2000). Environmental technology producers thus benefited slightly more from public subsidies for innovation. In over 50 percent of all cases, the innovation was developed by the companies themselves. The greatest concentration on in-house development can be found in the air technologies sector (60 percent).

- ***Innovation motives and economic effects***

In the current survey, the main motivation for innovation is the aim to improve the technology (about a quarter of all responses). This is particularly pronounced in the clean technologies sector and, when broken down by environmental sectors, among air and energy technologies. The greatest stimulus for innovation is provided by customers – a fact that is to be expected considering that environmental technology producers frequently customise their products. Close co-operation between customers and producers generates a positive spillover effect on the innovation activity of environmental technology firms. In-house R&D ranks second as a trigger for product innovation, followed by company management. EU legislation is attributed more importance as a stimulus for innovation than national legislation, due

in part to the fact that much of the Austrian legal framework is defined by the EU and the EU member countries are of great relevance as markets for Austrian environmental technologies. Half of innovating enterprises said innovations had improved their competitiveness, and over a third said this improvement was substantial.

It is interesting to note that there is a significant negative correlation between expected employment growth and the employment size class. Companies in the upper employment size classes expect fewer additional employment effects from innovation, whereas smaller enterprises expect to substantially increase their staff in the future.

- ***Economic importance of the Austrian environmental technology industry***

It is estimated that 331 companies in Austria produce environmental technologies. It is assumed that the 118 additional producers estimated to offer environmental technologies achieve the turnover of an average company covered by the survey, and that their employment and exports correspond to the average of the sample. Based on these assumptions, total turnover for the Austrian environmental technology industry is estimated at € 3.78 billion in 2003, with an employment effect of 17,200 individuals. Exports by the Austrian environmental technology industry are projected to amount to € 2.45 billion; turnover of clean energy technologies is projected to account for € 1.8 billion and 7,480 employees. The environmental industry clearly shows higher growth rates than total manufacturing. While the environmental industry achieved an average annual growth rate of turnover of 7.3 percent in the period from 1997 to 2003, the corresponding value for manufacturing was 3.5 percent. The relative importance of the environmental technology industry grew constantly over the ten-year period between 1993 and 2003. While environmental technology turnover made up 2.1 percent of manufacturing turnover in 1993, the figure climbed to 2.9 percent by 1997 and 3.7 percent by 2003. In terms of manufacturing employment, the environmental technology industry's share was 2 percent in 1993 and had risen by almost one percentage point by 1997. In 2003, the environmental technology industry contributed 3.3 percent to manufacturing employment. Similarly, the industry increased its contribution to nominal GDP from 1 percent in 1993 to 1.4 percent in 1997 and 1.7 percent in 2003.

- ***Austria's environmental technology industry in an international context***

With respect to OECD exports of environmental technologies in the period from 2001 to 2004, Germany ranks first in export shares (19.3 percent), followed by the US (18.0 percent) and Japan (14.1 percent). Considerable market shares are also held by Italy (7.6 percent), France and the UK (almost 6 percent each). Austria matches Sweden and Denmark, holding an average export share of 1.7 percent in the 2001 – 2004 period. In summary, it can be said that, as a small country specialising in environmental technology at an early stage, Austria has achieved an excellent position on the global market for environmental technologies. Increasing competitive pressure in Austria and abroad constitutes a challenge for Austria's environmental technology industry in its aim to maintain or improve its competitive position by offering high quality technologies.

1 Introduction

Environmental protection and environmental policies have been at the centre of attention in various facets and focus points for several decades. The first major environmental movement in the 1970s was characterised by its local dimension: it aimed primarily to reduce the environmental pollution (water, air, waste) that could be seen and felt, for which end-of-pipe technologies were mainly used.

By the late 1980s, the publication of the *Brundtland Report* (1987) and the increased acceptance of the sustainable development concept opened up a wider perspective on ecological problems. On the one hand, the focus was redirected from a national to a global perception, and on the other hand, sustainable development attempted to integrate economic, ecological and social aspects.

Both approaches crucially depend on the availability of environmental technologies. In the early stage, environmental legislation emphasised end-of-pipe technologies, however integrated technologies that aim to avoid pollution from the outset have recently gained in importance. Integrated technologies involve a shift towards production processes that have a less negative impact on the environment. But the environmental industry is not just important to solving ecological problems; it is also a key economic factor in terms of employment potential, competitiveness and innovative strength.

The subject was taken up by the European Commission. Through the implementation of the Environmental Technologies Action Plan[1] (ETAP), the European Union aims to support the growth potential of the environmental technology industry and to actively contribute to the development and diffusion of clean technologies. With its initiative, the European Commission intends to strengthen the environmental sector's potential contribution to the Lisbon strategy, thereby combining environmental policy topics with broader European political strategies. The ETAP aims to guide innovative capacity and technological change into a direction that establishes economic structures that put less pressure on the environment, while at the same time strengthening Europe's competitiveness.

Considering that the environmental technology industry is a typical cross-cutting sector, it cannot be identified in conventional economic statistics. Any estimates of its growth and employment potential are thus rather difficult to make. The market for environmental goods and services therefore consists of enterprises with a large variety of economic activities and technological competences.

In order to analyse the supply of environmental technologies, it is first necessary to define the economic sector. The WIFO has already performed two analyses of the range of environ-

[1] *European Commission*, 2004.

mental technologies available in Austria.[2] The first study was carried out in 1995 based on company data from 1993, and the second in 2000 using company data for 1997.

Both studies focused on the core area of environmental technologies: producers of clean and end-of-pipe technologies, whereas environmental services were not covered by the analyses. This definition also applies to the present study.

Since the 1995 and 2000 studies, there has been a change in the framework within which producers of environmental technologies operate. This refers to a shift in priorities governing national environmental policy and the fact that the legal framework for environmental policies has been established at the national as well as European level. Climate change has become a topic of priority in political discussion, and there has been a shift in preferred environmental policy tools from regulatory command and control mechanisms towards economic instruments. This shift in the focus of environmental policy has been accompanied by an increase in the importance of integrated technologies, in particular that of clean energy technologies, within the range of environmental technologies produced in Austria. Due to the greater integration of national and European environmental policy, the competitive conditions have similarly changed for producers of environmental technologies.

2 Database

As in the previous studies, a database was developed for a detailed analysis of Austrian environmental technologies, drawing on a written survey of the industry. Sources of information for the database of addresses included the Austrian environmental technology database in the internet (www.umwelttechnik.at), exhibition and trade show catalogues and a list of firms provided by the Dachverband Energie-Klima (Umbrella Organisation Energy-Climate Protection).

Questionnaires containing detailed information obtained from 183 companies were used to analyse the range of Austrian environmental technologies. In order to estimate the dimensions of the industry, additional information was obtained from another 30 companies, primarily covering economic indicators. Table 1 illustrates the composition of the sample of companies and the response rate. While 818 companies were originally contacted, the sample was adjusted to exclude those companies stating that they did not produce any environmental technologies.

[2] *Köppl – Pichl* (1995), *Köppl* (2000).

Table 1: Response rate

	Absolut	Percentage share	Of which energy technologies
Company sample adjusted for "non-producers"	489	100,0	
Respondents: long questionnaire	183	37,4	86
Respondents : short questionnaire	30	6,1	9
Total response rate	213	43,6	95

The extensive questionnaire achieved a response rate of 37 percent. Including the response to the abbreviated questionnaire, the two questionnaires achieved a response rate of 44 percent – an excellent result for a written survey.

For many companies, environmental technologies are just one of the production segments pursued. The extensive sample of 2005 found 37.6 percent (80 companies) in this "mixed" category. Accordingly, the "specialised" environmental technology producers constituted a clear majority.

3 Economic importance of the Austrian environmental technology industry

The sample described in the previous section was used to project the dimension of the Austrian environmental technology industry.

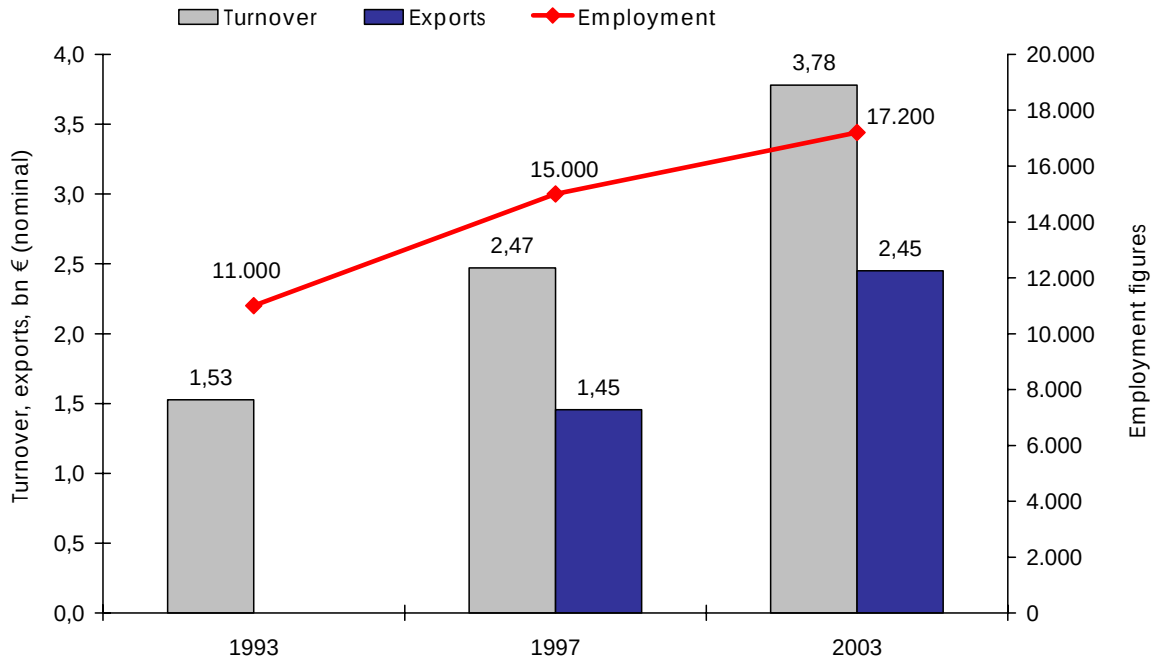
Together with this estimation, the findings of the two previous studies (*Köppl – Pichl*, 1995, *Köppl*, 2000) provided the figures to indicate the importance of the sector across a period of ten years.

The estimation covers those companies which did not respond to the questionnaire. For 2003, this resulted in an estimate of 331 companies producing environmental technologies in Austria. In order to obtain an estimate of turnover, employment and exports, it is assumed that those companies projected to provide environmental technologies achieve the turnover of an average company covered by the survey, and that their employment and exports correspond to the average of the sample. Based on these assumptions, the estimate for total turnover is € 3.78 billion for the Austrian environmental technology industry. An employment effect of 17,200 individuals in 2003 is calculated. Exports by the Austrian environmental technology industry are estimated to amount to € 2.45 billion.

Fig. 1 illustrates the growth of the environmental technology industry in the period from 1993 to 2003. Due to a shortage of data, no estimates are available for exports in 1993. The figure clearly demonstrates the positive development experienced by this sector. Yet it must be pointed out that both turnover and export figures are shown on a nominal basis. Still, the rise does not just concern the turnover and export volumes; employment figures similarly show a

clear upward trend across time. Shifts can be found in the importance of production segments within the Austrian environmental technology industry (activities and environmental sectors), but there was overall steady growth (Fig. 1).

Fig. 1: Development of the Austrian environmental technology industry

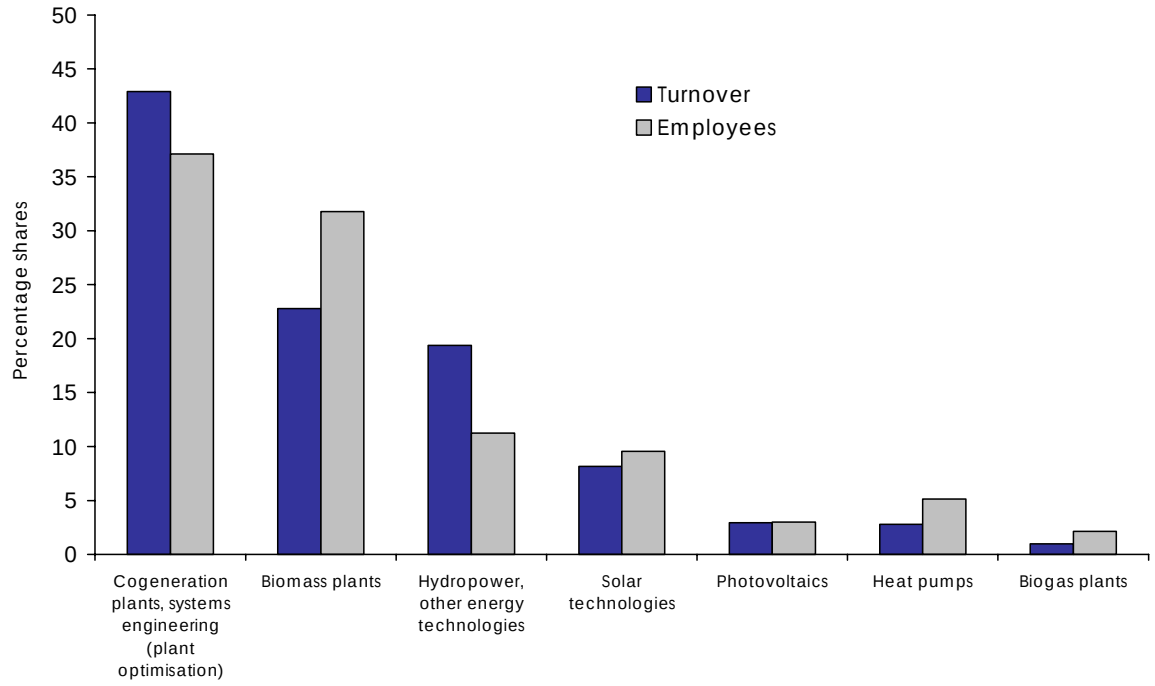


Source: WIFO surveys 1995, 2000, 2005, – estimate.

Integrated technologies play a prominent role within the Austrian environmental technology industry. In the integrated technologies segment, clean energy technologies are the most significant, contributing an estimated € 1.8 billion to turnover in the environmental technology industry and employing almost 7,500 people.

The largest segment is that of cogeneration plants/systems engineering which contributes slightly over 40 percent to the turnover of clean energy technologies and over a third to employment (Fig. 2). Biomass plants rank second in importance within the energy technologies sector, followed by technologies for the generation of hydropower. Solar technologies add 8 percent to the turnover of energy technologies. Interestingly, some production segments show considerable variations in their turnover and employment shares, i.e. the ratio of turnover to employment varies strongly within the energy technologies segment.

Fig. 2: Clean energy technology production segment



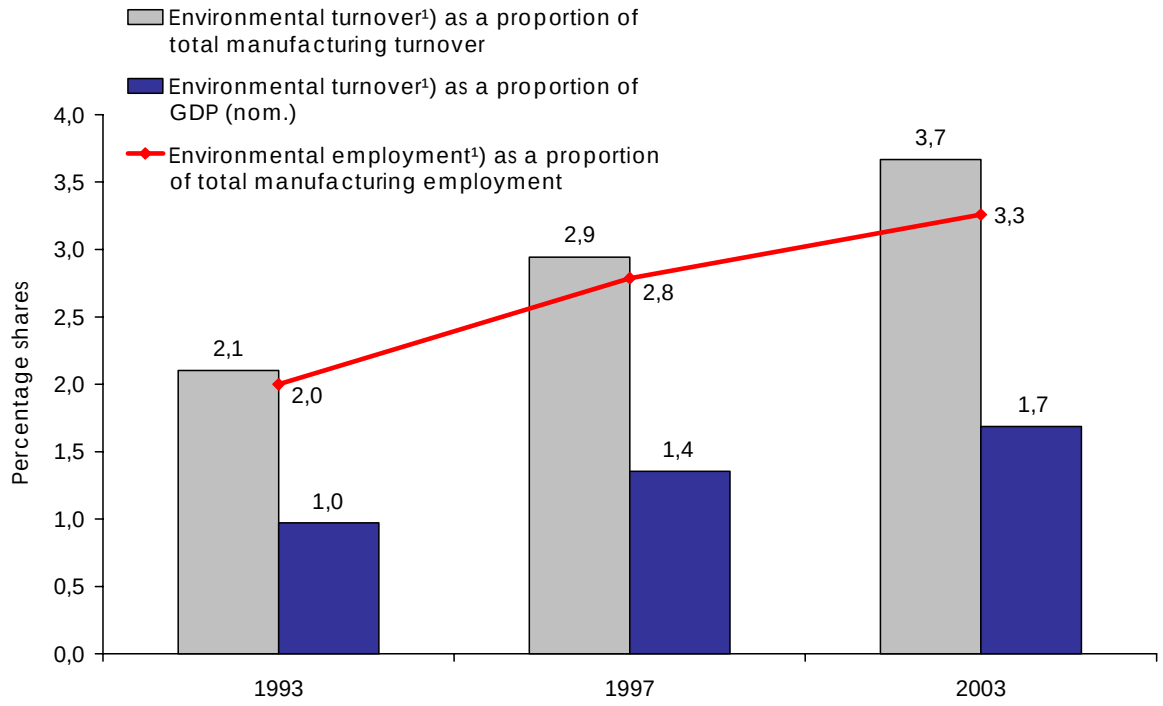
Companies are assigned by their main product. Other energy technologies: wind power, bio diesel, geothermal systems – estimate.

Figure 3 shows the importance of the Austrian environmental technology industry relative to total manufacturing and in terms of its contribution to GDP. In the decade between 1993 and 2003, the importance of the environmental technology industry constantly increased. In 1993, its share of manufacturing turnover had reached 2.1 percent, by 1997 it had risen to 2.9 percent, and by 2003 it had added another 0.8 percentage points to reach 3.7 percent. In terms of employment, the environmental technology industry held a share of 2 percent in 1993, which it increased by almost one percentage point by 1997. By 2003, its share of manufacturing employment was 3.3 percent.

The situation is similarly positive when it comes to the environmental technology industry's contribution to GDP. Its share of nominal GDP was 1 percent in 1993, rose to 1.4 percent by 1997, and reached 1.7 percent by 2003. To summarise, it can be stated that environmental technologies are a genuine growth sector.

For 2003, turnover figures for the environmental technology industry were comparable to the NACE two-digit sectors "publishing, printing and reproduction" and "rubber and plastics products".

Fig. 3: Relative importance of the environmental technology industry, 1993 - 2003

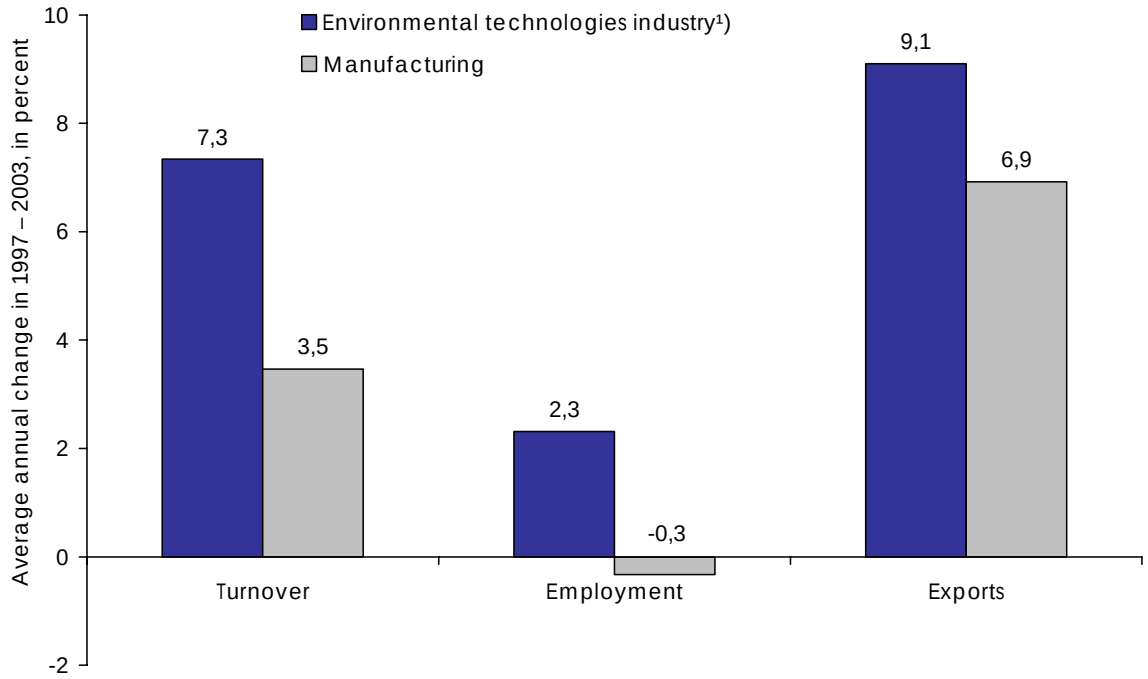


Source: WIFO surveys 1995, 2000, 2005, WIFO calculations, Statistics Austria: economic statistics, Austrian foreign trade database. - ¹) estimate.

When one compares the changes in turnover, exports and employment figures for the period 1997 to 2003 in the environmental technology industry and in total manufacturing, the excellent performance achieved by the former becomes obvious. During this period, the environmental industry showed higher growth rates for all three parameters than did total manufacturing. While the environmental industry achieved an annual average growth rate of 7.3 percent, manufacturing grew by 3.5 percent.[3] With regard to exports, the environmental technology industry also achieved higher growth rates (9.1 percent), although the deviation from manufacturing (6.9 percent) was smaller than in the case of turnover. With regard to employment, total manufacturing experienced a decline of 0.3 percent per year during the period from 1997 to 2003, while the environmental technology industry increased its employment by 2.3 percent p.a. on average (Fig. 4).

[3] The reference parameter for manufacturing is production sold (Statistics Austria, economic survey). Turnover figures for 1993 are not available from the official statistics.

Fig. 4: Economic indicators – annual growth rates in 1997 – 2003

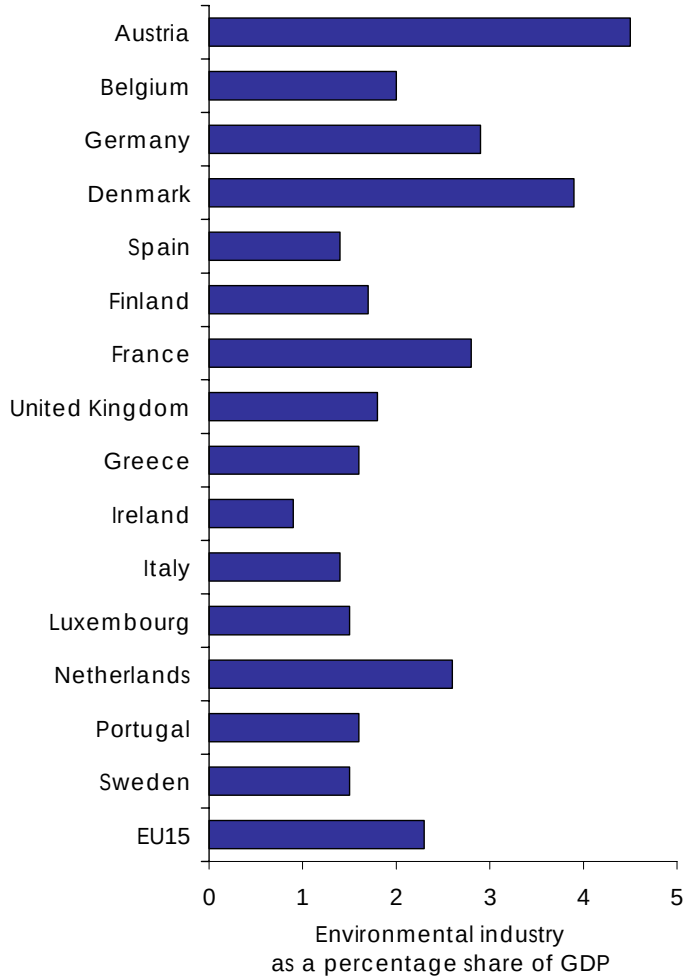


Source: WIFO surveys 2000, 2005, WIFO calculations, Statistics Austria: economic statistics, Austrian foreign trade database. - ¹) estimate.

Due to the cross-sectional character of the sector, it is difficult to perform international comparisons regarding the relevance of the environmental industry in terms of its contribution to GDP. No studies using a comparable definition of the sector are available for other countries. A study by *ECOTEC* (2002) commissioned by the European Commission investigates the employment and export potentials of the environmental industry in the EU member states. *ECOTEC* (2002) extends its definition beyond that used in this study for Austria to encompass not only the production of environmental technologies, but also the wide range of environmental services.

Based on these estimates, the Austrian environmental industry's share in GDP for 1999 amounts to 4.5 percent, which is 2.5 times higher than the value calculated using the narrow definition of the present analysis. Including environmental services, Austria is among those countries with a large share of the GDP contributed by the environmental industry (Fig. 5).

Fig. 5: Environmental industry (technologies and services) as share of GDP in 1999



Source: *ECOTEC* (2002).

The challenge is not just to assess a country's environmental industry, but also to project future developments of the global market for environmental technologies. Such estimates involve major uncertainties. A recent projection of the global environmental technologies market was carried out by *Helmut Kaiser Consultancy* in 2005. The consultancy arrived at an estimate of US$ 560 billion for the global environmental market in 2003 and estimated the market at US$ 744 billion in 2010. The analysis assumes that end-of-pipe technologies will continue to play a major role, due to growing demand in Asian countries such as China. Technologies for waste management, waste water treatment and water supply are considered the largest market segment (*Helmut Kaiser Consultancy*, 2005).

4 Structure of the Austrian environmental technology industry

The sheer complexity of the environmental technology industry poses a challenge to the assessment of its economic importance and the specificities of individual production segments.

Disaggregation is necessary both for activities (end-of-pipe technologies, clean technologies and M&C technologies) and the environmental media (air, water, waste, energy, soil, noise, traffic). Considering that a part of the respondents produces technologies for several media and offers end-of-pipe as well as clean technologies, it would be necessary to break down the economic data by these characteristics in order to obtain an exact analysis of each subsector.

Such a procedure would, however, go far beyond the scope of a written survey and would also drastically reduce the companies' willingness to respond to questionnaires. Thus, in order to obtain an approximate perception of the importance of these subcategories, the questionnaire asked about the respondents' main product[4] in the environmental technology field. This information was then used to assess the economic importance of each of the categories in the Austrian environmental technology industry. Although such an assignment can blur the information regarding single enterprises, on average the companies surveyed achieve about 70 percent of turnover in environmental technologies with their main product, so that calculations of turnover and employees by environmental sectors and activities constitute a good approximation.

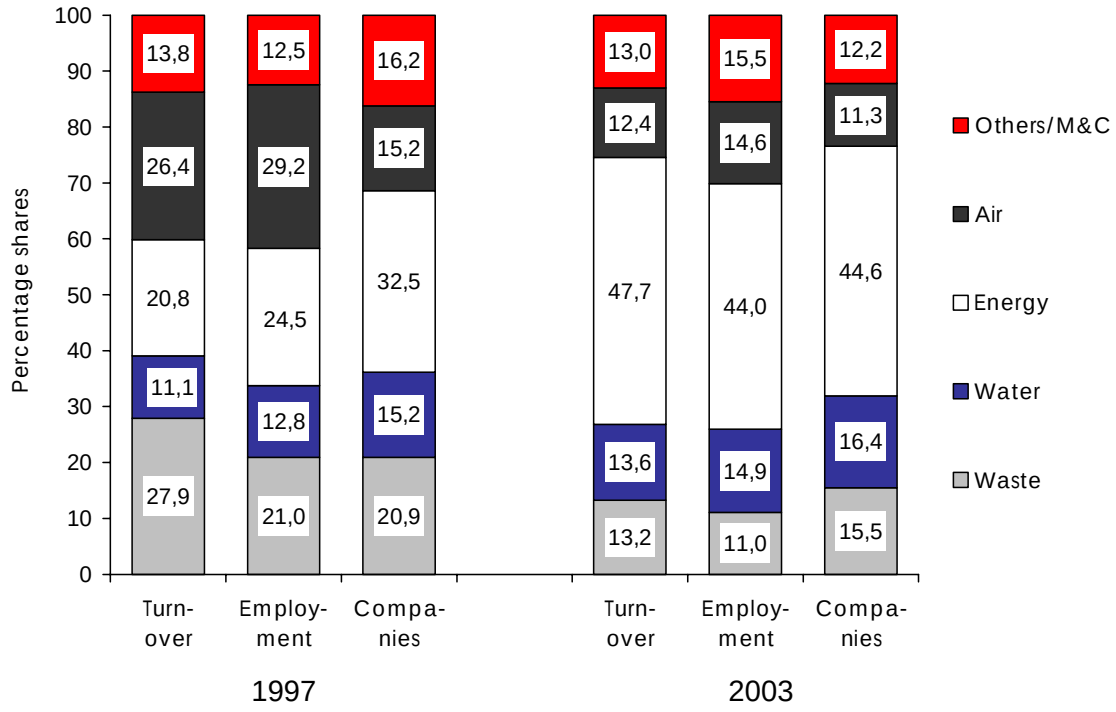
Fig. 6 provides a distribution of employees and turnover by environmental sectors. Considering that M&C technologies cannot always be clearly assigned to an environmental sector, they are included in the category "other environmental technologies". The figure illustrates that the share, respectively, of turnover and employment is not always commensurate. Taking the ratio of turnover to employees as an approximate value for productivity, this means that productivity varies between environmental sectors. The difference between the share of employment and that of turnover is most pronounced in the categories of air and energy technologies, however with reversed proportions: In air technologies the turnover share is lower than that of employment, while the opposite is true for energy technologies. However, such figures should be viewed with due caution, as the production of environmental technologies is frequently just one of several production segments for companies supplying air technologies and statistical allocation problems may occur. There is a statistically significant difference between "mixed" and "specialised" producers by environmental sectors, i.e. producers of air technologies are significantly more likely to offer other products than do producers of energy technologies.[5]

[4] The allocation by main products to activity sectors and environmental sectors was made by technical consultants Walter Beyer and Wolfgang Gaubinger.

[5] The differences are statistically significant with a significance level of 1% (chi square test).

In the present sample, energy technologies rank first, both in terms of turnover and in terms of employment. In 1997, this place had been taken by waste technologies. The environmental sectors air, water and waste currently have similar dimensions. The other environmental media (soil, noise and traffic) are summarised in the category "others" due to the low response rate. Even in this aggregated group they play only a minor role within the Austrian supply of environmental technologies.

Fig. 6: Environmental sectors as share of the environmental industry, 1997 and 2003



Allocation to environmental sectors according to the main product. For soil, noise, traffic and others, company responses are insufficient for a more detailed analysis. They are shown jointly with M&C technologies.

A breakdown of the Austrian production of environmental technologies by activities (end-of-pipe, clean and M&C technologies) shows that a clear shift from end-of-pipe to clean technologies has taken place since 1997. While clean technologies generated 48.6 percent of the turnover in 1997, this figure was up to 54.2 percent in 2003, largely due to an increase in the supply of clean energy technologies.

5 Characterisation of Austrian environmental technology producers

Characteristics marking Austrian producers of environmental technologies include, among others, the time of entry into the environmental market and the motivation driving such market entry.

One out of four companies entered the environmental market between the mid 1970s and mid 1980s and one fifth arrived in the second half of the 1980s, whereas 16 percent entered the market in each of the following two five-year periods. Just below ten percent of the companies only recently entered the environmental technology market, i.e. since 2001.

Two out of three companies producing integrated technologies have entered the environmental market since the mid 1980s, and 13 percent have been active since 2001. If one assumes that legal regulations drive the increasing supply of environmental technologies in some sectors and, on the other hand, a change in the environmental policy discussion directs more attention towards integrated environmental technologies, then their growing importance in Austria is also confirmed by the increased market entry of Austrian clean technology companies. This reorientation to precautionary environmental protection was strongly affected by international events, such as the delineation of the concept of sustainable development in the *Brundtland Report* (1987) or international conferences on climate protection. In the more recent past, this has also been promoted by the European Union's "Environmental Technologies Action Plan" *(European Commission*, 2004).

Of those companies offering end-of-pipe technologies as their main product, more than 40 percent were already active before the mid 1980s. In recent years they failed to keep pace with the rate of market entry observed in the clean technologies segment. Yet end-of-pipe technologies still play an important role in the Austrian environmental industry, as can be seen in the rate of new entries in this segment since 1985.

The entrepreneurial decision to establish a new company or change and extend the production range is typically the result of a combination of numerous internal and external factors. These include expectations of macroeconomic development, the economic policy framework, and market trends in Austria and abroad. The present survey aimed to pinpoint the driving motives for entry into the environmental technologies market (Table 2).

The dominant motive for entering the market was market prospects expected from environmental protection (45 percent of responses). This figure echoes results from previous studies. One out of four companies named environmental protection as the decisive criterion. Competitive strategy was named by almost 13 percent of the respondents as the main motive. This motive has had an even greater importance in the past. Technical innovations ranked fourth, specified as the driving force for market entry by 11 percent of the respondents. Legislation and internal environmental problems are less often mentioned as market entry motives. At first glance, the minor importance attributed to legislation might be surprising, because this factor is important as a determinant for demand. The reason for this appears to lie in the fact that market expectations and competitive strategy together cover at least part of the role that legislation plays as a framework condition for market entry. The structure of responses is relatively homogeneous for the various subsegments of the environmental technology market (broken down by activities and environmental sectors) and no statistically significant deviations can be found.

In remarkable contrast to earlier findings, the environmental argument has increased in importance as a factor for entering the environmental technologies market, i.e. producers consciously opt to offer solutions to environmental problems. Among producers of clean technologies this is one of the strongest motives for market entry (31.8 percent) after market expectations (44.3 percent), but it is less prevalent among producers of end-of-pipe technologies (20.6 percent) and producers of M&C technologies (11.8 percent).

Table 2: Motivations for entering the environmental market (by activities and environmental sectors)

	Total	Enterprises with their main product in the activity sector			in the environmental sector			
Entry due to		Clean technologies	End-of-pipe environmental protection	M&C technology and environmental monitoring	Waste	Water	Energy	Air
	Share of responses in percent	Share of responses in percent			Share of responses in percent			
Market expectation	44,5	44,3	41,2	58,8	48,1	34,6	44,6	31,3
Environmental protection	25,4	31,8	20,6	11,8	14,8	30,8	33,7	12,5
Competitive strategy	12,7	11,4	11,8	23,5	11,1	15,4	10,8	12,5
Technical innovation	11,0	9,1	16,2	0,0	11,1	11,5	8,4	31,3
Legislation	4,0	3,4	5,9	0,0	7,4	3,8	2,4	12,5
In-house environmental problems	2,3	0,0	4,4	5,9	7,4	3,8	0,0	0,0
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
N° of enterprises	173	88	68	17	27	26	83	16

In the environmental sectors soil, noise, traffic and others, company data are insufficient for a detailed analysis; enterprises whose main product is M&C technology are included in the activity sector: they cannot be attributed to environmental sectors.

Specialised producers of environmental technologies (i.e. companies that concentrate solely on environmental technologies) named the founding of their enterprise as the dominant entry strategy. For "mixed" enterprises, on the other hand, the diversification of their product range was the main strategy for market entry.

Enterprises are also characterised by the source of their know-how and their ownership structures. Two out of three respondents named in-house technology as the basis for producing environmental technologies. Almost one fifth said they drew on acquired patents and licences for their know-how. In 12 percent of the responses, the improvement of an acquired

technology was named as the foundation for the current production of environmental technology. Such findings by and large confirm earlier results. A significant majority of the companies included in the sample is completely Austrian owned (77 percent), while 7 percent are majority-owned by Austrians. Fourteen percent of the companies are exclusively foreign owned, and the rest have a foreign majority stake. Foreign capital mainly comes from Germany, as found in earlier studies.

6 Demand drivers for environmental technologies

Growth opportunities for the environmental industry largely depend on economic policy and socio-political factors that are essentially beyond the producers' control. The macroeconomic importance of the sector is thus substantially shaped by exogenous factors. A key determinant identified in international studies and the two previous studies[6] is legislation.

The 2005 survey again asked the respondents to rank the importance of demand determinants. The survey listed nine categories of demand stimuli, which were to be rated from "very important" to "unimportant". The study confirmed the important role that legislation plays in providing a stimulus for environmental technologies. Another main incentive named was subsidies.

For three out of four Austrian producers of environmental technologies, national legislation plays a very important or important role as a determinant of demand for their technology[7] . EU legislation received an almost identical rating – which is not surprising when one considers that the EU member states are a major market for Austrian environmental technologies. The legislation of other countries is considered very important or important by 50 percent of the respondents. Subsidies for environmental protection investments are considered just as important as domestic legislation as an incentive for demand for environmental technologies. Public environmental awareness is perceived as a very important or important factor for about 70 percent of the respondents. Less important are environmental management systems and EU enlargement. The latter category, however, in part overlaps with the categories "legislation in the EU and other countries".

A ranking was calculated to evaluate the determinants of demand. For this purpose, the responses regarding the demand stimuli were weighted, ranging from "four" for "very important" to "one" for "unimportant". In Tables 3a and 3b the ranking for 2005 is compared to the findings of *Köppl* (2000) and disaggregated by activity and environmental sectors. Although the comparison is limited by the fact that the categories used for the demand stimuli vary slightly between the two surveys, the key categories are nevertheless included in

[6] *Eurostat* (1994), *Köppl – Pichl* (1995), *US-Department of Commerce* (1998), *Köppl* (2000).

[7] *Jaffe et al.* (2002) further emphasize that the type of environmental policy regulation has an impact on technology development and diffusion.

both samples. For a better comparison, categories that were different in the 2000 survey are shown as well. The ranking for 2005 shows that environmental technology producers considered subsidies for environmental protection investments to be the most important factor creating demand. In 2000, this factor ranked fourth. In the current survey, EU legislation ranks second, followed by national legislation at third place. Legislation in the EU and in Austria is similarly weighted. EU legislation affects demand through two channels: First, the EU member states are an important market for Austrian environmental technologies, and, second, the framework in Austria is greatly determined by EU legislation. In 2000, national legislation was considered the most important demand determinant for domestic environmental technologies.

Public environmental awareness is also seen as an important stimulus for demand in both years. Legislation in other countries follows at fifth place. This rating reflects the presence of Austrian producers of environmental technologies on international markets. Discussions frequently stress the role of investments in the public sector for the diffusion of environmental technologies. Factors of less importance for companies are competitive strategy, EU enlargement and environmental management systems.

Broken down by activity sectors, EU and national legislation is clearly more important for end-of-pipe technologies (ranks 1 and 2) than for clean technologies. Demand for the latter is largely determined by subsidies for environmental investments (1st rank) and public environmental awareness (2nd rank). Broken down by environmental sectors, domestic and EU legislation is decisive for waste and air technologies. Energy technologies are driven by the same demand determinants as integrated technologies. Demand for water technologies is mainly affected by domestic legislation (1st rank), followed by subsidies for environmental investments at the 2nd rank.

Table 3a: Ranking of demand determinants, 2005 and 2000

	Rank in 2005	Rank in 2000
Subsidies for environmental investments	1	4
EU legislation	2	-
Domestic legislation	3	1
Public environmental awareness	4	3
Legislation in other countries	5	-
Investments by the public sector	6	6
Competitive strategy	7	8
EU enlargement	8	-
Environmental management systems	9	-
Legislation abroad	-	2
Cost savings	-	5
Environmental awareness of the corporate sector	-	7

Table 3b: Ranking of demand determinants, by activity and environmental sectors

	Enterprises with their main product in the activity sector			in the environmental sector			
	Clean tech-nologies	End-of-pipe environ-mental protection	M&C tech-nology and environmental monitoring	Waste	Water	Energy	Air
	Rank in 2005			Rank in 2005			
Subsidies for environmental investments	1	3	6	3	2	1	5
EU legislation	3	2	1	1	4	3	2
Domestic legislation	4	1	2	2	1	4	1
Public environmental awareness	2	5	3	6	5	2	4
Legislation in other countries	6	6	5	4	6	6	3
Investments by the public sector	7	4	4	8	3	7	6
Competitive strategy	5	8	9	9	7	5	8
EU enlargement	8	7	7	5	8	8	7
Environmental management systems	9	9	8	7	9	9	9

7 Market share and market structure

The strength of Austrian companies operating in the environmental technology market is expressed by their market position and their market share.[8] Accordingly, the survey asked for these data from the Austrian environmental technology producers. Altogether, one out of five companies reports a market share of above 50 percent on the domestic market – about the same figure that was found by *Köppl* (2000). For Europe, market shares reported in 2000 were higher than in the current study. Still, it is not possible to make any direct comparison because no differentiation was made between the EU15 and the rest of Europe. In the EU15, 3 percent of the respondents have acquired a market share of more than 50 percent, and the figure is similar for the rest of Europe. If a company's market dominance is defined as starting with a market share of about 30 percent,[9] then one out of three companies can be said to dominate the domestic market, whereas the figures for the EU15 and the rest of Europe are 13 percent and 10 percent respectively.

Almost 30 percent of the respondents have a market share of less than 5 percent on the domestic market. Slightly more than half the respondents state about the same market share

[8] Share of turnover achieved by the company in the relevant market.

[9] Austrian cartel law assumes that a company possesses a dominant market position once its market share exceeds 30 percent.

for the EU15, and almost two thirds of the companies have a market share of less than 5 percent in the rest of Europe (Table 4).

Table 4: Market share in the environmental technology sector

	Producers of environmental technologies, total			Producers of clean technologies			Producers of end-of-pipe technologies		
	National	EU15	Rest of Europe	National	EU15	Rest of Europe	National	EU15	Rest of Europe
	Percentage shares			Percentage shares			Percentage shares		
0 - 5 %	28,1	53,1	64,2	30,6	56,9	69,8	30,6	52,9	62,2
5 - 10 %	15,6	15,6	10,4	21,2	15,4	5,7	9,7	13,7	11,1
10 - 20 %	13,1	6,3	4,7	12,9	6,2	1,9	8,1	3,9	8,9
20 - 30 %	9,4	11,7	10,4	4,7	9,2	11,3	11,3	15,7	8,9
30 - 40 %	8,1	7,0	5,7	9,4	7,7	5,7	6,5	5,9	4,4
40 - 50 %	5,0	3,1	1,9	4,7	3,1	3,8	6,5	2,0	0,0
More than 50 %	20,6	3,1	2,8	16,5	1,5	1,9	27,4	5,9	4,4
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
N° of enterprises	160	128	106	85	65	53	62	51	45

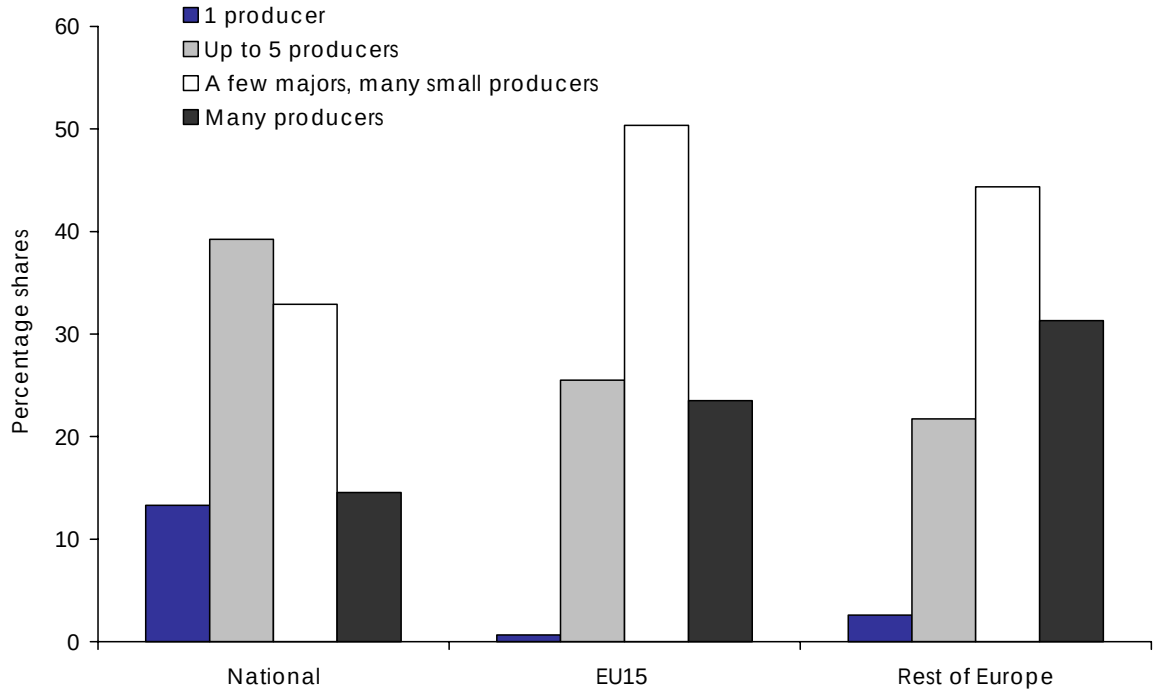
Allocation to activity sectors by main product.

Producers of clean technologies generally exhibit less market dominance than producers of end-of-pipe technologies. On the domestic market, almost two thirds of the producers of integrated technologies rank in the lower three categories, i.e. their market share in Austria is at most one fifth. This is the case for fewer than 50 percent of producers of end-of-pipe technologies. Similarly, on the European markets producers of clean technologies have lower market shares than do producers of end-of-pipe technologies, although the difference is not statistically significant (Table 4).

As has been demonstrated in the past, Austrian producers of environmental technologies encounter different market structures when operating in Austria and abroad. The domestic market is characterised by its oligopolistic, and in some cases monopolistic, market structure, whereas the European market generally consists of a few large and many small competitors.

13 percent of the respondents consider the Austrian market a monopolistic market. Almost a quarter of the companies surveyed operate in a market with many competitors in the EU15, and the figure is even higher when it comes to the rest of Europe (Fig. 7).

Fig. 7: Market structure for Austrian producers of environmental technologies

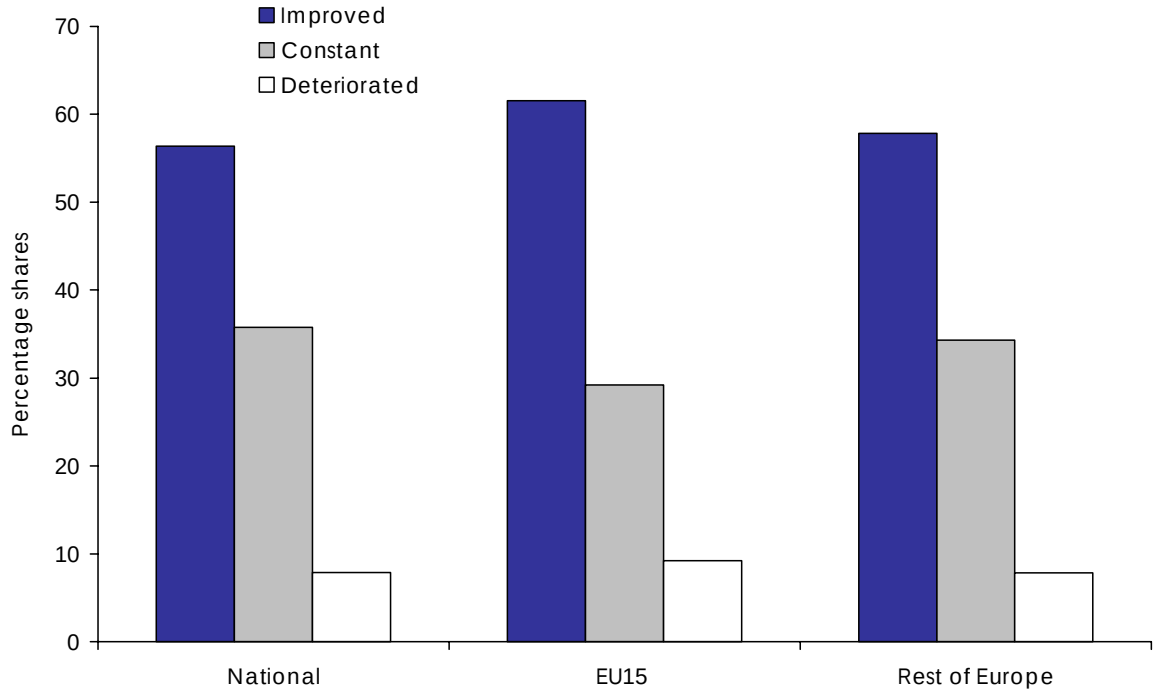


Companies generally hold a positive assessment of the development of their market position over the past three years. Between 56 percent and 62 percent of the companies were able to improve their market position over that period, depending on the submarket. The greatest improvement was achieved in the EU15. Fewer than 10 percent of the companies reported a deterioration of their market position (Fig. 8).

The share of companies that improved their market position was markedly higher in the clean technologies sector than among producers of end-of-pipe technologies. 73 percent of the Austrian producers of clean technologies were able to expand their market presence, especially in the EU15.

Significant differences can be found between the two activity sectors in terms of those companies that failed to maintain their market position. For producers of clean technologies, this share is 2–4 percent at the domestic and EU15 levels and 6 percent for the rest of Europe. In contrast, 18 percent of the producers of end-of-pipe technologies failed to maintain their market position in the EU15 over the past three years. Fourteen percent found their position on the domestic market to be deteriorating, and 11 percent suffered a loss of market share in the rest of Europe.

Fig. 8: Change in market position in the last 3 years



The picture differs when we analyse figures by environmental sectors: Companies offering waste technologies improved their market position at an above-average rate in all submarkets during the past three years. This result stands out positively against the 2000 study. In the case of water technologies, the EU15 market was especially difficult: One out of four respondents reported a deterioration of its market position in the EU15 countries. Similarly, more than 10 percent experienced deterioration on the domestic market and in the rest of Europe. Energy technologies, on the other hand, experienced a dynamic growth over the past three years. Sixty-three percent of the respondents achieved an improvement in their market position on the domestic market as well as in the rest of Europe, and 70 percent did so in the EU15. Producers of energy technologies had already shown a positive development in the past.

In the case of air technologies, the share of companies reporting an improvement in their market position within the EU15 and in the rest of Europe was distinctly higher than that for the domestic market. By contrast, the share of companies that were able to maintain their market position was higher at the domestic level. The share of those experiencing a deterioration of their market position in this sector is relatively high in all three submarkets. Assessments of market positions for air technologies had been substantially more positive in the past.

8 Innovation activities in the Austrian environmental technology industry

The link between the level of economic development and the technological position of a country has been emphasised in economic policy discussions for many years. Expenditure on R&D and innovations is a challenge for a country like Austria, which cannot compete with low costs at an international level but needs to define its competitive position through quality. The expenditures on R&D and innovation activities of an economy – or, at the microeconomic level, of a company – are key factors for ensuring growth and a dynamic economic performance.

In the mid-term, the level of R&D expenditure by an enterprise will depend on the internal targets and on its environment. In the case of the environmental technology industry, the regulatory framework for environmental protection - in addition to the competitors in this sector - is a key factor.

For manufacturing, the most recent data have been provided by an analysis of corporate R&D expenditure in 2002 (*Messmann – Schiefer*, 2005). According to these, manufacturing enterprises show average R&D expenditures[10] of 2 percent. Compared to this figure, the companies of the current sample (i.e. environmental technologies and other production segments) report R&D expenditures of 3.5 percent.[11] Compared to the two above groups, R&D expenditures are significantly higher at 5.6 percent in 2003 when there is an exclusive concentration on environmental technologies production. In this case, the percentage of R&D spending only considers expenditure for R&D on environmental technologies for "mixed" companies.

In total, 83 percent of the environmental technology producers reported having introduced innovations in their product segment between the years 2000 and 2003. The response rate varies little between sectors of activities. The result differs from former findings where producers of end-of-pipe technologies reported fewer innovations than did producers of clean technologies and M&C technologies. Companies producing waste technologies are the most research intensive in the current sample. Enterprises that offer air technologies have the lowest innovation percentage in our sample. In an earlier study, water technologies lagged far behind the remaining environmental sectors.

Forty-six percent of innovating companies obtained financial support from the public sector. In the waste technologies segment, 59 percent of the innovating companies received subsidies. Similarly, innovations in energy technologies benefited from public funds at an above average rate (47 percent). Compared to the environmental industry 38, percent of all innovating companies obtained subsidies for their innovations (between 1998 and 2000).[12]

[10] R&D expenditure as proportion of turnover.

[11] For calculating the aggregate R&D rate of the respondents, the company sample was adjusted for one outlier.

[12] *Falk – Leo*, 2004.

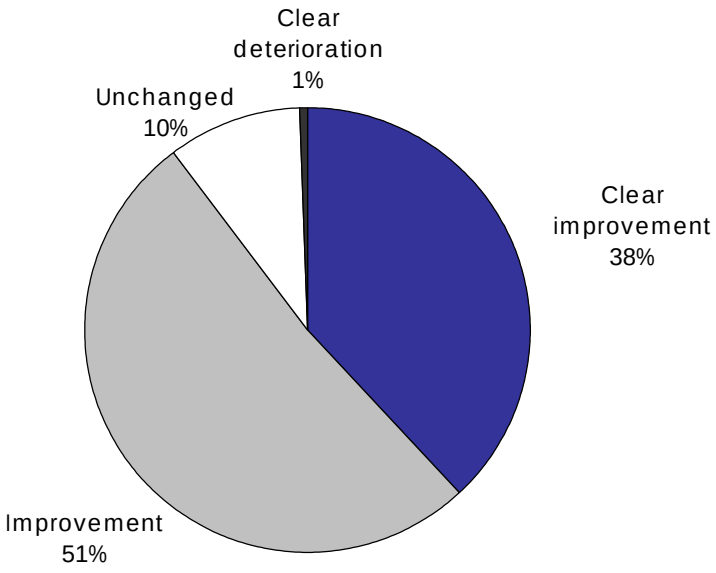
Producers of environmental technologies thus benefited slightly more than others from public subsidies for innovation.

The significance of an innovation can be measured by whether it is a novelty either on the domestic or global market. As in the previous studies, the innovating enterprises were asked to characterise their innovation by this criterion. The share of those reporting that theirs was a sector-wide innovation has grown (three quarters compared to 60 percent in 1997). To some extent this points toward a higher quality of Austrian innovations in the environmental technology sector. Ninety percent of the companies reported that their innovation was a novelty for the Austrian market.

The decision to innovate is affected by a number of factors, including market expectations and technical options. In the more recent literature on innovation,[13] great importance is also afforded to whether benefits can be accrued from an innovation. A key indicator of whether enterprises are able to benefit from innovation is patent applications: In 47 percent of our sample, innovations led to a patent application, most frequently in the segment of waste technologies (57 percent).

R&D and innovation ultimately aim to defend and improve a company's competitive position internationally. The survey specifically asked about the effects of innovations on the companies' competitiveness (Fig. 9).

Fig. 9: Change in the competitive position through innovation



[13] cf. *Leo* (1999), *Falk – Leo* (2004) and above.

More than a third of the innovating enterprises reported that their competitive position had clearly improved as a result of their innovation. For half the companies, the innovation contributed to an improvement of their competitive position, and only 10 percent stated that their innovation activity did not produce any change (Fig. 9).

Changes in employment resulting from a company's innovation activities are difficult to assess because employment generally depends on a multitude of factors. In order to at least capture some trends in the correlation between the development of new products and a change in employment level, enterprises were asked to provide a rough estimate of the employment effects. Slightly more than a third reported that innovation had not caused any change in employment in their company. The effects reported by the other companies contribute some 6 percent to employment in the environmental technology industry, and are thus little more than a marginal factor. Such changes, however, do not provide any evidence of employment effects resulting from the production and sale of the new products.

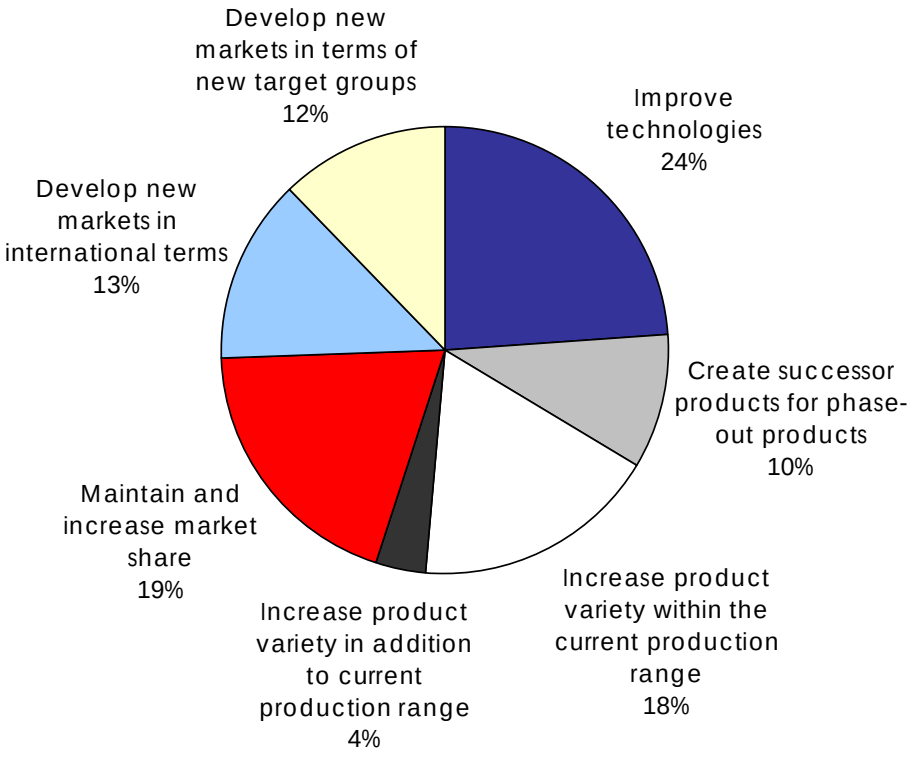
It is of interest to note the significantly negative correlation between expected growth of employment and company size with respect to employment (size classes).[14] Companies operating in the upper employment size classes expect modest additional employment effects from an innovation, whereas smaller companies assume that their innovation will have a clearly positive effect on their future employment.

An analysis of the employment effects of innovations in the Austrian economy yields a differentiated picture (*Falk – Leo*, 2004). The strongest effects can be found among novel or substantially improved product innovations, i.e. in the category which includes innovations in environmental technologies, as captured by our sample.

A company's decision to undertake innovation activities generally depends on a number of factors. The survey asked for the decisive motivations and multiple responses were accepted. According to the survey, the main motive for innovation was to improve the technology (about a quarter of the responses, Fig. 10). Compared to previous studies, this factor has gained in importance. This is particularly visible in the clean technologies sector and, when broken down by environmental sectors, in the segments of air and energy technologies.

[14] Statistically significant at a 1% level of significance (Kendall Tau-b).

Fig. 10: Motives for product innovation



The incentive for a company to innovate must be seen in the context of the company's environment. Accordingly, a number of driving forces will play a role. It is generally possible to distinguish between internal and external factors driving innovation – whether an impulse originates from within the company itself or from outside, such as through predetermined conditions, e.g. legislation (Table 5).

The main driving force named by companies was their customers (1st rank). This should not come as a surprise considering that environmental technologies are frequently customised to the clients' needs. In other words, the close collaboration between customers and producers has a positive spill-over effect on a company's innovation activities. In-house R&D ranks second as a driving force for product innovation, followed by management as initiators of innovation. Legislation in the EU and in Austria is also afforded an important role in driving innovation. There appear to be two reasons for this: First, much of the framework for national legislation is specified at the EU level, and second, the EU plays a dominant role as a market for Austrian environmental technologies.

Public subsidies are not crucial in driving innovation, even though a number of innovating companies in the sample receive public funds for carrying out their innovation activities.

Literature, science and patents provide little impetus for innovation. The ranking has changed little compared to *Köppl* (2000), although competitors and affiliated companies abroad played a greater role at that time.

Table 5: Driving forces for innovation, 2003

	Total	Companies with their main product in the clean technologies segment
	Rank	Rank
Domestic legislation	5	7
EU legislation	4	4
In-house		
Research and development	2	2
Production and resource management	8	8
Marketing, product management	6	5
In-house suggestion scheme	16	16
Management	3	3
External		
Affiliated companies		
in Austria	13	11
abroad	10	14
Competitors	7	6
Suppliers	14	13
Customers	1	1
Expert literature	15	10
Science	12	15
Patent specification	17	17
Trade shows, conferences, etc.	9	9
Public R&D promotion programmes	11	12

Ranking calculated from responses, weighted by the importance afforded by the companies (very important – important – less important – not important).

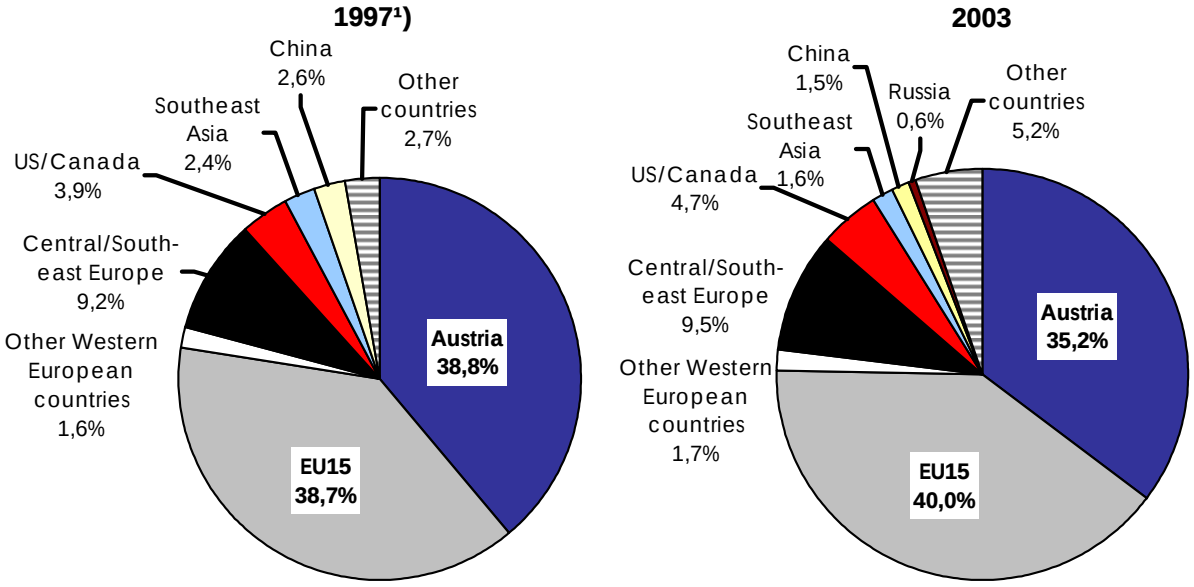
9 Markets and international competitiveness

In the mid 1990s, some 50 percent of environmental technologies were sold on the Austrian market and the rest were exported. By 1997, exports had gone up to over 60 percent. In this sample, companies were again able to increase their exports, which achieved about 65 percent (Fig. 11). In total, the companies in the sample exported goods in the amount of € 1.6 billion.

Compared to the environmental technology industry, manufacturing also had an export share of 65 percent (measured as exports as share of exports in turnover).[15] The domestic environmental industry thereby mirrors the dimensions of manufacturing in terms of increased internationalisation and exports over time.

When analysing export revenues by countries, we see the same strong concentration on the EU15 that was found in the past (see Fig. 11): Forty percent of the total turnover generated by the Austrian environmental technology industry was obtained in the EU15. The German market alone generated 22 percent of the turnover of Austrian companies. The share of sales in Central and Southeastern Europe is unchanged relative to 1997. The US and Canada, key markets for environmental technologies world-wide, contribute 4.7 percent to the turnover of the companies in the sample. China's share has declined (to 1.5 percent) compared to *Köppl* (2000).

Fig. 11: Markets for environmental technologies, 1997 and 2003



[1]) *Köppl*, 2000.

In order to avoid sample-specific distortions in analysing the country structure of domestic exports, Fig. 12 shows the export structure based on the UN world trade database. For this analysis, the environmental technology industry was defined using a preliminary list of environmental technologies and goods prepared by the OECD (*OECD*, 2000). To facilitate

[15] *Statistics Austria*, "Leistungs- und Strukturerhebung" 2003, Austrian Trade Statistics.

comparisons, the country structure of exports from the current survey has been shown as well. Total manufacturing goods exports are also shown, in order to provide an impression of the export performance achieved by the environmental technology industry.

The outstanding role played by the EU15 in terms of Austrian exports – both exports of environmental technologies and goods in general – is clearly shown in Fig. 12. According to the data from the UN world trade database,[16] the EU15 are slightly more important for overall goods exports than for exports of environmental technologies. Of total goods exports, 57 percent go to the EU15, while the corresponding share of environmental technology exports is 52 percent. Germany, which is still Austria's main export partner, receives 33 percent of Austrian exports of environmental technologies.

For the other countries and groups of countries shown (with the exception of "other countries"), exports of environmental technologies are of greater importance. Thus, the proportion of goods exports into the Central and Eastern European countries (CEECs) is 14 percent, compared to an 18 percent share for environmental technologies exports. In 2000, environmental exports did not achieve the same level as total exports of manufacturing goods (but environmental exports were solely measured in terms of the survey sample). Currently, they seem to have won back their position – a satisfactory situation considering that the new EU members and candidate countries have some substantial catching up to do in terms of environmental protection.[17] The importance of South-east Asia and China for the Austrian environmental technology industry can also be regarded as positive. In both cases, the share of environmental technology exports is greater than the share of total goods exports.

Looking at the country structure of environmental technology exports derived from the sample data, the most noticeable factor is the greater importance of the EU15 countries, which dwarfs exports into the CEECs and South-east Asia. Russia is similarly underrepresented in the survey when compared to the UN world trade database.

The comparison of the two data sources (company sample and UN world trade database) indicates that slight distortions are possible in calculations of export shares by countries, due to the low representation of some countries and/or groups of countries in the sample.

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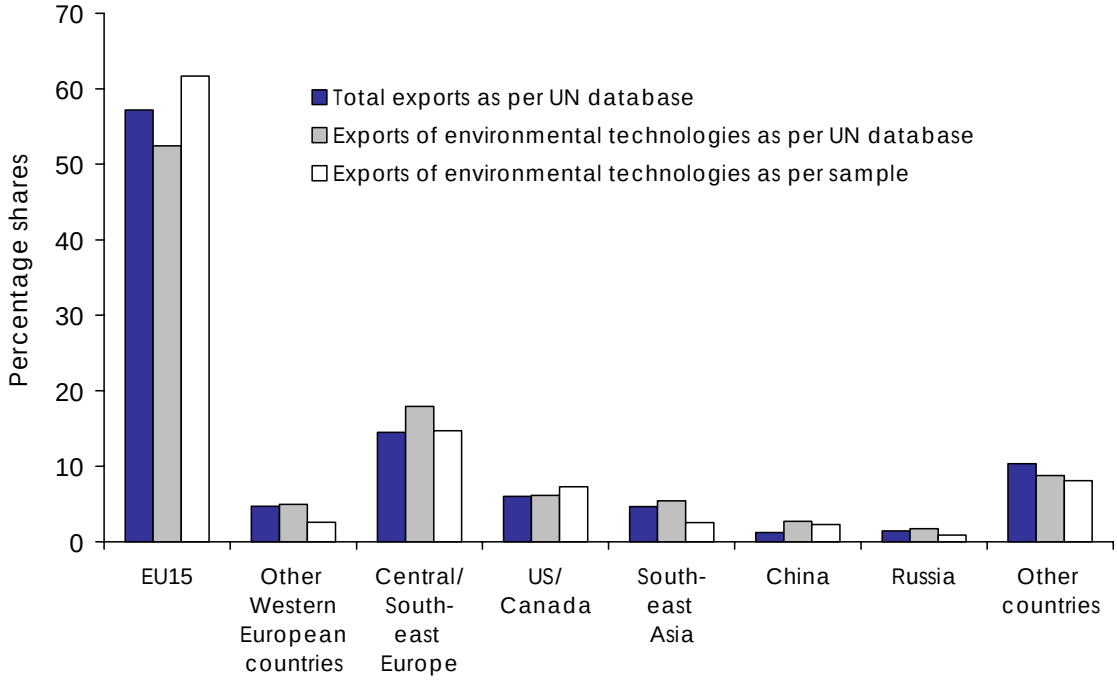
[16] For the definition of the environmental industry used in the UN world trade database see below.

[17] Analyses of South-eastern European countries performed by ÖGUT with a view to their environmental policy framework and market potential for environmental technologies confirm that Austrian environmental technology producers have excellent opportunities in these countries. The analyses conclude that in the new EU members Austrian producers of environmental technologies are increasingly faced with competitors from other Western European countries. Austria enjoys an excellent reputation especially in the countries of the second EU accession wave, in terms of its provision of environmental technologies as well as environmental services. Considering the great backlog of environmental protection measures in these countries (water supply and waste water treatment, improving energy efficiency, waste management, etc.) this offers major market potentials for Austria. Austria could also use JI projects to improve its position as a producer of environmental technologies (cf. *ÖGUT* 2004, 2005).

Fig. 12: Export structure in 2003, by countries



Source: UN database, Harmonised System 1996, definition of environmental technology goods as per OECD (2000), WIFO calculations.

For energy technologies, the domestic market is of subordinate importance compared to other environmental sectors. Almost 50 percent of the turnover of energy technologies is generated in the EU15. The CEECs constitute another important market for Austrian energy technologies. Of the energy technologies covered by the sample, over 12 percent are sold into these countries. The US and Canada also buy energy technologies from Austria, and their share makes up 3 percent. For cogeneration plants/systems engineering, the respondents report lower turnover on the Austrian market (12 percent).

By far the most important market is the EU15 (almost 60 percent). Central and Southeastern Europe have about the same importance as Austria as a market for cogeneration plants and systems engineering. More than 40 percent of the biomass plants are sold domestically. Slightly fewer than 40 percent of the sales revenues derive from the EU15. Exports to Central and Southeastern Europe generate 12 percent of the turnover of biomass technologies. Russia is also an interesting market, although its share is still low. Hydropower technologies are mainly sold in foreign markets, dominated by EU15 countries and Central and Southeastern Europe.

The Austrian environmental technology industry has become increasingly export-focused over time. Foreign direct investment also plays a role for the sector as a strategy for internationalisation. Just as the Austrian environmental technology industry aims to also sell its products on foreign markets, other countries producing environmental technologies pursue a similar strategy. The internationalisation of the environmental industry must thus be analysed from the aspect of the competitive performance of Austrian environmental technologies.

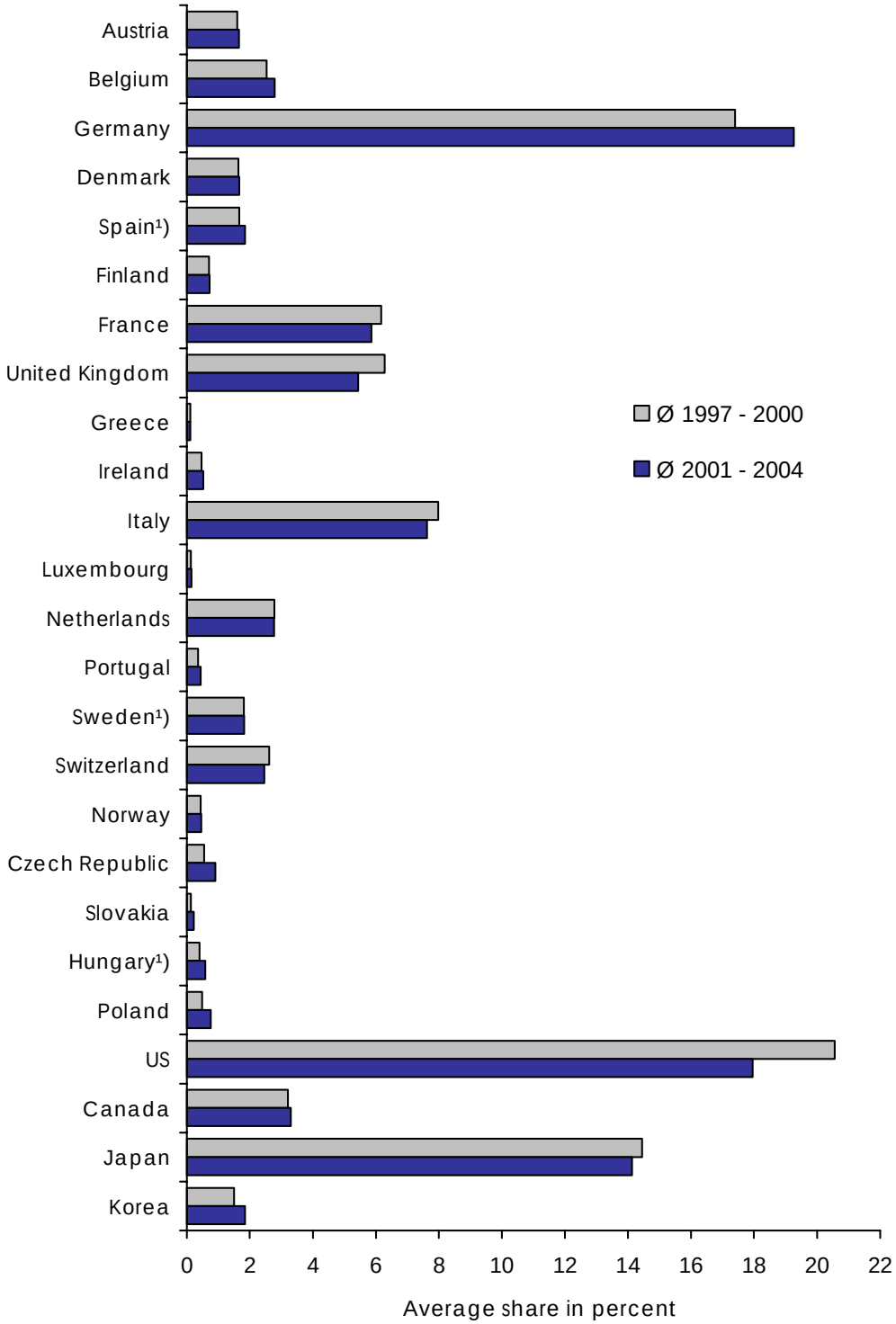
An empirical analysis of the competitiveness of the Austrian environmental technology industry is faced with the problem that no details on the environmental industry are available, whether at European or global level, and that, where specific analyses do exist, their results are difficult to compare.

For this study calculations were carried out based on the UN world trade database. To do this, it was necessary to identify those goods which are internationally traded under the label of environmental goods. Since the environmental technology industry is not defined as an economic sector of its own, there is no internationally agreed list of goods which can be defined as environmental goods in trade statistics. In 2000, the OECD published a preliminary list of environmental goods that can be identified in the UN world trade database by means of the Harmonised System classification.[18] While this list provides a valuable tool for analysing international trade, some restrictions must still be considered. The survey also involved problems of demarcation and allocation, especially in the field of clean technologies. The same problems apply to the OECD's international trade codes. The list also becomes problematic in the case of multiple-purpose products, i.e. products that can be used for environmental as well as other purposes. The extent to which they are used for environmental protection varies considerably between countries, so that distortions may be expected when looking at trade in environmental goods and competitive positions in the individual countries. As an approximation for delimiting the environmental industry, the OECD list of goods can certainly serve as a valuable base, offering a way to identify the sector in all countries from the UN world trade database and to calculate indicators of the competitive position assumed by Austria and other countries.

The development of market share (a country's proportion of the OECD countries' global exports of environmental goods) gained by the various countries in the environmental technology market is shown in Fig. 13. In terms of the OECD countries' environmental technology exports in 1997 – 2000, the US ranked first (20.6 percent), followed by Germany (17.4 percent) and Japan (14.4 percent). Other countries holding considerable market shares are Italy (8 percent), France and the United Kingdom (some 6 percent each). With an average share of 1.6 percent in 1997 – 2000, Austria is approximately on par with Sweden and Denmark.

[18] Harmonised System, international goods classification, *OECD*, 2000.

Fig. 13: Development of market shares in trade with environmental goods



Source: UN database, Harmonised System 1996, definition of environmental technology goods as per OECD (2000), WIFO calculations dollar-based – ¹) Ø 2001 – 2003.

As an average of 2001 – 2004, the ranking shows a shift in the values for the US and Germany. While Germany's market share rose by nearly 2 percentage points to 19.3 percent, the US share dropped by about the same percent. Japan managed to maintain its position, as did Canada and the Netherlands. Austria recorded a slight increase in its market share. In terms of its market share in total goods exports, Austria shows a similar position as the average of both periods (Fig. 13).

Using dollar-based export figures to calculate market shares may result in a distortion when there are significant fluctuations in the exchange rate. Export figures may rise even when quantities remain constant or even when demand decreases due to an appreciation of the euro over the dollar, simply because the price effect may impact more than the quantity effect. A country may thus gain a good export position purely due to exchange rate fluctuations in spite of exporting fewer goods. In such a case it would be important to calculate the market share in real terms, which is, however, not possible, due to the lack of regional export price statistics.

Measured in terms of the relative competitive position[19] that Austria holds in its trade with environmental goods, for both periods (1997 – 2000 and 2001 – 2004) Austria's international trade specialises in environmental technologies (Fig. 14), although this was more pronounced in the period 1997 – 2000 than in 2001 – 2004.

In the last two years for which data are available, Austria lost its international trade specialisation in environmental technologies. Other countries also show significant fluctuations. The development of the RWS values not only reveals a change in the export volume of environmental goods, but also a change in total goods exports. In Austria, total goods exports grew more rapidly in 2003 than did the exports of environmental technology, which was partly compensated in 2004 by a higher growth rate for environmental technology exports. At the OECD level, the high growth of Austrian goods exports in 2003 was accompanied by a higher growth rate of environmental technology exports in proportion to the total OECD goods exports. Such various influences resulted in a negative turn in 2003.[20]

Of the European countries, Germany, Denmark, Italy and Switzerland specialised in international trade in environmental technologies across the whole period.

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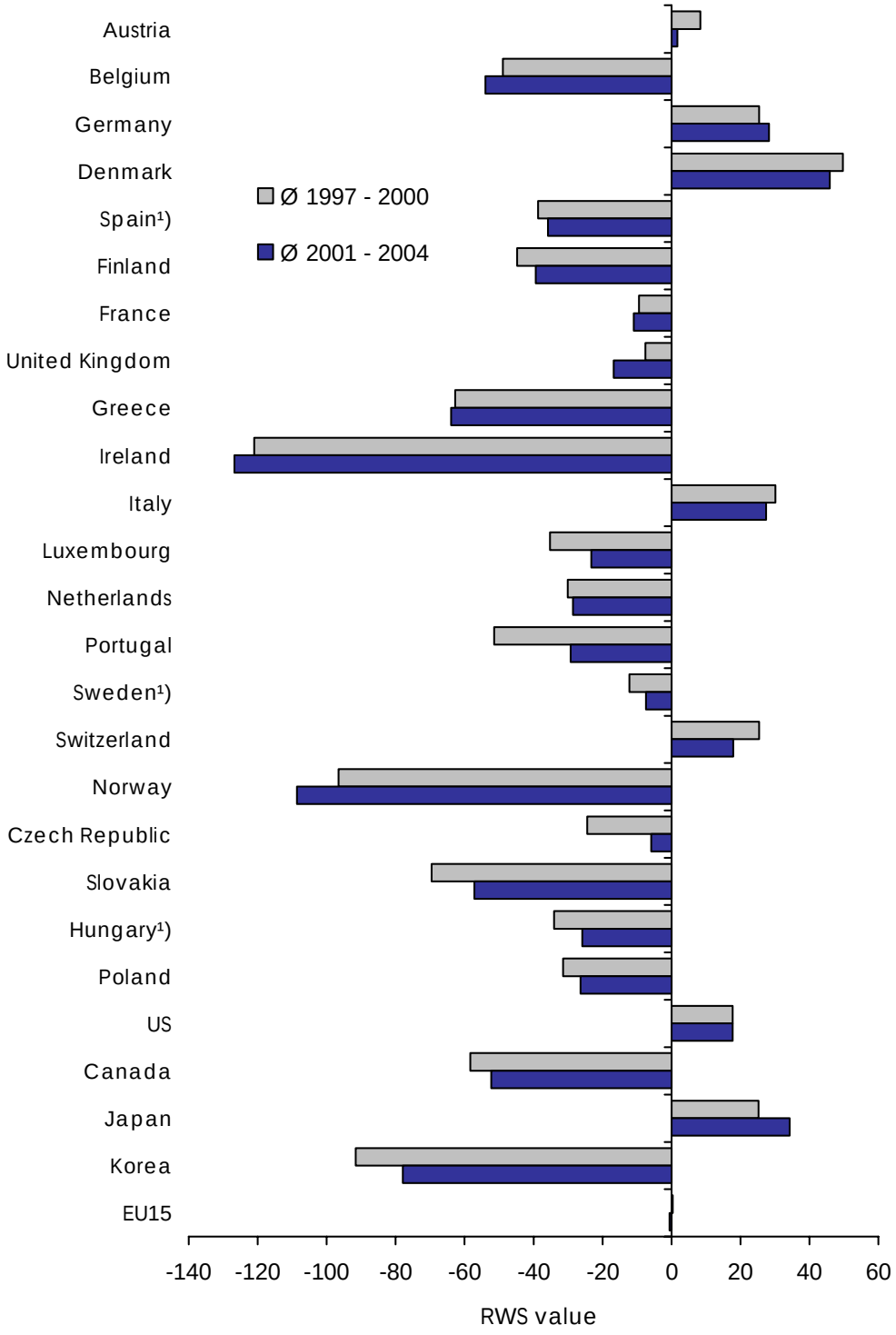
[19] Relative world trade share or market share (RWS): This indicator relates a country's share of the trade in environmental goods to its share of exports of processed industrial goods in general. A value of zero means that the export of the category considered has the same share of OECD exports as do total exports. A positive value means that the world trade share or market share of the category considered is higher than the average of exports. The higher the share held by environmental goods in a country's total goods export in international terms, the higher will be the value of this indicator.

[20] Calculations made by *Legler et al.* (2003) already found a negative RWS value for Austria in 2000. When interpreting this, it should be noted that international trade flows are recorded in dollars, so that it is not possible to make any direct comparisons with findings based on the sample. Differences in aggregate definitions must also be considered.

Fig. 14: Relative competitive position of Austria in its trade with environmental goods (Relative world trade share or market share)



Source: UN database, Harmonised System 1996, definition of environmental technology goods as per OECD (2000), WIFO calculations dollar-based – ¹) Ø 2001 – 2003.

In terms of the RCA value (revealed comparative advantage), an increase in import competition is found for Austria in the environmental technologies sector.

Competition indicators and an analysis of the international trade activities based on the survey provide a differentiated picture of the Austrian environmental technology industry. The export growth rate, as obtained from the sample, was higher in 1997 – 2003 than that of total Austrian manufacturing. Austria has managed to keep its market share of environmental technologies since 1997. However, when measured by two indicators of foreign trade specialisation, Austria's position has recently deteriorated. Up to 2002, Austria recorded a greater market share in its trade with environmental goods than in its total goods trade, but this no longer applies to 2003 and 2004. The international trade analysis also points toward an increase in import competition. Rising intra-industrial trade appears to be linked to European progress towards integration and a harmonisation of environmental policy standards, among other factors.

In summary it can be said that Austria, a small country which specialised in environmental technologies at an early stage, has achieved a good position in international competition. Growing competitive pressure on both foreign markets and the domestic market constitutes a challenge for the Austrian environmental technology industry in its aim to maintain or improve its competitive position. Supplying continually improving high-quality technologies is one way achieving this goal.

10 Conclusions

Production structure

- The environmental technology industry demonstrates a shift between sectors of activities and environmental sectors. Over time, the integrated technologies sector has gained in importance compared to end-of-pipe technologies. In particular, clean energy technologies have gained considerable weight within the range of Austrian environmental technologies. The structural shift towards integrated technologies and clean energy technologies indicates that Austrian producers of environmental technologies have caught on to key topics of recent years. These include climate change, activities in connection with sustainable development and the aim to raise the proportion of electricity generated from renewables on both the national and EU level. A positive effect also comes from the fossil fuel prices, which are higher than in the past.

Dynamic sector

- To summarise, it shows that, through its early specialisation in environmental technologies, Austria has achieved a good global competitive position in spite of its small size. Increased competitive pressure on foreign and domestic markets is confronting the Austrian

environmental technology industry with the challenge to compensate for the recent deterioration in some competitive indicators by providing high-quality technologies.

- It is estimated that 330 companies operated in this sector in 2003, achieving a turnover of € 3.78 billion and employing 17,200 workers. They exported environmental technologies in the amount of € 2.45 billion, about half of which came from clean energy technologies. The Austrian environmental technology industry is a dynamic sector. Potentials that arise especially on new markets or that are generated by innovative technologies should be exploited by a proactive approach.
- The relative importance and dynamics of the environmental industry over time are evident in the growth of its contribution to GDP and its share in manufacturing turnover and employment. Its contribution to GDP amounted to 1 percent in 1993, rose to 1.4 percent in 1997 and reached 1.7 percent in 2003. In terms of manufacturing turnover, the share of the environmental technology industry grew from 2.1 percent in 1993 to 3.7 percent in 2003. Employment grew at a similarly dynamic pace, reaching 3.3 percent of manufacturing in 2003. In that year, the environmental technology industry was comparable to the sectors "publishing, printing and reproduction" and "rubber and plastics products" in terms of its turnover at the two-digit NACE level.

Innovative strength

- Earlier studies have already found that Austrian producers of environmental technologies are characterised by their willingness to innovate, a finding that was confirmed by this analysis. R&D and innovation activities aim to increase a company's competitiveness. For Austrian enterprises, innovations contributed to an improvement in their competitive standing. SMEs in particular expect their employment to rise over the next years due to their innovation activities. In order to further support this readiness to innovate, targeted technology policy programmes are an interesting tool. Predictable regulations for environmental policy issues are of equal importance to fostering innovation, especially in the field of clean technologies, in order to exploit any first-mover advantage in the coming years.

Framework for producers of environmental technologies

- The framework within which Austrian producers of environmental technologies act has changed considerably over the past few years – both through shifts in environmental issues and through an increasing internationalisation and globalisation of the environmental industry, which also increases the competitive pressure in the sector. When it comes to international competitiveness in trading environmental technologies, Austria presents a differentiated picture. Rising globalisation in this sector is also increasing competition for domestic producers both abroad and at home. This requires an active strategy for internationalisation. In order to access new markets in a globalised environ-

mental industry and identify new opportunities for exports, government assistance is of critical importance. This need was highlighted by an analysis of export barriers. Young and/or small enterprises in particular find the information and transaction costs associated with developing new markets to be very high. Public sector activities to reduce such costs will improve the opportunities for domestic companies to succeed against international competition. With its export and internationalisation strategy, Austria has taken key steps forward. For a medium-term strategy it is necessary to evaluate the support measures so as to ensure their benefit for domestic technology producers.

- The Joint Implementation (JI) and Clean Development Mechanism (CDM) instruments of international climate policy may also be used to develop the prospective markets pinpointed in the market studies, e.g. within the scope of the Austrian JI/CDM programme. This programme could foster a more rapid diffusion of integrated technologies and could be used as an opportunity to direct demand for end-of-pipe technologies towards clean technologies. However, it is not currently possible to quantify the investment potential for such projects. The JI/CDM programme aims not so much to promote the environmental technology industry but rather to identify emission reductions that can be counted towards the Kyoto targets. Nevertheless, public funds used for this purpose should also, to the extent possible, benefit domestic producers of environmental technologies.
- In order to exploit the development potentials offered by the environmental technology industry, it is necessary to strive for an ongoing improvement in the international statistical reporting of this sector.

International trade and competitiveness

- Over the past ten years, the Austrian environmental technology industry has managed to continuously increase its export rate. The share of its turnover obtained abroad (65 percent) now equals that of manufacturing turnover. The domestic market and the EU15 still dominate as markets, but it can be assumed that in the mid term some satiation will be experienced in certain sectors, while others will increase in importance. The latter certainly include the markets of the new EU members, but also, to an increasing extent, countries in Asia. Market studies (e.g. *Helmut Kaiser Consultancy*, 2005) emphasise the importance of the Asian demand for the development of the global market in environmental technologies. The importance of these markets for the Austrian industry has not substantially increased compared to previous studies. Accordingly, there is a need to develop and access these markets, especially when considering that these markets will show an ongoing high demand for end-of-pipe technologies over the next years.
- Within the scope of OECD trade in environmental technologies, Austria has been able to maintain its market share since 1997. However, when measured by two indicators of specialisation in international trade, Austria's position has deteriorated in the recent past.

Up to 2002, Austria enjoyed a higher market share in its trade with environmental goods than in its total trade, but this no longer applied in 2003 and 2004. The international trade analysis also points toward growing import competition. Increased intra-industry trade appears to be the consequence of European steps towards integration and a harmonisation of environmental standards. For Austria to be able to maintain its position as an international competitor and key producer of environmental technologies, it must continually improve the quality of its supply of environmental technologies.

- A strongly competitive environmental technology industry requires a predictable and stable national environmental policy framework. This is of particular relevance for long-term investment projects and innovation activities. Competitive strength also derives from an explicit inclusion of environmental aspects into Austria's research programmes. With the domestic environmental technology industry increasingly directing its focus abroad, international framework conditions – at the EU level as well as in a global context – gain in importance. An active role played by Austria in designing the framework at an international level will increase growth opportunities for domestic producers of environmental technologies.

References

Brundtland Report, Gro Harlem, World Commission on Environment and Development, Our Common Future, Oxford University Press, Oxford, 1987.

ECOTEC Research & Consulting Ltd., Analysis of the EU Eco-Industries, their Employment and Export Potential, A Final Report to DG Environment, Birmingham, 2002.

European Commission, Environmental Technologies Action Plan (ETAP), Simulation von Technologien für nachhaltige Entwicklung: Ein Aktionsplan für Umwelttechnologie in der Europäischen Union, KOM(2004) 38 endgültig, Brussels, 2004.

Eurostat, SERIEE 1994 Version, Environment series method, Brussels-Luxembourg, 1994.

Falk, M., Leo, H., Die Innovationsaktivitäten der österreichischen Unternehmen. Empirische Analysen auf Basis der Europäischen Innovationserhebung 1996 und 2000, Studie des WIFO im Auftrag des Bundesministeriums für Wirtschaft und Arbeit, Vienna, 2004.

Helmut Kaiser Consultancy, Environmental Technologies and markets Worldwide 2004-2005-2010-2015, Summary of the Total Study: Environmental Technologies, Tübingen, 2005.

Jaffe, A.B., Newell, R.G., Stavins, R.N., "Environmental Policy and Technological Change", in: Environmental and Resource Economics, N° 22/2002, p. 41 - 69, Kluwer Academic Publishers, 2002.

Köppl, A., Österreichische Umwelttechnikindustrie, Studie des WIFO im Auftrag des Bundesministeriums für wirtschaftliche Angelegenheiten, Vienna, 2000.

Köppl, A., Österreichische Umwelttechnikindustrie, Branchenanalyse, Studie des WIFO im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft und der Wirtschaftskammer Österreich mit Unterstützung des Dachverbands Energie - Klima und des Bundesministeriums für Wirtschaft und Arbeit, Vienna, 2005.

Köppl, A., Pichl, C., Wachstumsmarkt Umwelttechnologien. Österreichisches Angebotsprofil, Studie des WIFO im Auftrag des Bundesministeriums für wirtschaftliche Angelegenheiten, Vienna, 1995.

Legler, H., Schmoch, U., Gehrke, B., Krawczyk, O., Hg.: Bundesministerium für Bildung und Forschung, Innovationsindikatoren zur Umweltwirtschaft, Studien zum deutschen Innovationssystem, Nr. 2-2003, Niedersächsischen Instituts für Wirtschaftsforschung, Berlin, 2003.

Leo, H., Die Innovationsaktivitäten der österreichischen Wirtschaft. Band 1: Produzierender Sektor, Studie des WIFO im Auftrag von Eurostat und dem Bundesministerium für wirtschaftliche Angelegenheiten, Vienna, 1999.

Messmann, K., Schiefer, A., "Forschung und experimentelle Entwicklung (F&E) im Unternehmenssektor 2002", Statistics Austria, Statistische Nachrichten 6/2005, p. 492 - 515, Vienna, 2005.

OECD, Environmental Goods and Services, An Assessment of The Environmental, Economic and Development Benefits of Further Global Trade Liberalisation, Joint Working Party on Trade and Environment, COM/TD/ENV(2000)86/FINAL, 2000.

ÖGUT, Austrian Society for Environment and Technology, Umweltpolitiken MOE III, Umwelttechnikmärkte der EU-Beitrittsländer in Mittel- und Osteuropa CZ, SK, H, SLO, PL (Februar 2004), Bericht 2004, in Zusammenarbeit mit der Wirtschaftskammer Österreich, Abteilung für Umwelt-, Energie- und Infrastrukturpolitik, und der Kommunalkredit Public Consulting GmbH, Vienna, 2004.

ÖGUT, Austrian Society for Environment and Technology, Umweltpolitiken MOE IV, Umwelttechnikmärkte in Südosteuropa: Umweltpolitiken, –programme und Strategien von Bulgarien, Rumänien, Kroatien, Mazedonien, Serbien und Montenegro, Albanien sowie Bosnien und Herzegowina (Mai 2005), Bericht 2005, 285 Seiten, in Zusammenarbeit mit der Wirtschaftskammer Österreich, der Außenwirtschaft Österreich (AWO) - Ko-Finanzierung von Mitteln der Initiative "Go International", Lebensministerium (BMLFUW, Abteilung Internationale Umweltangelegenheiten) und Bank Austria Creditanstalt, Vienna, 2005.

U.S. Department of Commerce, Office of Technology Policy, The US Environmental Industry, 1998.

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