



Environmental Industry in Bavaria Management Summary

Preface



Global environmental challenges such as climate change, resource scarcity and environmental pollution are calling for new solutions. Many Bavarian companies dedicate themselves to these topics and make an essential contribution for a sustainable and environmental-friendly future through their innovative and excellent products, processes and services. Together, they form the interdisciplinary sector of environmental industry whose diversity lets it penetrate many areas of the economy. Frequently underestimated, this interdisciplinary sector is no longer an economic niche. With almost 4.7 % of the workforce in Bavaria and a turnover of around EUR 51.5 billion, it is one of the key areas of the Bavarian economy besides vehicle construction and mechanical engineering. The innovation potential of this pioneering sector is particularly worthwhile noting.

With sophisticated technologies and high-quality products, the environmental industry sector in Bavaria and Germany as a whole, is also internationally well represented. It is exactly the global markets in the environmental industry sector that are rapidly developing, driven by ecological rethinking and environmental-policy-related incentives. Corresponding megatrends like digitisation act as additional drivers of growth. This growth offers unique chances for the Bavarian economy and now it is vital to continue opening up to emerging markets. Many small and medium-sized enterprises want to expand their international activities and make use of opportunities for global sales. As a high-tech location with diverse and highly specialised companies with keen sense of innovation, well-trained specialists, and excellent research, Bavaria provides outstanding prerequisites for enterprises in the environmental industry.

A handwritten signature in blue ink that reads "Hubert Aiwanger". The signature is fluid and cursive, with a long horizontal stroke at the end.

Hubert Aiwanger

Bavarian State Minister of Economic Affairs,
Regional Development and Energy

Introduction

The environmental industry sector is already permeating the economy of the Free State of Bavaria in many different forms. Environmental industry is an integral part of the economy. On the one hand, this is due to its own economic significance of its employment effects and the economic impulses. On the other, the environmental industry sector has an extremely promising outlook: Against the backdrop of global trends, it can be assumed that the rapid economic dynamics (worldwide average growth in exports of 6.2 % from 2015 to 2025)¹ will continue to rise. There are further development potentials, particularly with regard to international markets.

Global challenges such as climate change, resource scarcity and urbanisation call for new solutions – the environmental industry can make a decisive contribution in this regard. As drivers of growth, corresponding megatrends such as digitisation and social change in values towards sustainability are just as important as environmental-policy-related incentives. By now, the world trade in environmental technologies comprises products from Germany with a volume of more than EUR 400 billion² and in particular, there is strong demand the world over also for products from Bavaria. Germany's share of world trade is currently 13 % (2015).

This study examines the structures and markets of the interdisciplinary sector. First, the characteristics and the economic significance of the environmental industry in Bavaria are elaborated. In this context, the various segments of the interdisciplinary sector are analysed and defined in detail, using key structural features such as workforce, turnover and innovation achieved. In addition, a comprehensive study of international markets is carried out. In addition to the current export linkage of the Bavarian environmental industry, world market trends, the international demand and the potentials of the various international sales markets for further market development are examined.

The analytical approach of the study is based on official economic statistics. This is how a comprehensive and differentiated picture of the environmental sector could be gained.

¹ See Chapter 4.2.3 of the summary of this study.

² Figures on the basis of the calculations made by Prognos in the environmental industry report NRW 2015.

Management Summary

1 Environmental industry: An interdisciplinary sector

The nature of the interdisciplinary sector of environmental industry

Products and services from the environmental industry already have a significant impact on Bavaria's economy. With a share of almost 5% of the total industrial workforce, corresponding sales of more than EUR 50 billion and pleasing future prospects, the environmental industry has a high economic significance in the Free State of Bavaria.

As an interdisciplinary sector, the environmental industry consists of various branches of the economy. In addition to classic areas, such as the recycling and water industry sectors, it also brings together parts of mechanical engineering and other industrial sectors, various service sectors or parts of the construction industry.

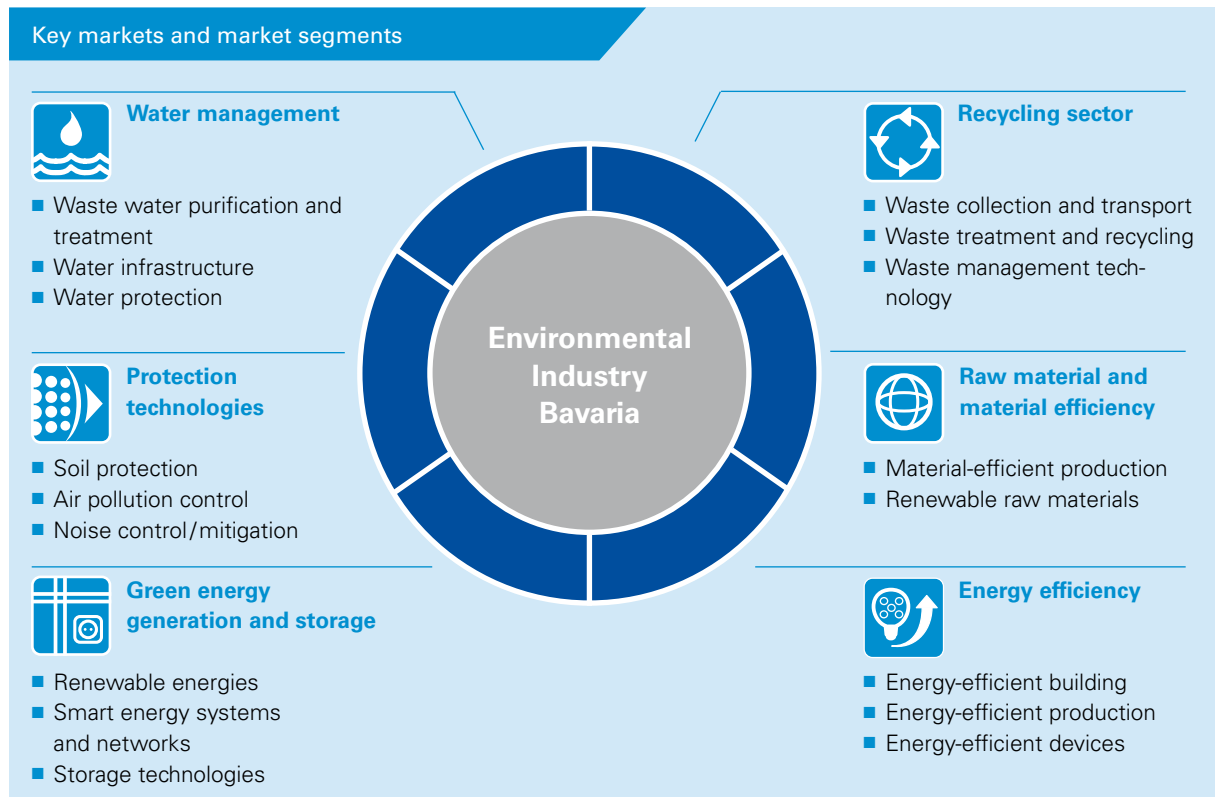
As a technology location with innovative entrepreneurs and excellent research facilities, Bavaria has the opportunity to continue to be economically successful in this interdisciplinary market even in the future – the Bavarian environmental industry is well-positioned.

Distinction and definition of the environmental industry

The environmental industry includes all products and services that bring about a „direct environmental benefit“ and/or represent an „environmentally friendly substitute“. The distinction model, with which the secondary statistics sources can be analysed, is based on this definition of the environmental industry.

Innovative technologies for waste water treatment have, for example, a direct, positive impact on environmental protection. Renewable energies are an environmentally friendly alternative to conventional energy generation. Accordingly, both products are part of the environmental industry. Based on this basic assumption that a product or service of the environmental industry has to yield an environmentally friendly benefit and/or substitutive effect, the interdisciplinary sector is further subdivided into six thematic key markets, comprising different market segments (see Figure 1).

Figure 1: Systematisation of environmental industry in key markets and market segments





The present study examines the significance of the environmental industry in Bavaria and in the international context. Since the environmental industry is not a term in the official classification of industries by sectors and commodity categories, its analysis is more complex compared to classical market analyses.

- Other studies on environmental industry quantitatively approach the topic, but examine only companies, which are classified under the environmental industry according to the self-declaration principle. These include, among others, the environmental industry data, regularly published by the state statistical authorities.
- In further studies, economic indicators of industry structure are deduced on the basis of investments in environmental protection; however, such indicators do not allow conclusions to be drawn on international trade links.
- Some studies also use their own surveys to illustrate the environmental industry. However, their results are subject to the risks of subjectivity and lack of reliability, depending on the sample size.

In contrast to the described approaches, this study examines the complexity of the environmental industry and its key markets in Bavaria, using an innovative distinction model for the analysis of secondary statistics³.

This method allows a detailed depiction of the environmental industry in the Free State of Bavaria as well as its linkage with international market players. The quantitative results are supported by findings from 20 expert conversations with companies from the Bavarian environmental industry.

By the combination of quantitative and qualitative approaches, the importance of the environmental industry in Bavaria can be reliably demonstrated and developed on a continuous basis.

³ Environmental industry model – envigos of Prognos AG.

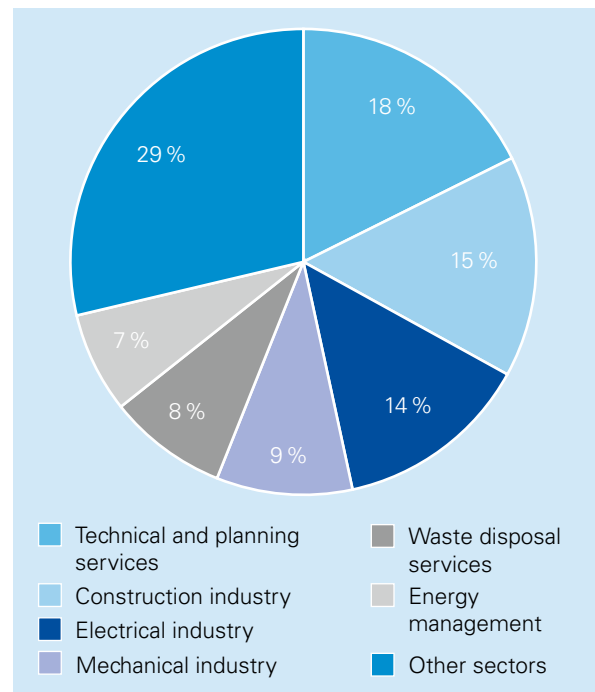
2 Environmental industry: A dynamic growth market

The environmental industry in Bavaria has a dynamic and positive image with regard to the size of the workforce and the sales generated. In a nationwide comparison, the Bavarian environmental industry is second only to North Rhine-Westphalia on average.

The significance of the interdisciplinary sector in Bavaria The environmental industry assumes great importance in Bavaria. In 2015, 4.7 % of the total workforce in Bavaria found employment in the environmental industry, which was even higher than mechanical engineering (3.8 %) and only slightly behind vehicle construction (4.9 %). By far the largest share of the workforce in the environmental industry is employed in the services sector (almost 39 % in total). These especially include technical and planning services, for example, in the areas of energy and material-efficient production as well as supply and disposal services (see Figure 2). Another 35 % is attributable to the manufacturing sector. The electrical and mechanical engineering industries are particularly prominent here. Construction services account for about 25 % of the environmental industry. In addition to the construction industry, this also includes architectural and building design services.

In Bavarian and nationwide comparison, the workforce in this industry recorded above-average growth. While between 2010 and 2015 the average number of employed persons in the Federal Republic of Germany increased by 1.8 % p. a. and 2.2 % p. a. in Bavaria, the workforce in the environmental industry of the Free State of Bavaria increased annually by 3.1 %. The economic significance of the environmental industry is underlined by the turnover of EUR 51.5 billion (5.2 % of the sales volume of the total Bavarian economy). Characterised by the slump in renewable energy technologies, the growth rate of the Bavarian environmental industry is now roughly at the German level. All in all, the business landscape of the environmental industry – similar to the Bavarian economy – is

Figure 2: Structure of the interdisciplinary environmental industry sector in Bavaria, based on the number of persons employed in 2015



characterised by small and medium-sized enterprises. 92 % of the 33,000 companies from the Bavarian environmental industry have fewer than ten employees.

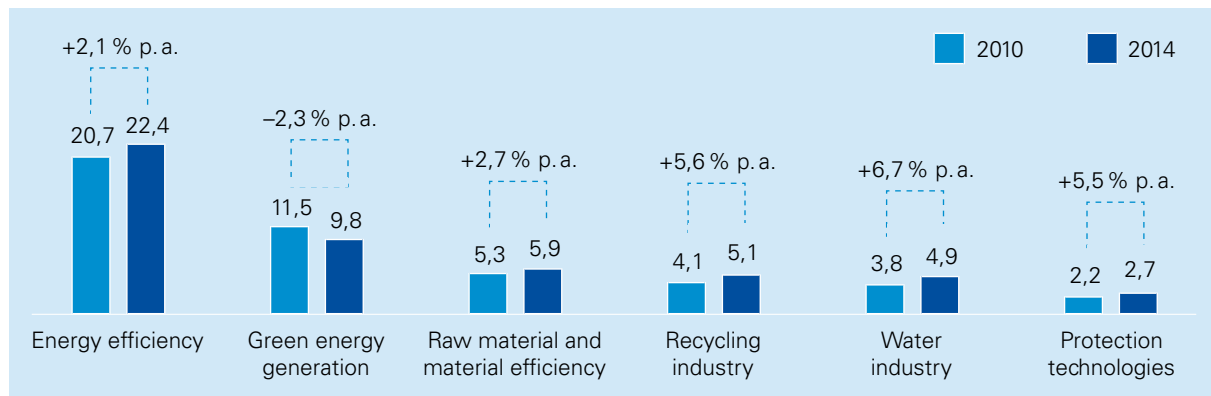
The key markets of the environmental industry in the Free State of Bavaria The economic significance of the six key markets of the environmental industry is very different in Bavaria.

The two energy-related key markets dominate the interdisciplinary sector. Looking at the number of employed persons (2015: 112,000) as well as the companies (2014: 13,000) and their sales (2015: EUR 22.4 billion), energy efficiency is the strongest key market in the Bavarian environmental industry.

Green energy generation ranks second in terms of sales. However, its sales performance shows a marked decline of -2.3 % p.a. From 2010 to 2014, the most dynamic trend was observed in the classical

key markets of recycling and water industry sectors with excellent annual growth rates of 5.6 % and 6.7 % respectively (Figure 3).

Figure 3: Sales of the Bavarian environmental industry by key markets, 2010 and 2014, in EUR billion and growth rate p.a. in %



3 Environmental industry: Driver of innovation in the economy

As a pioneering interdisciplinary sector, the environmental industry needs innovative approaches and technological developments for further growth. Bavaria's ambitions to expand its national and global position in the environmental industry are reflected in the high number of interdisciplinary, international research facilities and projects. In addition, patent activities quantitatively demonstrate the innovation performance.

The research landscape in Bavaria is distinguished by a large number of institutions and initiatives. From excellent basic research to operational cluster work, Bavaria's systematic focus on technology is also apparent in the environmental industry. The Centre for Energy Technology at the University of Bayreuth allows, for example, interdisciplinary research and teaching with research focus on environmental industry. One of many cooperation projects in the Free State of Bavaria is, for example, the initiative of the Bayerisches Zentrum für Angewandte Energieforschung e.V. (Bavarian Centre for Applied Energy Research), the Fraunhofer CSP and E.ON, which jointly study the quality of photovoltaic systems throughout Germany. Other research associations, such as ForCycle, which deal with innovative recycling

processes and technologies, are made up of several university and private institutions and organisations.

The innovation potential of the Bavarian environmental industry is quantitatively demonstrated by the number of patents registered. In Germany, the share of Bavarian patents granted in the key market of green energy generation was around 35 % in 2010 and rose to as high as 40 % by 2014. The share of Bavarian patents in the key markets of protection technologies, recycling, and raw material and material efficiency also rose significantly from 2010 to 2014, while the share of the key market of energy efficiency declined slightly.

In an international comparison, Germany is one of the leaders when it comes to innovation in the environmental industry. In 2014, the Federal Republic's share of globally issued patents varied between 10 % and 14 %, depending on the key market. However, Germany's share has declined since 2010. This is mainly due to increase in the innovation activities of China, Japan and the USA. In the key market of energy efficiency, which is relevant for Bavaria, China has expanded its innovation activities the most.

4 Environmental industry: Bavaria's international market position

Export volume of the Bavarian environmental industry

With an export volume of EUR 8.6 billion, a significant portion of sales of environmental industry commodities is attributed to exports. The share of exports in the turnover of the Bavarian environmental industry is 32 % (services not taken into account). Thus, the degree of internationalisation of the interdisciplinary sector lies behind very strongly export-oriented sectors, such as mechanical engineering (67 %) and vehicle construction (46 %), but ahead of the metal industry (26 %). In terms of total exports of commodities, the Bavarian environmental industry share of 4.5 % is about the nationwide average (4.6 %).

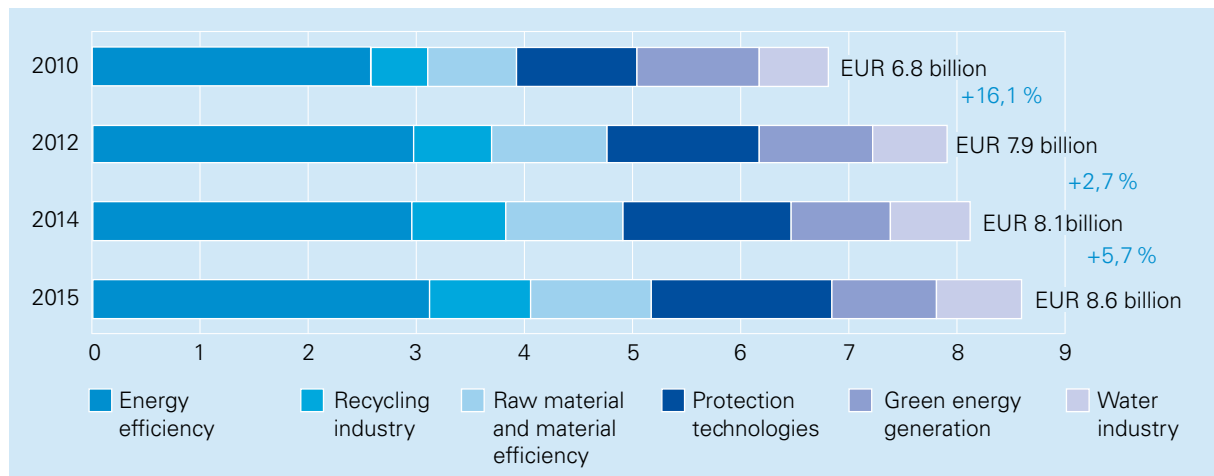
In the past few years, the highest share of the export volume was held by the key market of energy efficiency that is significant for the Bavarian environmen-

tal industry and accounted for 36 % of environmental industry exports by the Free State of Bavaria in 2015 (EUR 3.1 billion). With the exception of the key market of energy generation and storage, exports of the other key markets grew dynamically between 2010 and 2015 (Figure 4). Overall, the environmental industry exports showed a very positive dynamic trend. After the catch-up effect between 2010 and 2012 (16.1 %) and the subsequent consolidation, the development between 2014 and 2015 again shows a growth of 5.7 % in just one year.

Export technologies of the Bavarian environmental industry

The innovation potential of the Bavarian environmental industry is also reflected in the exported technologies. The export of process measuring and control technology⁴, which comprises, among oth-

Figure 4: Export volume of the Bavarian environmental industry from 2010 to 2015, by key markets, in EUR billion and growth in %



4 Process measuring and control technology.

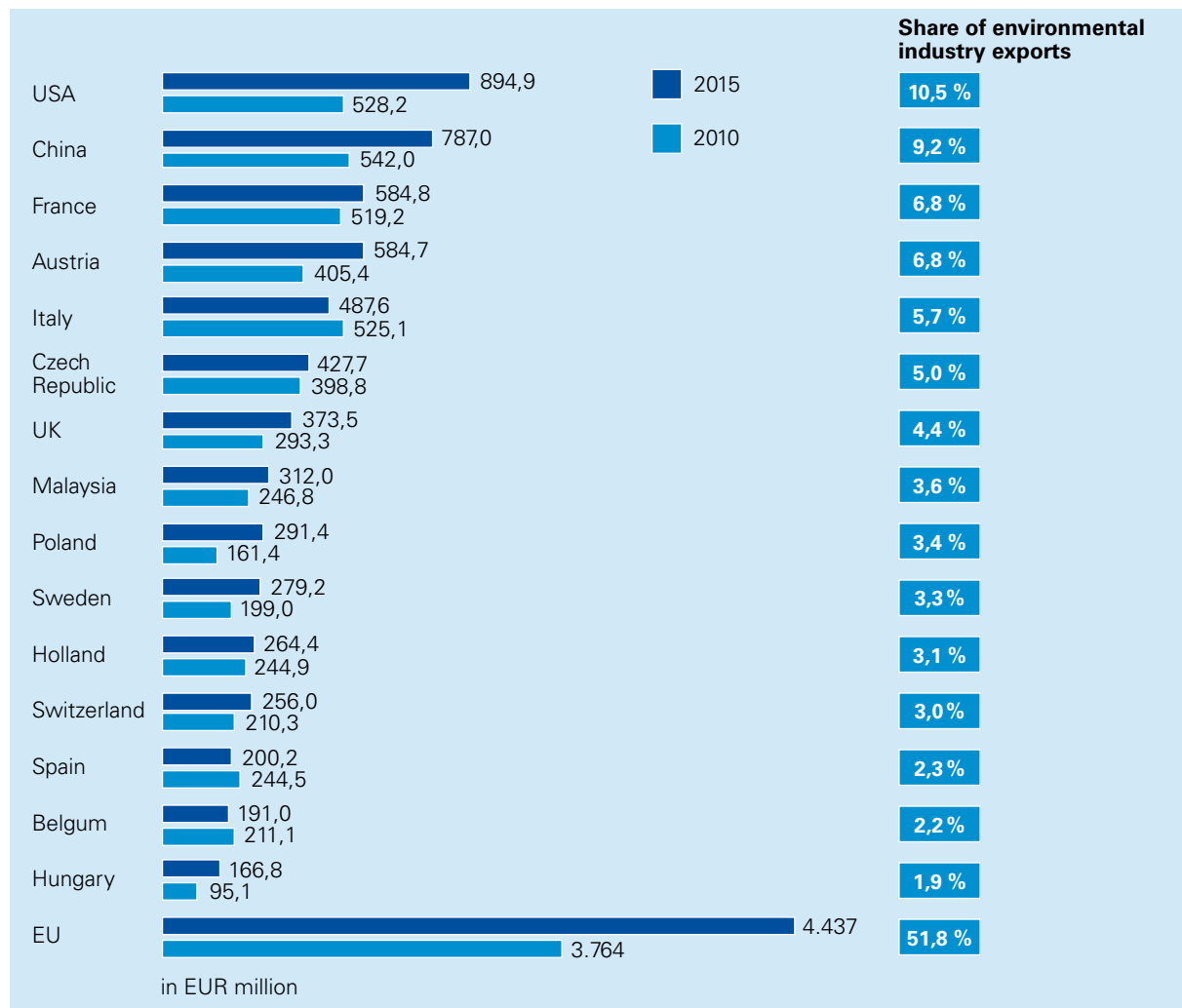
ers, digital networking technologies, filter technology and catalysts as well as energy-efficient building technology (for example, smart home solutions) together account for 30 % of the environmental industry exports. A particularly dynamic trend has been observed in the areas of measuring technology for air pollution control, material recycling and the machine-construction-related process technology for waste management since 2010. Solar technology alone recorded an export decline by 14.2 % between 2010 and 2015.

USA and China. With EUR 850 million, USA accounts for 10.5 % of the export volume and with EUR 787 million, China accounts for 9.2 % thereof. However, the Member States of the EU together constitute the most important sales market. Nearly 52 % of the commodities from the Bavarian environmental industry are exported to this region. With the exception of Italy, Spain and Belgium, exports to the 15 main sales markets have increased dynamically since 2010. The following figure shows the export volumes of the Bavarian environmental industry.

Largest sales markets of the Bavarian environmental industry

The largest single markets for the export commodities from the Bavarian environmental industry are

Figure 5: The 15 largest sales markets in the Bavarian environmental industry, export volumes in 2010 and 2015, in EUR million as well as their share of the total environmental industry exports in 2015 in %



5 Environmental industry: Dynamics of global markets

Global trend

The export of environmental industry commodities has more than tripled from USD 117 billion to USD 411 billion between 1995 and 2015. Similar to the Bavarian domestic market, the export of energy efficiency commodities accounts for the largest share of the global export volume (2015: USD 120 billion). In relative terms, the key market of green energy generation and storage with a growth rate of just under 8 % p. a. is the highest, as can be seen in Figure 6.

The analysis of changes in the export of environmental industry commodities shows a sharp increase in the NIC group (Newly Industrialised Countries), which recorded an average growth rate of 15 % over the last two decades – China by as much as 20 %. By contrast, the industrialised countries increased their export of environmental commodities by 4 % per year on average during the period analysed.

The increased importance of NIC in the environmental industry is also apparent when looking at the world trade shares. While industrial countries accounted for 91 % of world trade in 1995, it was only 61 % in 2015.

The People's Republic of China was able to expand its formerly insignificant market share in the world trade of environmental industry commodities in the same period to 21 % in 2015. Even if the share has fallen from 15 % to 13 %, Germany is still the only European country to be represented in the group of the six largest exporters.

Compared to the situation in Bavaria, the key markets differ in the individual countries (see Figure 7). The focus of China on the areas of green energy generation and storage as well as energy efficiency is clearly visible. Germany is the world market leader in the water industry sector, while Mexico, France and the Netherlands are more focused on the key market of raw material and material efficiency.

Overall, the environmental industry accounts for 3.7 % of world trade, while it accounts for 4.6 % of Germany's exports. The 8 % share of environmental industry commodities in Denmark's total exports is most significant in relative terms.



Figure 6: Global exports of environmental industry commodities, divided into six key markets, in 1995 and 2015, in USD billion

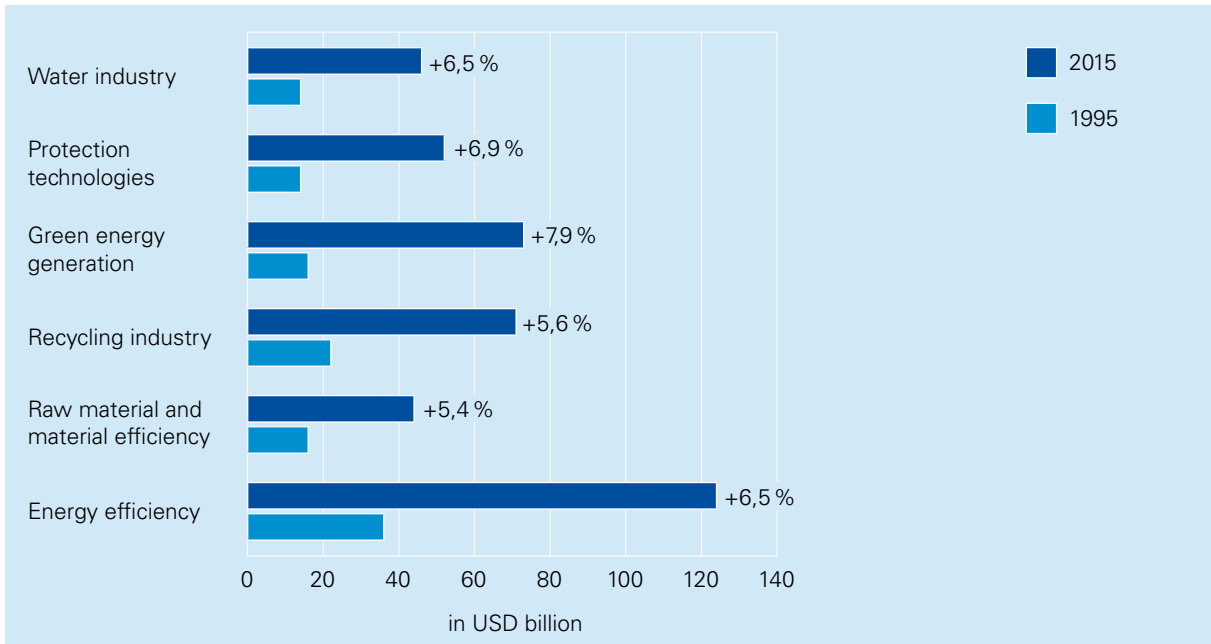


Figure 7: Export of environmental industry commodities by the 15 largest exporters, breakdown by key markets, in 2015, in USD billion

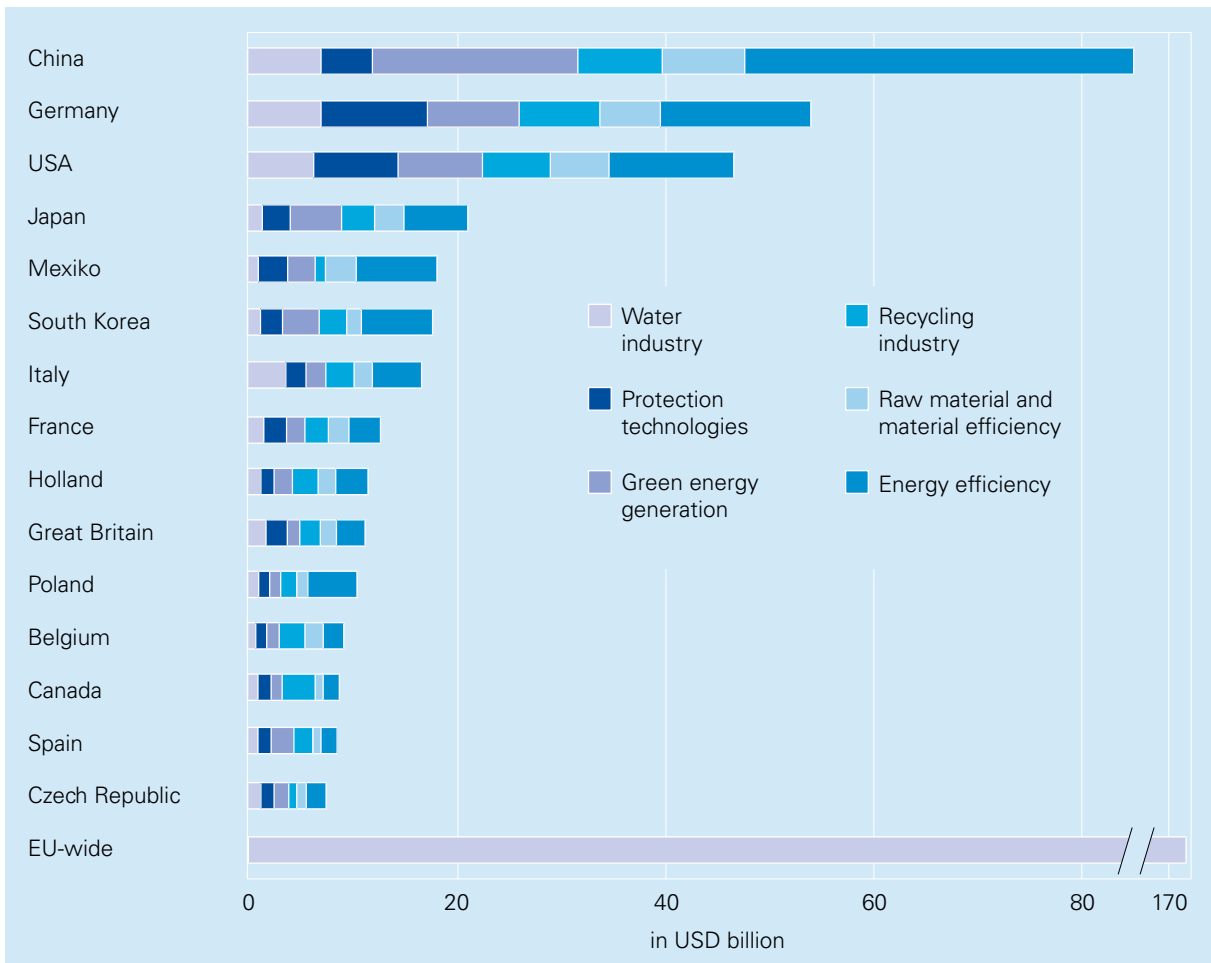
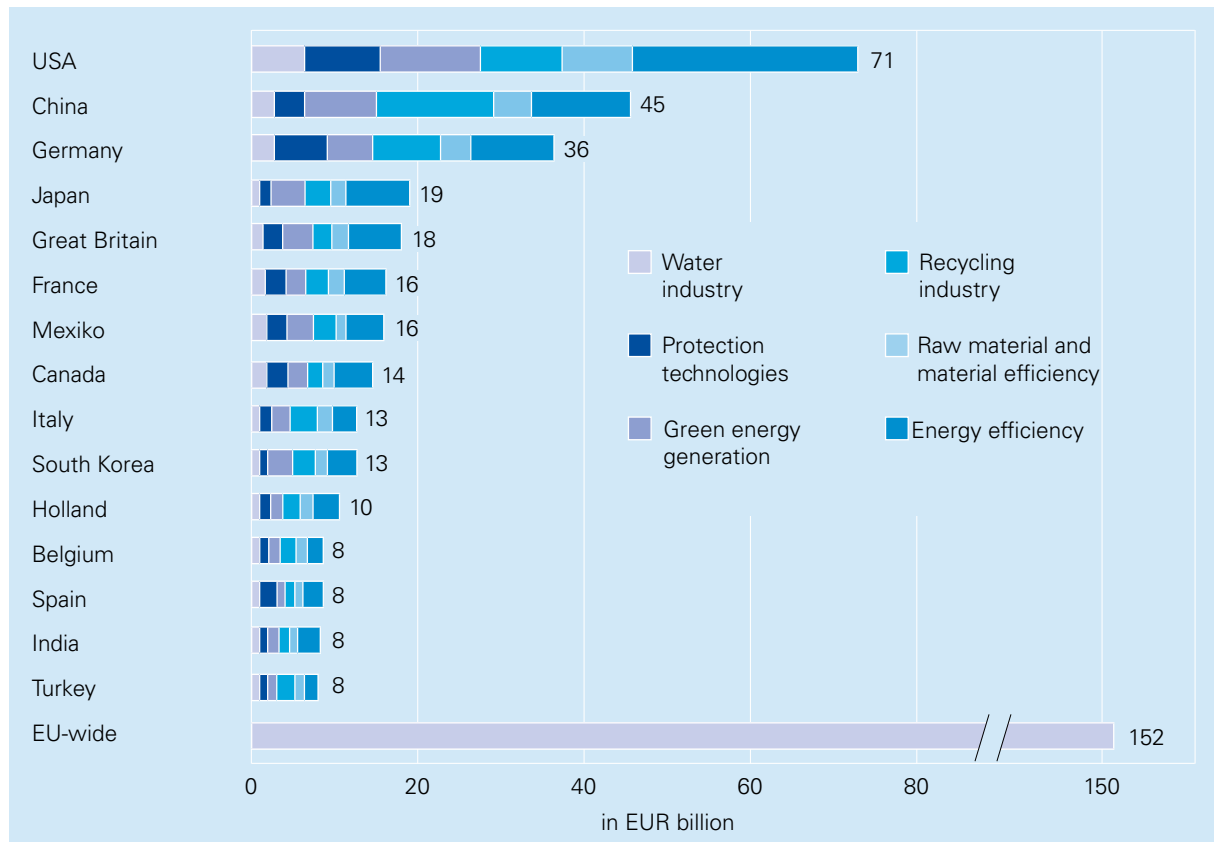


Figure 8: Import of environmental industry commodities by the 15 largest importers, breakdown by key markets, in 2015, in USD billion



International demand

The demand trend in the environmental industry sector corresponds to the observed trend in the world trade. While China is the largest supplier, USA is the world's leading importer of environmental industry commodities worth more than USD 70 billion. China imported goods worth USD 45 billion in 2015 and Germany USD 36 billion. Thus, countries such as China and Germany have a high foreign trade surplus and the USA a foreign trade deficit in the environmental industry. The high US and Chinese demand for environmental industry commodities on the world market should not mislead the fact that the countries of the European Union in total⁵ import significantly more than the two largest single countries combined. The EU is the largest sales market for companies from Germany and Bavaria (Figure 8).

The volume of imports is the most significant demand parameter in terms of international trade. Fur-

ther insights into the extent of the environmental industry markets in the individual countries can be obtained from the respective domestic market volumes of the countries. Measured by this parameter ([own production + imports] - exports), China ranks first, followed by the United States of America, Japan and Germany. This ranking that deviates from the import points to protectionist attitudes of the national economies. While the US imports many commodities to meet domestic demand, countries like China or Japan are characterised by high production to meet the domestic demand, and relatively low import.

Perspective of the environmental industry till 2025

Using the Prognos economic outlook and the Prognos world trade model, the import and export trends of the individual countries can be estimated till 2025.

⁵ Internal trade between EU countries is also included.

According to this, the global export volume of environmental industry commodities will increase by more than 80 % to around USD 750 billion by 2025. However, this assessment is based on the premise that free trade is not restricted to a greater extent by protectionist trade barriers. In terms of import trends, USA with a predicted import growth of 6.0 %

and China 6.8 % remain the main consumers of environmental industry commodities. India, Spain and South Korea also show a high growth rate. The average projected growth of 5.8 % in the demand for imports by all countries will lead to future growth potential for the Bavarian environmental industry.

6 Environmental industry: From the perspective of Bavarian companies

The focus of the present study is to present the environmental industry in Bavaria, as well as its linkage in an international context, using a complex distinction model. Market potentials and prospects for companies from the Bavarian environmental industry are also identified. The quantitative approach was extended by holding 20 expert conversations with companies from the Bavarian environmental industry. The results obtained may not have any statistical significance due to the sample size, but provide further insights into the international market trend, the characteristics of the corresponding sales markets, market drivers and obstacles.

According to the statements by the surveyed company representatives, growing environmental problems, increased environmental awareness in politics and society as well as suitable legal framework conditions are the main drivers of the demand for environmental commodities on international markets. Companies see barriers primarily in political changes, sanctions, lack of legal enforcement, import duties and transport costs. Moreover, linguistic and cultural differences were also often regarded as trade barriers, depending on the country in question.

In order to improve their own market position abroad, all surveyed companies have already availed support services from the Bavarian foreign trade promotion initiative or the Bavarian environmental cluster.

From the companies' perspective, the network of Bavarian representative offices abroad is one of the most effective tools of foreign trade promotion.

Furthermore, services offered by Bayern International such as joint participation at trade fairs or events for establishing contacts and setting up networks were also rated as particularly successful. Many companies use services offered by the German Chambers of Commerce abroad, Bayern Innovativ and the Bavarian foreign trade centre. Delegation and business trips as well as the reception of foreign delegations in Bavaria were mentioned as an interesting and helpful opportunity for exchange. A challenge here lies in maintaining the established contacts. Complementary support was suggested in areas such as the certification of products abroad or a programme for the promotion of young professionals. There is also a need for awareness-raising and lobbying on environmental issues and the relevant legal framework in the target countries (for example, via the Capacity Building Programmes).

The Bavarian environmental cluster enjoys a very high level of trust, since it is already known and appreciated both at home and abroad. The existing cluster network is found helpful here. In this network, companies are active themselves in working groups and specialist events. In this way, partner companies could be found in order to exchange information on country-specific challenges and to acquire common customers.