Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

German Resource Efficiency Programme (ProgRess)

Programme for the sustainable use and conservation of natural resources

IMPRINT

Decision of the Federal Cabinet of 29 February 2012

Compiled pursuant to Cabinet decision of 20 October 2010 on the German Government's Raw Materials Strategy, based on the National Sustainability Strategy "Perspectives for Germany" of 17 April 2002 and the "Thematic Strategy for the Sustainable Use of Natural Resources" of the Commission of the European Union of 21 December 2005.

IMPRINT

Published by: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
Division WA III 1 · 11055 Berlin · Germany
Email: WAIII1@bmu.bund.de · Website: www.bmu.de/english

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Text: Federal Environment Agency (UBA)

Design: design_idee, büro_für_gestaltung, Erfurt
Printed by: Bonifatius GmbH, Paderborn

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Date: May 2012
First Print: 2,000 copies

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SUMMARY

The current use of natural resources is already far exceeding the Earth's regenerative capacity. A responsible and efficient use of natural resources will therefore be a key competence for any society seeking to ensure its future viability. Improving resource efficiency can limit environmental damage, strengthen the competitiveness of the German economy, create new jobs and secure long-term employment. Therefore, on 29 February 2012, the Federal Cabinet adopted the German Resource Efficiency Programme (ProgRess). With this, the German government implemented the decision in its Raw Materials Strategy of 20 October 2010 to develop a national resource efficiency programme. This paper provides an overview of the key elements of ProgRess.

1. Background information

Natural resources, especially raw materials, are key production factors and are therefore at the heart of our prosperity. More than 68 billion tonnes of raw materials were used worldwide in 2009. This is around one third more than in 2000, two thirds more than in 1990 and about twice as much as at the end of the 1970s. With a projected world population of more than 9 billion people in 2050 and rapid economic growth in newly industrialising countries, demand for raw materials continues to rise strongly. Per capita raw material consumption is currently around four times higher in industrialised nations than in less developed countries.

This is a major challenge from an economic, ecological and social perspective. Rising and volatile raw material prices and supply risks present a heavy burden for the German economy. It is becoming increasingly difficult to obtain some key raw materials such as crude oil, cobalt and heavy rare earths from readily accessible sources. At the same time, resource use has impacts on the environment across the entire value chain, ranging from the release of greenhouse gases and inputs of pollutants into the air, water and soil to adverse effects on ecosystems and biodiversity. The current use of natural resources is already far exceeding the Earth's regenerative capacity.

A responsible and efficient use of natural resources will therefore be a key competence for any society seeking to ensure its future viability. Germany is in an excellent position to lead the way in the necessary global transformation towards a resource-efficient economy. Improving resource efficiency can limit environmental loads, strengthen the competitiveness of the German economy, create new jobs and secure long-term employment.

Germany is willing to take on a pioneering role internationally by proving that resource efficiency in a highly developed country can be increased without a detrimental impact on prosperity while at the same time reducing raw material consumption. Germany can already demonstrate increased economic performance with reduced resource use: While there was strong economic growth during the years 2000 to 2010, resource consumption decreased by 11.1 percent.

As early as in 2002, the German government in its National Sustainability Strategy laid down the goal of doubling raw material productivity by 2020 compared with 1994. This goal makes Germany an international pioneer. The German Resource Efficiency Programme aims to contribute to reaching it.

2. Programme content and goal

The goal of the German Resource Efficiency Programme is to make the extraction and use of natural resources more sustainable and to reduce associated environmental pollution as far as possible. By doing this we want to live up to our responsibility to future generations and create a prerequisite for securing a high quality of life for the long term.

The German government is striving to decouple economic growth as far as possible from resource use, to reduce the burden on the environment and to strengthen the sustainability and competitiveness of the German economy, thus promoting stable employment and social cohesion. Resource efficiency policy will help us meet our global responsibility for the ecological and social impacts of resource use. Our goal must be to reduce the use of resources.

In this context, ProgRess deals with raw materials. The focus is on abiotic, non-energetic resources, supplemented by the material use of biotic resources. The use of raw materials is connected to the use of other natural resources such as water, air, land, soil, biodiversity and ecosystems. However, as these resources are already covered by other programmes, processes or legislation, they are not addressed in any detail by ProgRess.

ProgRess gives an overview of numerous existing activities and describes approaches and measures for increasing resource efficiency. It covers the entire value chain.

3. Contents and measures

ProgRess is based on a draft text by the Federal Environment Agency (UBA). It is divided into three parts: basic programmatic statements, strategic approaches along the entire value chain and specific examples. Proposals for government measures are made for the strategic approaches and examples. An annex lists activities already being carried out by the German government, the Federal Länder and associations and institutions in the field of resource efficiency.

The first part of the programme analyses the **opportunities and potential of resource efficiency** in Germany and worldwide. It sets out **guiding principles and objectives** as well as potential indicators that can be used to measure progress in improving resource efficiency.

The German Resource Efficiency Programme is shaped by four guiding principles:

- **Guiding principle 1:** Joining ecological necessities with economic opportunities, innovation support and social responsibility
- **Guiding principle 2:** Viewing global responsibility as a key focus of our national resource policy
- **Guiding principle 3:** Gradually making economic and production practices in Germany less dependent on primary resources, developing and expanding closed cycle management.
- **Guiding principle 4:** Securing sustainable resource use for the long term by guiding society towards quality growth.

Open-cast lignite mine "Welzow Süd"

The **second part** of the programme contains **specific measures** on the basis of an analysis of the entire value chain. Five strategic approaches are considered:

- Securing a sustainable raw material supply
- Raising resource efficiency in production
- Steering consumption towards resource efficiency
- Enhancing resource-efficient closed cycle management
- Using overarching instruments.

A total of **20 strategic approaches** are identified and underpinned with measures. The programme attaches particular importance to market incentives, information, expert advice, education, research and innovation and to strengthening voluntary measures and initiatives by industry and society. Examples include measures for strengthening efficiency advice for small and medium-sized enterprises, supporting environmental management systems, taking greater account of resource aspects in standardisation processes, placing greater focus on the use of resource-efficient products and services in public procurement, strengthening voluntary product labelling and certification schemes, enhancing closed cycle management and increasing the transfer of technologies and knowledge to developing countries and emerging economies.

The **third part** of the programme presents eleven **examples** of material flows, areas of life and technologies that are particularly relevant for the chosen strategic approaches and specify them in more concrete terms. Examples include sections on bulk metals, rare and strategic metals, future technologies such as photovoltaics and electric mobility, but also on sustainable construction, which is an especially significant sector for the resource balance, and the closed-cycle management of plastic waste.

An **annex** to ProgRess details activities by six Federal ministries, the Federal Länder and 24 associations and institutions in the field of resource efficiency. The annex is designed as a 'living document' that will be supplemented in the coming months.

4. Procedure

The Federal Environment Ministry BMU carried out a broad consultation process in the first half of 2011 involving meetings, talks and events. Detailed discussions on ProgRess were held with experts and representatives of civil society, associations and the Länder in the course of nine meetings at working level, two conferences by the Resource Efficiency Network and numerous individual meetings; participation by the general public was ensured through internet consultation. Around 100 written opinions and contributions from associations, civil society and the scientific sector have been incorporated into the programme.

When it adopted ProgRess on 29 February 2012, the German government decided that it will report every four years on the development of resource efficiency in Germany, assess progress and develop the Resource Efficiency Programme accordingly. On 8 March 2012, the Bundestag passed a resolution to support the work on ProgRess and requested a report every four years.

By launching ProgRess, the German government is joining European efforts. The European Commission has devoted one of the seven flagship initiatives under the Europe 2020 strategy to the goal of creating a resource-efficient Europe and adopted a detailed roadmap on this in September 2011. In doing this the Commission has reinforced its call to the member states to draw up national resource efficiency programmes. With ProgRess, Germany is one of the first European countries to present a comprehensive resource efficiency programme.

5. Outlook

The German Resource Efficiency Programme does not mark the end; it is in fact the beginning of a process in policymaking, science and society. Implementing the measures contained in ProgRess will require a high level of self-initiative and activities by many social actors, close cooperation between politics, industry, science and civil society as well as the commitment of the German public. The programme aims to provide sound and long-term orientation for all stakeholders. Implementing this programme will contribute to the conservation of the ecological foundations of life, economic growth and long-term employment, and will safeguard the prospects of prosperity for future generations.

PART I: GENERAL INFORMATION ON THE PROGRAMME

1. Resource efficiency – challenge and opportunity

Natural resources are the Earth's natural capital and the basis for all economic activity. Without natural resources such as raw materials, soil, water and air we can neither meet our daily needs for life nor create prosperity. Global use of resources has taken a course which cannot be maintained in the long term without affecting the prospects of future generations for economic prosperity and social cohesion. Even today, the use of natural resources considerably exceeds the planet's regeneration capacity.[1]

This is not only an ecological, but also an economic and social challenge: natural resources, especially raw materials, are important production factors and hence the basis for our prosperity. There are limits to the extent they can be replaced. At the same time, however, the use of raw materials in the entire value chain – from extraction through processing and use to disposal – gives rise to environmental pressures which can range from the release of greenhouse gases, through emission of pollutants into air, water and soil, to harmful impacts on ecosystems and biodiversity.

A large proportion of natural resources are only available on a limited scale and are not renewable. For example, a number of important raw materials, such as oil, cobalt and certain heavy rare earths[2] are becoming increasingly difficult to obtain from readily accessible sources. Price increases and price fluctuations, which are exacerbated by growing demand, speculation and political intervention, and uncertainty about the availability of raw materials can affect economic and social development in both the exporting and the importing countries.

United Nations estimates indicate that the world's population will grow from the present 7 billion to over 9 billion people by 2050. Population growth and increasing prosperity in newly industrialising and developing economies will give a further boost to the demand for raw materials, food and energy. Per capita consumption of raw materials is currently about four times greater in the industrialised countries than in less developed countries.

Reducing the consumption of resources and materials is one of the central challenges of a sustainable society in the 21st century.[3] But this challenge also offers great opportunities. It is up to us to pave the way for future generations to live in a world where economic prosperity for all goes hand in hand with social cohesion and the conservation of the natural basis for life.

Sparing and at the same time efficient management of natural resources will be a key competence of societies with a viable future. In the necessary process of global change, Germany is in an excellent position to lead the way towards resource-efficient management and become one of the world's most resource-efficient economies: contributory factors include innovative strength, a modern industrial structure, ambitious environmental standards and a population with a great awareness of the need for sustainability. Thus improving resource efficiency can become a German hallmark, strengthen the competitive position of the German economy, create new jobs and safeguard employment on a sustainable basis.

1 National Sustainability Strategy, Progress Report 2012, p. 17.
2 The heavy rare earths are yttrium (Y), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu).
3 National Sustainability Strategy, Progress Report 2012, p. 190.

Rotary excavator in open-cast lignite mining

1.1 Combining diverse activities: a programme for resource efficiency

The extensive and interlinked ecological, economic and social challenges and opportunities of resource utilisation call for the German government to adopt a broadly based programme for the sustainable use and conservation of natural resources. In its resource strategy of 20 October 2010 the German government therefore decided to develop a National Resource Efficiency Programme which "aims in particular to minimise adverse effects of raw materials extraction and processing on environmental media".

The German Programme for Resource Efficiency (ProgRess) which is presented here provides an overview of existing activities, identifies needs for action, and describes approaches and measures for improving resource efficiency. As long ago as 2002 the German government, in its National Sustainability Strategy, set itself the target of doubling Germany's resource productivity by 2020 compared with 1994. This target makes Germany an international pioneer. ProgRess is designed to help achieve this target of the Sustainability Strategy.

It focuses first of all on abiotic, non-energy raw materials and the use of biotic resources as material.

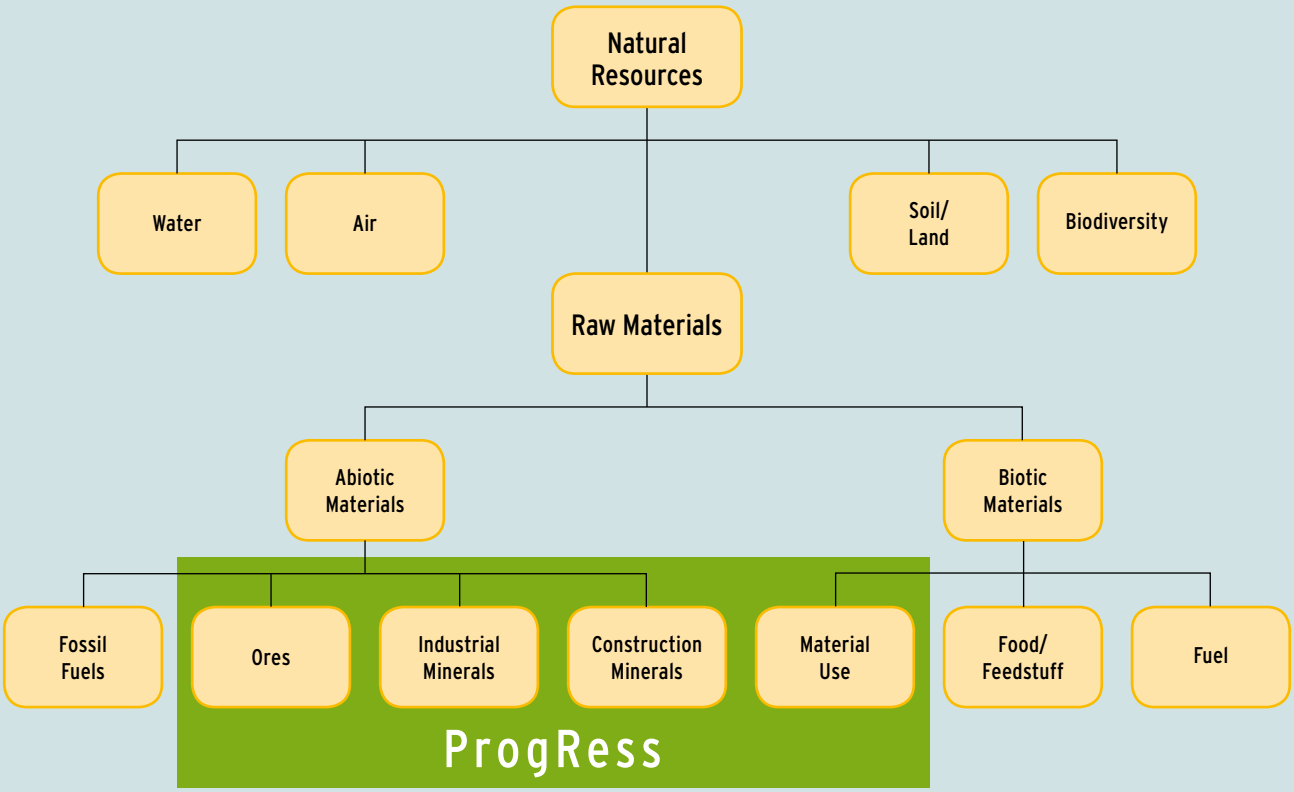
Successful implementation of the measures described in ProgRess will require a high degree of initiative and activity on the part of numerous social actors, and hence close cooperation between politics, industry, research and a wide range of social groups – in other words participation by the entire population. The programme is intended to provide all actors with a soundly based long-term framework of guidance on the goals and priorities of sustainable use of resources. The implementation of ProgRess is intended to contribute to conserving the ecological basis of life, to economic efficiency, employment and social cohesion, and to international equity.

The programme is to be financed within the limits of the approved budget and the medium-term financial plans. This applies to both income and expenditure. Regular evaluation and updating is planned to ensure the progress and success of the National Resource Efficiency Programme. The Federal Statistical Office will provide annual information on the development of the indicators. Every four years, the German government will report on the development of resource efficiency in Germany, evaluate the progress made, and develop and update the programme.

1.2 Focus of the programme: efficient management of raw materials

This programme focuses on improving resource efficiency and responsible resource management in the use of abiotic raw materials that are not used primarily for energy production (ores, industrial minerals, construction minerals). In order to take better account of opportunities for substitution between abiotic and biotic resources, biotic raw materials are included where they are used as materials. It looks at the efficient and sparing use of resources, and also reductions in resource inputs and the related environmental pressures.

Figure 1: Resources treated in ProgRess [4]



Source: ffu/IFOK commissioned by the BMU

The use of raw materials is closely connected with the use of other resources such as water, land/soil, air, biological diversity and ecosystems. However, the prevention or avoidance of environmental pressures arising from the use of these resources is already the subject of other extensive strategies and processes. For this reason they are not discussed in depth in this resource efficiency programme. A brief description of interfaces is given below.

As the programme is updated, the German government will consider whether there are grounds for gradually expanding the programme and including other resources. Care will be taken to ensure consistency with other strategies of the German government.

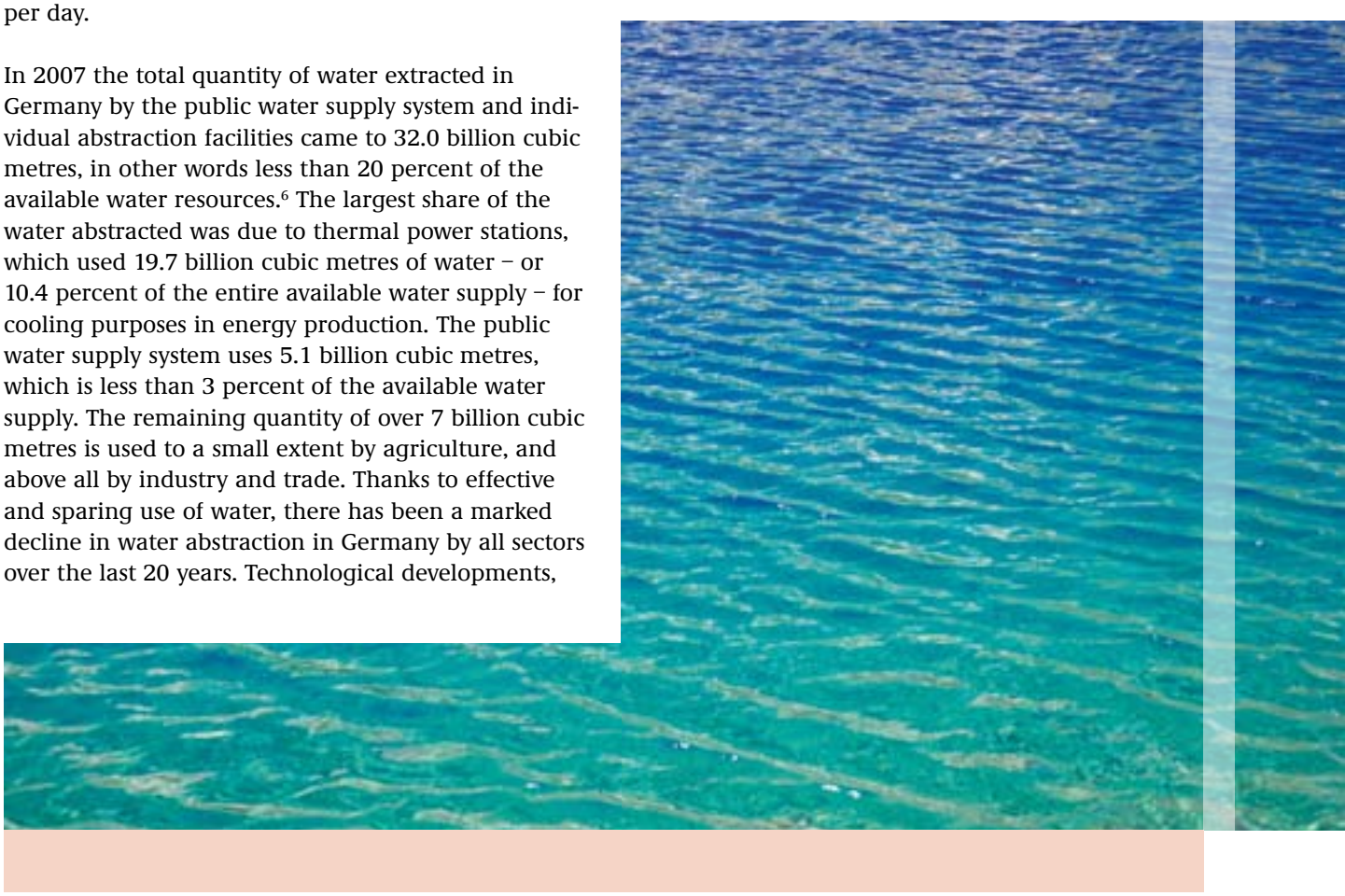
4 Diagram based on the research project: "Environmental strategy development – Sustainable management of political environmental goals and strategies" (ffu/IFOK for the Federal Environment Ministry).

1.3 Other resources and their uses

Water

With an available water supply[5] of 188 billion cubic metres, Germany is a water-rich country. This means there is about 2,300 cubic metres of usable water available every year per capita of the population of roughly 82 million. This corresponds to a potential water quantity of approximately 6,300 litres per capita per day. This contrasts with an average private drinking water consumption of 122 litres per capita per day.

In 2007 the total quantity of water extracted in Germany by the public water supply system and individual abstraction facilities came to 32.0 billion cubic metres, in other words less than 20 percent of the available water resources.[6] The largest share of the water abstracted was due to thermal power stations, which used 19.7 billion cubic metres of water – or 10.4 percent of the entire available water supply – for cooling purposes in energy production. The public water supply system uses 5.1 billion cubic metres, which is less than 3 percent of the available water supply. The remaining quantity of over 7 billion cubic metres is used to a small extent by agriculture, and above all by industry and trade. Thanks to effective and sparing use of water, there has been a marked decline in water abstraction in Germany by all sectors over the last 20 years. Technological developments, multiple-use and closed-cycle systems have resulted in a reduction of more than 30 percent in water abstraction since 1991. From a national point of view, therefore, there are no shortage problems with regard to water as a resource, and on the whole there is unlikely to be any fundamental change in this situation as a result of climate change.



5 Available water supply means the quantity of freshwater from the natural hydrological cycle that is available for use in a specified period. The available water supply is calculated from the quantities of precipitation and evaporation and the balance of inflows and outflows.

6 "Öffentliche Wasserversorgung und Abwasserbeseitigung" ("Public water supply and wastewater disposal") – FS 19 R. 2.1; Fachserie 19 Reihe 2.1 – 2007; Federal Statistical Office (2007).

In spite of the generally adequate water supply, however, there are – even in Germany – regionally limited areas with only small usable quantities of groundwater and surface water. Shortages can occur as a result of seasonal fluctuations in precipitation and evaporation and variations in demand for water. Nevertheless, appropriate abstraction and distribution systems make it possible at present to ensure adequate supplies to meet water requirements for the various uses within Germany.

In recent years there has been a greater focus on the effects on water resources of the growing international trade in the course of globalisation and the increasing international division of labour. The "external water footprint" of a country, in other words the quantity of water that the country consumes through its imports and makes available through its exports, has become an issue for discussion as an additional criterion for sustainability in relation to water resources. The water footprint concept seeks to cover in the entire consumption of water resources (for example including evaporation from irrigation farming, and water quantities polluted by production processes). The largest shares of this "virtual" water are imported by Germany through agricultural produce from Brazil, the Ivory Coast and France[7]. By contrast, it exports water via agricultural produce, for example meat or grain, to regions that are short of water (North Africa or China).

The water footprint concept makes it clear that because of the international exchange of goods and services, part of the consumption of water resources takes place outside the country. It also indicates the direction and scale of these "virtual water flows". This can help to develop options for sustainable use of renewable water resources for regions where the use of water has adverse ecological and social impacts due to exports of virtual water. Regions short of water could use imports of food to conserve their own scarce water resources. As a result, possible solutions are the province of bilateral and multilateral cooperation aimed at developing and implementing such options in the countries of origin.

Further discussion of the topic of "Water" is also found in other contexts, for example the National Strategy for Adaptation to Climate Change[8].

7 "Der Wasserfußabdruck Deutschlands" ("Germany's Water Footprint"); WWF Deutschland (2009); Table 2; page 14, www.wwf.de/fileadmin/fm-wwf/pdf_neu/wwf_studie_wasserfussabdruck.pdf.

8 www.bmu.de/klimaschutz/anpassung_an_den_klimawandel/doc/42781.php

Soil and land

Soil is the basis for the life of humans, animals and plants, and is a resource of great importance for a country's economic development. Soil is the basis for agriculture and forestry, a source of mineral resources and fuels, and a basis for settlement, recreation, transport, supply and disposal, and other uses. At the same time it performs a large proportion of material conversion and degradation functions in the natural regime and serves as a filter and reservoir for the water and materials balance.

In view of the nature and intensity of land use and the impacts of climate change, conservation of the soil and its natural functions calls for special attention. If no precautionary measures are taken, humus reduction, soil compaction, wind and water erosion, substance inputs and surface sealing have adverse impacts on valuable resources and seriously interfere with the natural balance and the carbon cycle.

The complexity of soil as an ecosystem makes it necessary to take adequate account of soil conservation aspects in all relevant policy areas. Protecting the soil from harmful changes and maintaining and sustainably improving its productivity are tasks of great importance to society.

Another problem is the considerable consumption of new land for settlement and transport purposes (land take). A substantial proportion of such land is affected by surface sealing. This results in the disappearance of fertile arable land and near-natural areas with their typical biological diversity. Surface sealing results in the long-term loss of natural soil functions. In many cases the fragmentation of biotopes results in isolated areas that are too small to provide full support for species diversity.

Land is a finite good, a potential for future generations. In its National Sustainability Strategy and the National Strategy on Biological Diversity, the German government has therefore set itself the target of reducing land take for settlement and transport to 30 hectares per day by 2020. Although there are already signs of a reduction in daily land take (the rolling four-year average fell from 129 hectares for the period 1997–2000 to 87 hectares for the period 2007–2010), the current figure is still far from meeting the target. In order to implement the strategies mentioned above, the German government is therefore aiming to strengthen and make rigorous use of planning and economic instruments to reduce land take. Changes are to be made to the Federal Building Code (Baugesetzbuch – BauGB) to provide local authorities with planning instruments and give them incentives to strengthen their internal development and avoid designating new land for settlement and transport purposes in non-built-up areas. Furthermore, the German government is currently preparing a nationwide model experiment with interested municipalities to test a trading scheme with zoning certificates limited in line with the 30-hectare target.

The topics "Soil" and "Land" are covered by the National Sustainability Strategy and the National Strategy on Biological Diversity. The conservation of soil and land in Germany is also constantly updated in the relevant fields of legislation.

Air

Air is an environmental medium that is affected by inputs of substances associated with raw materials extraction and consumption. Atmospheric oxygen in particular is used, for example in all forms of combustion, and in certain chemical processes atmospheric nitrogen is used as well. On the other hand photosynthesis forms not only biomass, but also corresponding amounts of oxygen. Clean air is of vital importance for the life of humans, animals and plants.

In Germany comprehensive rules on the avoidance or minimisation of pollutant inputs into the air are laid down in the Federal Immission Control Act (Bundes-Immissionsschutzgesetz) and its more specific sub-statutory regulations. Firstly, it imposes requirements for maintaining and improving air quality by means of air quality standards and air quality monitoring and improvement measures, especially air quality control plans. And secondly it lays down, both for installations which require authorisation and for installations which do not, requirements aimed at avoiding or severely limiting air pollution.

These regulatory requirements directly serve the purpose of air quality control, in other words avoiding or limiting inputs of pollutants into the air. But they also have an indirect positive effect on reducing resource consumption. Use of the best available technology for air quality control usually helps the plant operator to make efficient use of resources. It is not necessary to include air as a resource in the Resource Efficiency Programme.

Biological diversity

Sustainable use of biological diversity provides long-term security for the needs of present and future generations. Water resources, soil and air are important natural bases of life and elements of biological diversity, nature and landscape that need to be conserved as habitats for numerous animals and plants and used on a sustainable basis. Together, they all form the natural bases of life for human well-being. Biological diversity as a resource is still undergoing rapid and extensive shrinkage worldwide. For this reason the United Nations proclaimed the years 2011–2020 as the UN Decade of Biological Diversity.[9]

The main reasons for the worldwide loss of biological diversity are over-exploitation of natural resources and the destruction, size reduction and fragmentation of habitats. In Germany the main reasons for the loss of biodiversity include the continuing high inputs of eutrophicating and acidifying substances and the destruction and fragmentation of the habitats of many animals and plants.

The German government acknowledges the contribution made by industry in cases where the landscape has been renatured or recultivated following temporary land use. It can be shown that after an encroachment on nature it is possible for biological diversity to develop which counteracts the original loss.

Policy on biological diversity is concerned not only with responsibility for nature, but also with biological diversity as a natural resource. Economic reasons for conserving biological diversity also play a role here. Intact ecosystems are an indispensable basis for human well-being and a foundation for the existence of economic activity. However, the "ecosystem services" which biological diversity provides us with free of charge are not reflected in public budgets or company balance sheets. In 2007 Germany and the European Commission initiated the TEEB study ("The Economics of Ecosystems and Biodiversity"), with the aim of making it possible to estimate the economic value of the "services" provided by nature (for example provision of soil functions, food, clean water, basis for medicines, protection from flooding, storage of CO_2) and to quantify the costs of destroying nature.[10] In order to apply the approach of the TEEB study to Germany, the study "Natural Capital Germany" was started in 2011.

The cause-and-effect relationships involved in loss of biological diversity are complex and long-term. In 2007 the German government therefore adopted the National Strategy on Biological Diversity. This lays down phased targets for the period up to 2020 for the conservation and sustainable use of biological diversity, and specifies concrete measures for achieving these targets. Moreover, the German government will – following the indicator report 2010 – present a report on the progress of implementation in 2012. In view of this situation, biological diversity as a resource will not for the moment be discussed in detail in the Resource Efficiency Programme ProgRess.

9 www.bfn.de/8107.html?&cHash=f1c2906d22&tx_ttnews%5BbackPid%5D=7747&tx_ttnews%5Btt_news%5D=3485
10 www.bmu.de/pressemitteilungen/aktuelle_pressemitteilungen/pm/46219.php

Biotic raw materials as fuel or food and feedstuff

In its National Biomass Action Plan for Germany in 2009, the German government indicated the contribution that biomass makes to sustainable energy supply. The Action Plan describes what potential we currently have in Germany, what proportion we are already using, and what reserves we still possess. On this basis it explains what strategies the German government is pursuing to expand the use of bioenergy in the heat, power and motor fuel sectors and what measures are planned. This provides a foundation for the ongoing work on the use of biotic raw materials for energy under the Energy Concept of 28 September 2010 and its accelerated implementation as decided in the early summer of 2011. At present, biotic energy sources contribute the largest share of energy production from renewable energy sources – over 70 percent.

In its "National Research Strategy BioEconomy 2030" the Federal Government lays the foundation for realizing a vision of a sustainable bio-based economy by 2030 which produces a wide range of healthy food and makes a sustainable contribution to energy from regrowable resources. This vision can only become reality if research is focused on the efficient use of biogenic resources.

The Federal Ministry of Food, Agriculture and Consumer Protection is currently drawing up a strategy for a bio-based economy. The bioeconomy embraces all economic sectors that produce, process and use biogenic resources for food and for energy and materials. The strategy is intended to show the importance and potential of a bio-based economy in Germany and identify major challenges and specific current fields of action in the agriculture and forestry sectors. The strategy is designed to supplement the Research Strategy BioEconomy 2030 and is also to focus on the political and legal framework conditions.

2. Where do we stand?

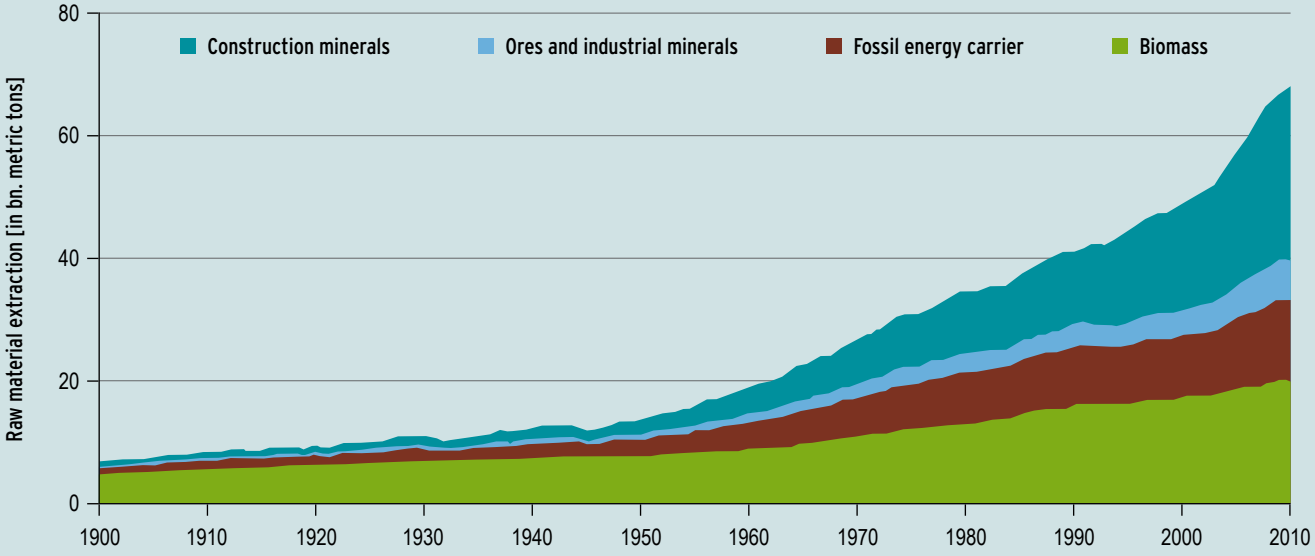
2.1 More growth, prosperity, quality of life – an increasing burden on the environment

More than 68 billion metric tons of raw materials were used worldwide in 2009. This was about one third more than in 2000 (approximately 50 billion tonnes), two thirds more than in 1990 (approximately 42 billion tonnes) and roughly double the figure for the late 1970s.[11] The main drivers for the increasing input of raw materials are the growth in the world's population from around 4.3 billion in 1980 to over seven billion today and an estimated 9.3 billion in 2050[12], and the increase in raw materials input per capita in newly industrialising countries such as China, Brazil or India.

11 Krausmann et al. (2009): Growth in global materials use, GDP and population during the 20th century, Ecological Economics Vol. 68, No. 10, 2696-2705, Version 1.2 (August 2011) including data 1900-2009, www.uni-klu.ac.at/socec/inhalt/3133.htm.

12 esa.un.org/unpd/wpp/index.htm

Figure 2: Growth in global materials use



Source: Krausmann et al. (2009): Growth in global materials use, GDP and population during the 20th century, Ecological Economics Vol. 68, No. 10, 2696–2705, Version 1.2 (August 2011), http://www.uni-klu.ac.at/socec/inhalt/3133.htm

The western industrialised countries use far more raw materials per capita than the less industrialised regions of the world. In 2004, for example, per capita consumption of raw materials was 55 kilograms per day in Europe and 102 kilograms in North America, but only 15 kilograms in Asia and around 11 kilograms in Africa[13]. Whereas the industrialised nations produce the bulk of global economic output, newly industrialising and developing countries are disproportionately affected by the ecological and social repercussions of resource consumption. For example, in 2006 more than half the minerals and ores extracted came from outside the industrialised countries.[14]

A look into the future reveals the challenges ahead: If the industrialised countries were to halve their input of raw materials per capita by 2050 (compared with 2006), and if at the same time the newly industrialising and developing countries were only to increase their raw materials input to this lower level, the use of raw materials worldwide would still show a 40-percent rise by 2050.[15]

The harnessing of mineral resources, id est their extraction and preparation, often involves major environmental pressures. The production and further processing of raw materials is associated with encroachments on nature and landscape, land requirements, material and energy consumption, and emissions into soil, water and air.

In Germany ambitious legal framework conditions, and in many cases commitment by industry, help to minimise environmental pressures. For example, it is possible to recultivate sites after extraction has ceased and raise them to an ecologically improved status. Numerous good examples of this exist in Germany and also examples of nature conservation oriented monitoring during the extraction phase.[16]

13 Sustainable Europe Research Institute (2010): Online portal for material flow data. www.materialflows.net.
14 UNEP (2011). Decoupling natural resource use and environmental impacts from economic growth. www.unep.org/resourcepanel/Publications/Decoupling/tabid/56048/Default.aspx.
15 www.unep.org/resourcepanel/decoupling/files/pdf/Decoupling_Report_English.pdf, p. 29
16 Joint declaration by NABU, BBS, IGBCE, IG BAU, September 2004: www.baustoffindustrie.de/root/img/pool/downloads/gem-rohstoff-erklaerung.pdf.

However, in many other countries from which Germany imports raw materials there are no comparable framework conditions. In many cases recultivation measures are not required or not carried out. The extraction and processing of certain minerals and ores may – depending on the technology used – give rise to considerable toxicological and ecotoxicological impacts as a result of impurities released from the ore or substances used in processing. This is particularly the case if the toxic substances accumulate in the soil, air or water.[17] The consequences are changes in and adverse effects on ecosystems, possible contamination of food and animal feed crops, and further loss of biological diversity.

View of the marina at the Großkoschen aquasport centre on Senftenberger See, a mining lake left over from the former Niemtsch open-cast mine.

Rising demand means that all over the world mineral resources are increasingly being exploited in areas that react especially sensitively to human activities. For many resources, extraction from deposits with low raw material concentrations is increasingly becoming a paying proposition, making their production more energy and material intensive. As a result, the environmental impacts of raw materials extraction are growing out of proportion to the increase in production quantities. Estimates indicate that currently about 7 percent of global energy consumption is needed for extracting, preparing and processing metals, and that this figure will continue to rise as ore content falls.[18] Since most raw materials projects are dependent on fossil fuels, demand for fossil fuels and emissions of greenhouse gases are likely to increase in the medium term.

17 UNEP (2010). Assessing the Environmental Impacts of Consumption and Production www.unep.org/resourcepanel/Publications/PriorityProducts/tabid/56053/Default.aspx.

18 MacLean, H. L., F. Duchin, C. Hagelücken, K. Halada, S. E. Kesler, Y. Moriguchi, D. Mueller, T. E. Norgate, M. A. Reuter, and E. van der Voet (2009): Stocks, Flows, and Prospects of Mineral Resources. In Linkages of Sustainability, edited by T. E. Graedel and E. van der Voet. Cambridge: MIT Press.

In connection with the sharp rise in demand for raw materials caused by the rapid economic growth of the last decade, especially in the newly industrialising countries such as China or Brazil, and also an evident increase in the impacts of speculation, raw materials prices on the global markets are displaying great volatility. In future there is reason to expect exploitation of deposits which are less readily accessible or involve inferior quality or increased financial risks. This could lead to rising production costs and raw materials prices. The development of raw materials quantities and prices is of strategic importance for Germany as an economic location. On 20 October 2010 the German government therefore adopted a Raw Materials Strategy.[19]

Especially in a large number of future technologies, there will be a sharp increase in demand for finite raw materials for which hardly any substitutes exist. This raises the prospect of shortages which could endanger economic development. As in the case of energy resources, some important resources for use as materials occur in marked geographical concentrations, and in some cases the extraction regions are located in areas of conflict. Some countries have already started to build up reserves of strategically important metals, cut back their exports or strengthen their access to resources in other regions by means of partnerships or company acquisitions. An additional factor tending to distort market developments is the fact that extraction is concentrated in the hands of a small number of large mining companies worldwide.

Car production at Pune, India

19 www.bmwi.de/Dateien/BMWi/PDF/rohstoffstrategie-der-bundesregierung,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf

2.2 The economic potential of resource efficiency

A resource policy that helps to improve resource efficiency and close substance cycles as far as possible offers benefits for businesses, the economy and society: resource efficiency has a positive effect on security of supply for German companies. Whereas gravel, sand and quarry stone are abundantly available in Germany and are mainly extracted and used on a local basis, Germany is largely dependent on imports in the case of metal ores and rare earths. Resource-efficient products and production processes and increased recycling reduce the economy's vulnerability to sharp price rises and fluctuations on the international raw materials markets.

This aspect is particularly relevant in the case of "critical resources" which are not only of great economic importance but also involve considerable procurement risks.

At the enterprise level, efficient use of resources can result in substantial cost savings and competitive advantages. Many companies have already achieved successes on this front. In view of the growing scarcity of resources, this aspect will become increasingly important, especially in international competition.

Gravel works with conveyor system at the Straberger Baggersee Lake, Dormagen

For companies in the manufacturing sector, the average share of costs due to raw materials and consumables in 2008 came to more than 45 percent of gross production value, more than double the figure for wages and salaries, which in 2008 stood at 18 percent. In sectors that are particularly dependent on raw material prices, like the automobile or mechanical engineering industry, material costs already account for more than 50 percent of gross production value. Despite this, many companies have focused their attention on stepping up labour productivity. Whereas materials productivity in Germany rose by a factor of two from 1960 to 2005, labour productivity increased by a factor of four during the same period.

Substantial further potential exists here. According to a study by the Federal Ministry of Economics and Technology dating from 2005, it would be possible for SMEs in the German manufacturing sector to achievedaverage savings of around 20 percent in material costs by means of investments with short payback periods involving technical modernisation and more efficient production workflows.[20] Exploiting resource efficiency potential and the associated cost savings could substantially improve the competitive position of SMEs on domestic and foreign markets and make a relevant contribution to saving resources, including resources for the development of future technologies.

The great importance of resource and material costs is also revealed by a survey of German industrial companies conducted in 2010. 85 percent of the companies questioned for the survey said that resource and energy prices were important factors influencing their future business situation. By contrast, only 75 percent described labour costs and 50 percent the shortage of qualified personnel as an important factor.[21]

If individual companies succeed in exploiting their economically worthwhile potential for improving resource efficiency, existing studies indicate that this could create new jobs on a considerable scale.[22] They also show that an increase in recycling tends to promote employment.

20 Studie zur Konzeption eines Programms für die Steigerung der Materialeffizienz in mittelständischen Unternehmen (Study aimed at designing a programme for increasing materials efficiency in SMEs), 2005, Arthur D. Little GmbH, Fraunhofer-Institut für System- und Innovationsforschung, Wuppertal Institut, www.demea.de.

21 BDI 2010, BDI- Mittelstandspanel – Ergebnisse der Online-Mittelstandsbefragung Herbst 2010 (SME panel – Results of online SME survey autumn 2010), page 12.

A further important contribution to saving abiotic raw materials can be made by using biotic, id est regrowable, raw materials.[23] The use of regrowable raw materials offers considerable innovation opportunities for new, resource-efficient technologies and products. For example, using regrowable raw materials in industrial biotechnology or chemical synthesis makes it possible to replace oil as a source of carbon. In the chemical industry, metallic catalysts can be replaced by enzymes. In the construction sector, regrowable raw materials can in suitable cases replace conventional abiotic materials, for example in construction materials or insulation. The German government aims to continue work on appropriate development of this potential. Furthermore, the sustainable production and sustainable use of regrowable raw materials can help to strengthen value creation and employment, including in rural areas as a place for raw materials production and initial processing.

However, even biotic raw materials are not available in infinite quantities because of the finite nature of the land on which they are grown. This aspect, combined with increasing competition between nature conservation, food production, animal feed production, industrial and energy production and other uses, makes it essential to maximise efficiency and sustainability in the production and use of regrowable raw materials, whether for use as materials or energy.[24]

Germany can already point to successes in the field of improving resource efficiency: The idea of resource conservation is already embodied in the legislation on plant licensing. Under the Federal Immission Control Act (Bundes-Immissionsschutzgesetz), installations subject to licensing must be constructed and operated such that precautionary measures using the best available technology are taken against adverse environmental impacts.[25]

22 Martin Distelkamp, Bernd Meyer, Mark Meyer 2010, Quantitative und qualitative Analyse der ökonomischen Effekte einer forcierten Ressourceneffizienzstrategie (Quantitative and qualitative analysis of the economic effects of pushing ahead with a resource efficiency strategy), Ressourceneffizienz-Papier 5.5. im Projekt Materialeffizienz und Ressourcenschonung, Wuppertal.

23 Aktionsplan zur stofflichen Nutzung nachwachsender Rohstoffe (Action plan for using regrowable resources as material), 2009: www.bmelv.de/SharedDocs/Standardartikel/Landwirtschaft/Bioenergie-NachwachsendeRohstoffe/NachwachsendeRohstoffe/AktionsplanNaWaRo.html?nn=453792.

24 Positionspapier Einsatz nachwachsender Rohstoffe in der chemischen Industrie" ("Position paper on the use of regrowable raw materials in the chemical industry"), Dechema, 2008, www.dechema.de/dechema_media/Downloads/Positionspapiere/PP_in_der_chemischen_Industrie_final_DINA5.pdf.

25 www.gesetze-im-internet.de/bimschg/__5.html

Other criteria for determining the best available technology include the use of raw materials and the nature of the resources used in the individual processes (including water), and also energy efficiency, promotion of the recovery and reuse of the substances produced and used in the individual process ("internal closed-cycle management") and, where appropriate, waste.

At the end of the life cycle, waste management is an important instrument for extracting and producing "secondary raw materials".[26] Polluter-related disposal prices combined with high environmental protection requirements provide incentives to avoid and recycle waste, and hence to reduce inputs of primary raw materials. Since the 1990s the establishment of a general priority for avoiding and recycling waste, and also product responsibility and an additional ban on the disposal of untreated municipal waste have resulted in much increased collection and recycling rates for municipal waste. Today some 63 percent of municipal waste is recycled.[27] Current estimates indicate that as much as 13 percent of German industry's raw materials requirements (excluding energy resources) is covered by secondary raw materials.[28]

Of the annual average of approximately 192 million tonnes of construction and demolition waste – the largest waste stream of all in Germany – some 90 percent is kept within the materials cycle and sent for environmentally sound recycling or reuse. In individual segments such as road construction rubble the recycling rate is much higher at nearly 99 percent. On the basis of these successes, there is a need for the waste industry to make further improvements in resource efficiency. Measures to increase the collection of raw materials of strategic or quantitative relevance are central fields of action here.

Germany is in a good position to exploit the efficiency potential described. Contributory factors include the favourable industrial structure, excellent innovation system, high level of environmental awareness and ambitious environmental standards. It is not a coincidence that German industry enjoys a good international competitive position in the field of efficiency technologies – a position capable of further expansion. In particular, the increasing demand from newly industrialising economies is creating fast-growing market potential. Thus technological innovations are a central lever for increasing not only resource efficiency, but also competitiveness, employment and growth.

However, Germany should not rest on its laurels – because other countries are making considerable efforts to prepare for creating good initial conditions for their industries as well. Competition in the field of efficiency technologies is an economic process which is critically dependent on favourable political framework conditions.

26 Secondary raw materials are resources recovered from waste or from production residues. Primary raw materials, by contrast, are obtained by extracting them from nature.

27 Federal Statistical Office (2011): Abfallbilanz 2009 (Waste balance 2009). www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Navigation/Statistiken/Umwelt/UmweltstatistischeErhebungen/Abfallwirtschaft/Tabellen.psml Online survey of 11 July 2011.

28 Press release by BDE e. V. dated 9 September 2010. www.bde-berlin.org/?p=3400.

2.3 Resource conservation – an important task for policy-makers

It was in 1972 that the topic of resource conservation was first brought to worldwide attention by the Club of Rome report "The Limits to Growth".[29] Since then the conservation of natural resources has come to play an important role at international and European level. At the UN Conference in Rio de Janeiro in 1992, the international community adopted the Agenda 21[30], which as a global action programme for development policy and environmental policy in the 21st century describes the conservation and management of resources as one of its focal points.

At the follow-up conference, the World Summit for Sustainable Development held in Johannesburg in 2002, conservation of the natural resource base was discussed in more detail as an important basis for sustainable development and was underpinned by recommendations for measures and their implementation.[31] At the UN Conference for Sustainable Development in Rio de Janeiro in 2012, one of the focal topics of discussion by the international community will be "Green economy within the context of sustainable development and poverty alleviation"; resource efficiency will play a central role here.

In the EU too, sustainable development is a priority goal that is of decisive importance for all policy sectors and measures in the Union. The EU Sustainability Strategy dating from 2006[32] identifies the conservation of natural resources as a central challenge. Essentially it is a matter of improving the management of natural resources and avoiding their overexploitation.

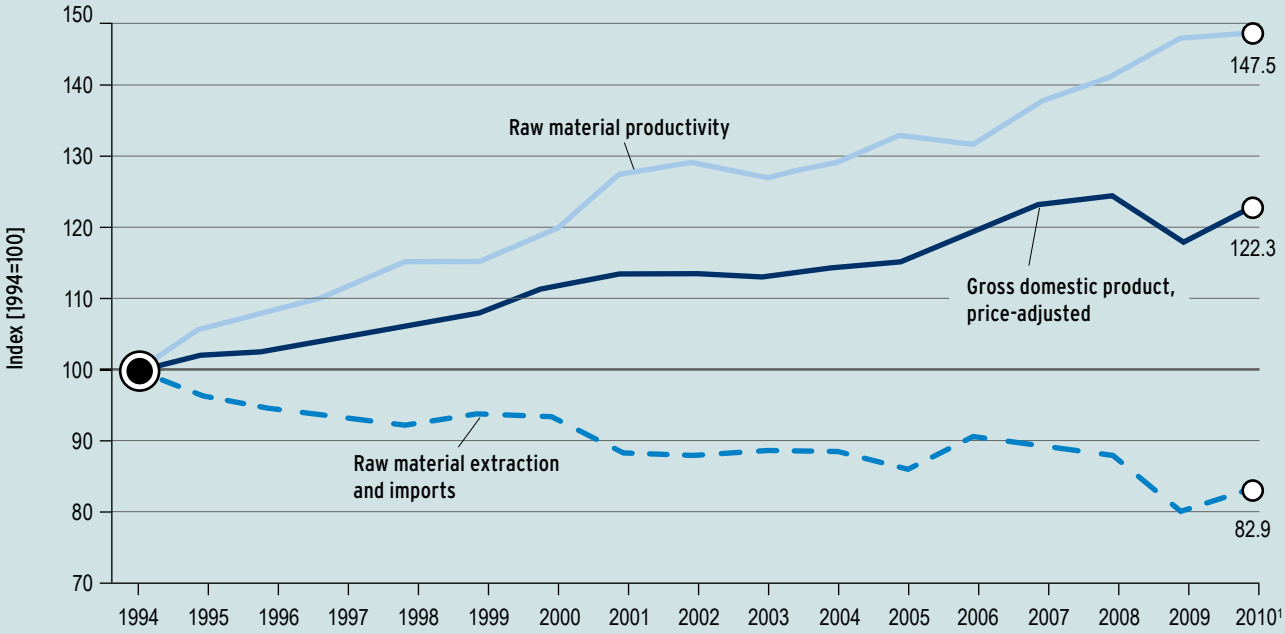
In December 2005 the EU Commission adopted in parallel a "Thematic strategy on the sustainable use of natural resources"[33], which also calls for national programmes for resource conservation. Since then the topic of resource efficiency has become increasingly important in the EU. The "Europa 2020" strategy adopted by the European Council in 2010 focuses in one of its lead initiatives on "Resource-conserving Europe".[34] The lead initiative sets out to decouple economic growth from resource consumption, support the transition to a low-emission economy, encourage the use of renewable energy sources, promote energy efficiency, and modernise the transport system.
On 20 September 2011 the Commission presented its "Roadmap for a resource-efficient Europe" giving concrete shape to the lead initiative.[35]

At national level the German sustainability strategy of 2002 is based on the vision of sustainability as outlined in the 1987 report "Our Common Future" by the Brundtland Commission.[36] The National Sustainability Strategy formulates as a goal: "bringing together environmental protection, economic efficiency and social responsibility in a manner which ensures that decisions are viable in the long term from all three points of view – on a global view. Maintaining the Earth's viability represents the absolute utmost limit; this is the framework within which the various political objectives have to be optimised."[37]

The Sustainability Strategy sets out specific targets for sustainable use of resources, in particular a doubling of resource productivity by 2020 compared with the 1994 figure. By 2010 a 47.5-percent increase had been achieved. Thus the indicator has on the whole been developing in the right direction, but the rate of increase in the last five years would not be sufficient to meet the target. By the target year 2020 the indicator would have covered 82 percent of the distance to the target. What is more, some of the increase achieved does necessarily reflect improvements in efficiency, but is due to relocation of production stages to other countries or other macroeconomic influences. Additional efforts will therefore be necessary to achieve the target in the sustainability strategy.

29 www.clubofrome.org/?p=326
30 www.nachhaltigkeit.info/artikel/agenda_21_dokumente_985.htm
31 www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm
32 www.bmu.de/files/europa_und_umwelt/eu-nachhaltigkeitsstrategie/application/pdf/eu_nachhaltigkeitsstrategie_neu.pdf
33 eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0670:FIN:DE:PDF
34 ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_de.pdf
35 ec.europa.eu/environment/resource_efficiency/pdf/com2011_571_de.pdf
36 www.un-documents.net/wced-ocf.htm
37 Fortschrittsbericht 2012 zur Nationalen Nachhaltigkeitsstrategie (Progress report 2012 on the National Sustainability Strategy), page 25.

Figure 3: Raw material productivity and economic growth, 1994=100



Source: Federal Statistical Office, Wiesbaden 2011

¹ Preliminary results

This National Resource Efficiency Programme describes approaches to improving resource efficiency along the entire value chain and integrates them in the context of sustainability. Targeted implementation of this programme is intended to improve the framework conditions for technological, economic and social innovations. This will give rise to very good opportunities for Germany to develop into one of the most resource-efficient economies worldwide. Together with other measures such as a resource-oriented foreign policy, the programme can help to ensure sustainable security of resource supplies for German industry.

2.4 Current activities in Germany – a wide range of initiatives

Efforts to improve resource efficiency are being made in many of the German government's policy areas within the sphere of responsibility of the individual ministries.[38]

The **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)** supports the "Resource Efficiency Network"[39] that has been developed since 2007. Since 2009 it has been supporting the "Resource Efficiency Centre" established by the German Engineers' Association (Verein Deutscher Ingenieure) (VDI ZRE)[40] with a view to improving information and communication about opportunities for increasing resource efficiency in industry, especially in small and medium enterprises. Through its Environmental Innovation Programme the Federal Environment Ministry promotes resource efficiency investment projects which are intended to set an example as models of "best practice".[41] Through projects in its environmental research programme, such as the research project "Material Efficiency and Resource Conservation (MaRess)" completed in 2011, which are largely controlled by the Federal Environment Agency **(Umweltbundesamt – UBA)**, it is constantly pressing ahead with advances in conceptual development. BMU-assisted projects in conjunction with associations are aimed at establishing the topic of resource efficiency on the political and social agenda and stimulating discussion about it.

38 See also the more detailed descriptions in the Appendix.
39 www.netzwerk-ressourceneffizienz.de/
40 www.vdi-zre.de/
41 www.bmu.de/foerderprogramme/pilotprojekte_inland/doc/2330.php

The **Federal Ministry of Economics and Technology (BMWi)**, which is responsible for the German government's policy on raw materials, promotes nationwide provision of expert advice on resource and material efficiency to SMEs in the manufacturing sector by authorised qualified consultants under the programme "BMWi Innovation Bonus (go-inno)". The aim is to identify potential for saving resources and material during production or product use and to indicate measures for improving the situation. These programmes are handled for the Federal Economics Ministry by the German Materials Efficiency Agency (Deutsche Materialeffizienzagentur – **demea**).[42] Since 2006 the Federal Economics Ministry has been helping SMEs to identify their potential for making efficient use of materials. The resulting practical experience shows that materials efficiency consulting can enable companies to save an average of 200,000 EUR a year on material costs alone.

The German Raw Materials Agency (Deutsche Rohstoffagentur – **DERA**) established by the Federal Economics Ministry in 2010 at the Federal Institute of Geosciences and Raw Materials (Bundesanstalt für Geowissenschaften und Rohstoffe – BGR) in Hanover advises the German government and the public on issues relating to secure and sustainable raw material supplies. It runs the Federal Economics Ministry's competition for the "German Resource Efficiency Award", which is presented for outstanding innovative achievements in industry and research.[43]

The Federal Institute for Materials Research and Testing (Bundesanstalt für Materialforschung und -prüfung – BAM) makes important contributions in the fields of safe and efficient use of materials, waste treatment and reuse of materials, for example by evaluating the use of biogenic materials and the recycling properties of construction materials and by providing reference materials, for example for electronic scrap.

The development of new cutting-edge technologies is a key to improving resource efficiency and hence a central innovation policy objective for the German government's high-tech strategy within the field of climate and energy. As part of its framework programme "Research for Sustainable Development (FONA)", the Federal Ministry of Education and Research (**BMBF**) therefore provides considerable assistance for research and development work on improving resource efficiency within the action field "Sustainable Management and Resources". Assistance is also provided under the "National Research Strategy BioEconomy 2030", and in other framework programmes such as "Innovative Materials for Industry and Society – WING".

42 www.demea.de/
43 First held in 2011.

Current assistance measures include:

- r^2 – Innovative technologies for resource efficiency – Resource-intensive production processes",
- "r^3 – Innovative technologies for resource efficiency – Strategic metals and minerals",
- "SME innovative: Resource and energy efficiency",
- "CLIENT – International partnerships for sustainable climate and environmental technologies and services",
- BioEnergy 2021,
- BioIndustry 2021,
- Plant biotechnology for the future,
- Industrial biotechnology innovation initiative,
- Competence networks for agricultural and food research,
- Biorefineries for the future,
- MatRessource – Materials for a resource-efficient industry and society.

In September 2010 the Federal Ministry of Education and Research established the Helmholtz Institute for Resource Technology (HIF) to give additional impetus to research into resource efficiency technologies.

The **Federal Ministry of Food, Agriculture and Consumer Protection (BMELV)** assists research, development and demonstration projects in the field of regrowable raw materials. The use of biomass for materials and energy makes it possible to embark on sustainable resource management. In certain areas of the economy, regrowable raw materials can be used to replace scarce abiotic resources. Other factors in favour of making greater use of regrowable raw materials include great innovation potential, added value and employment.

The Ministry of Agriculture supports innovative projects for crop breeding, and especially for improving nutrient and water efficiency, increasing resistance to harmful organisms, and using resource-conserving technologies in crop growing.

Under the "Federal programme for organic farming and other forms of sustainable agriculture" (BÖLN), the ministry assists research and development projects aimed at improving resource efficiency in land management and livestock production. Examples include promoting the closed-cycle management principle, soil protection and nutrient conservation by means of soil-conserving cropping methods, and also strategies for improving animal health.

As part of its departmental research and its programme for promoting innovation in the food and agriculture sectors, the Federal Ministry of Agriculture funds research projects for improving energy efficiency in agricultural production methods. In close cooperation with the Federal Environment Ministry, the Federal Ministry of Agriculture has launched the "Federal programme for increasing energy efficiency in agriculture and horticulture" with the aim of saving energy and CO_2. The necessary funds are provided by the Federal Environment Ministry. Among other things, this programme supports highly energy-efficient investment measures aimed at reducing climate-relevant CO_2 emissions in the agricultural and horticultural sectors. It supports investment projects in businesses in these sectors in the field of the production, processing and marketing of agricultural and horticultural products. These activities are expected to reduce energy consumption by between 30 and 50 percent.

As part of the "Research Initiative Building for the Future", the **Federal Ministry of Transport, Building and Urban Affairs (BMVBS)** supports numerous research projects in the field of innovative construction product and technology developments, and also in the field of resource efficiency and sustainable building, which create the basis for further development of the Sustainable Building evaluation system. Demonstration projects encourage the use of future technologies in the construction sector (for example PlusEnergy house (*Plusenergiehaus*) with electric mobility).

As long ago as 2001, on the basis of experience gained by the "energy officer for the building measures connected with the move from Bonn to Berlin", the Federal Ministry of Transport, Building and Urban Affairs published a first guide to Sustainable Building[44] and introduced it on a compulsory basis for the Federal Facilities Management Authority. In a decree dated 3 March 2011 this guide was superseded by a fully revised version of the Guide to Sustainable Building (*Leitfaden Nachhaltiges Bauen*).

The **Federal Ministry for Economic Cooperation and Development (BMZ)** helps to ensure that developing countries also benefit from German know-how in the field of resource efficiency. Knowledge and technology transfer is supported in particular by means of assistance measures in the fields of sustainable economic development, environmental policy consulting, industrial environmental protection and waste management. These measures are supplemented by development partnerships with German industry and through exchange and upgrading programmes for managerial and technical staff from developing countries. Under the Extractive Industries Transparency Initiative (EITI), the Federal Ministry for Economic Cooperation and Development supports the establishment of resource governance structures in Sub-Saharan Africa designed to ensure sustainable and transparent use of state revenue from raw materials.

The German **Länder** have also launched a large number of important initiatives in this field. The activities of the Länder are of crucial importance for the nationwide dissemination and impact of efforts to improve resource efficiency. **Associations**, institutions and individual companies make valuable contributions to the conceptual development, acceptance and practical effects of these initiatives.

Some of these activities are described in the Appendix.

44 www.bmvbs.de/SharedDocs/DE/Artikel/B/leitfaden-nachhaltiges-bauen.html

3. Guiding principles and objectives

The aim of the German Resource Efficiency Programme is to make the extraction and use of natural resources more sustainable and to minimise the associated environmental pressures. In this way – mindful of our responsibility for future generations – we are seeking to create a basis for safeguarding the quality of life at a high level in the long term.

The German government is aiming to decouple economic growth from resource consumption as far as possible and to reduce the associated environmental pressures, strengthen the future viability and competitive position of the Germany economy and thereby promote stable employment and social cohesion.[45] The resource efficiency policy is intended to help discharge our global responsibility for the ecological and social impacts of resource utilisation. The aim must be to reduce overall consumption of resources."

45 Federal Government's Sustainability Strategy, 2002: "Nachhaltige Entwicklung verlangt die Entkopplung des Energie- und Ressourcenverbrauchs vom Wirtschaftswachstum" ("Sustainable development calls for the decoupling of energy and resource consumption from economic growth"), page 10, and Progress Report 2012, page 151: "Megatrends such as globalisation, climate change and scarcer and more expensive raw materials present challenges for companies today. The need to increase resource and energy productivity with a view to maximising the decoupling of resource consumption from growth must become a more central focus of economic and ecological activities. The aim must be to reduce overall consumption of resources and energy."

3.1 Four guiding principles for the approach and prospects for the future

Guiding principle 1:

Combining ecological necessities with economic opportunities, innovation support and social responsibility

Sparing and efficient use of resources contributes to increasing Germany's security of supply and competitive position, relieving consumers of increased costs, and at the same time minimising national and global environmental pressure arising from resource extraction and use.

Using smaller quantities of natural resources also means reducing the greenhouse gas emissions associated with the production, treatment and use of resources and thereby making a contribution to climate protection. Measures to conserve and make sustainable use of natural resources and to decouple resource consumption from economic growth are steps in ecological modernisation which help to prevent global climate and resource crises. They also provide a thrust that points innovation and investment in a sustainable direction and thus contribute to improving competitiveness and safeguarding employment.

In the field of efficiency technologies Germany is one of the leading nations worldwide – but the competition is growing. Our resource policy sets out to maintain and further expand this position. In 2007, companies with energy and material efficiency technologies made sales of nearly Euro 95 billion worldwide. Forecasts indicate that the market for energy and material efficiency will grow to around Euro 335 billion by 2020 (driven by, among other things, biotechnology, biofuels and bioplastics).[46] In recent years companies operating in this market have created a large number of new jobs. Germany is an attractive location for these companies and is itself an important sales market.

German companies also play a leading international role in the field of closed-cycle management. Sales by the companies in this market have risen sharply in recent years, and the economic prospects for the future are excellent. In many areas the establishment of political frameworks has given a successful boost to innovations and will continue provide a dynamic thrust that takes account of the growing importance of closed-cycle management for the raw materials and resources debate.

By ensuring a stronger focus of responsible corporate activities on increasing resource productivity, it is possible to mobilise substantial efficiency potential and associated cost savings in the production and service sectors of the Germany economy without making any cuts in production quality. Appropriate framework conditions can be used to promote business models based on effective use of natural resources, for example a process-oriented, product-oriented or regional material flow management and services system, the establishment of regional synergy clusters and networks. The aim here is to use competition-oriented ways of information sharing and cooperation to identify regional potential, continuously improve processes, recognise innovation opportunities at an early stage and support their speedy nationwide implementation.

In this way resource efficiency can strengthen Germany's competitive position even in the face of increasingly globalised markets, and can also encourage international competitors to make efforts to contribute to resource conservation.

46 BMU, Ed. (2009): GreenTech made in Germany 2.0. Atlas of Green Technology for Germany.

Guiding principle 2:

Viewing global responsibility as a key focus of our national resource policy

Germany is ready to play a pioneering role internationally by showing how it is possible to increase resource efficiency in a highly developed industrialised country without sacrificing prosperity and thereby reduce resource consumption. Germany is already demonstrating this, reducing resource consumption while economic output is increasing: whereas economic growth rose sharply during the period 2000 to 2010, resource consumption fell by 11.1percent.[47]

Germany promotes the transfer of environment and resource-conserving technologies to developing and emerging economies and helps them to establish innovation-friendly framework conditions, and also to identify and implement their own routes to sustainable development.

In spite of its ongoing and increased efforts to improve resource efficiency and further optimise closed-cycle management, Germany will continue to depend on imports of many raw materials to a considerable extent. It therefore bears a share of responsibility for the ecological and social impacts of this demand for resources in the exporting country. Germany will do everything in its power to reduce the "ecological rucksacks" of its imports and as far as possible to prevent adverse impacts due to relocation effects and exports of waste ("burden shifting").

The aim is to minimise in particular the environmental pressures frequently associated with the extraction of resources in the exporting country, such as greenhouse gas emissions, destruction of ecosystems, loss of biodiversity and input of pollutants into soil, water and air. To this end the German government, in cooperation with its partner countries and in European and international bodies, is making intensive efforts to ensure the design of sustainable extraction methods and constant improvements in environmental standards in the extraction and processing of raw materials.

The extraction and use of resources should contribute to the economic and social development of the countries and the creation of permanent jobs that do not involve hazards to health. But they may also lead to corrupt internal structures, exploitation, child labour and armed conflicts, or be used to finance and maintain the latter. According to the United Nations Environment Programme, natural resources play a role in 40 percent of all domestic conflicts, mainly in Africa, the Near East and Asia. In these cases the probability that they will break out again in the next few years is twice as great as for other conflicts. In the period 1990–2008 alone, there were 18 military conflicts related to resources.[48] Sustainable and transparent resource management must therefore be regarded as an important starting point for consolidating peace in these regions.

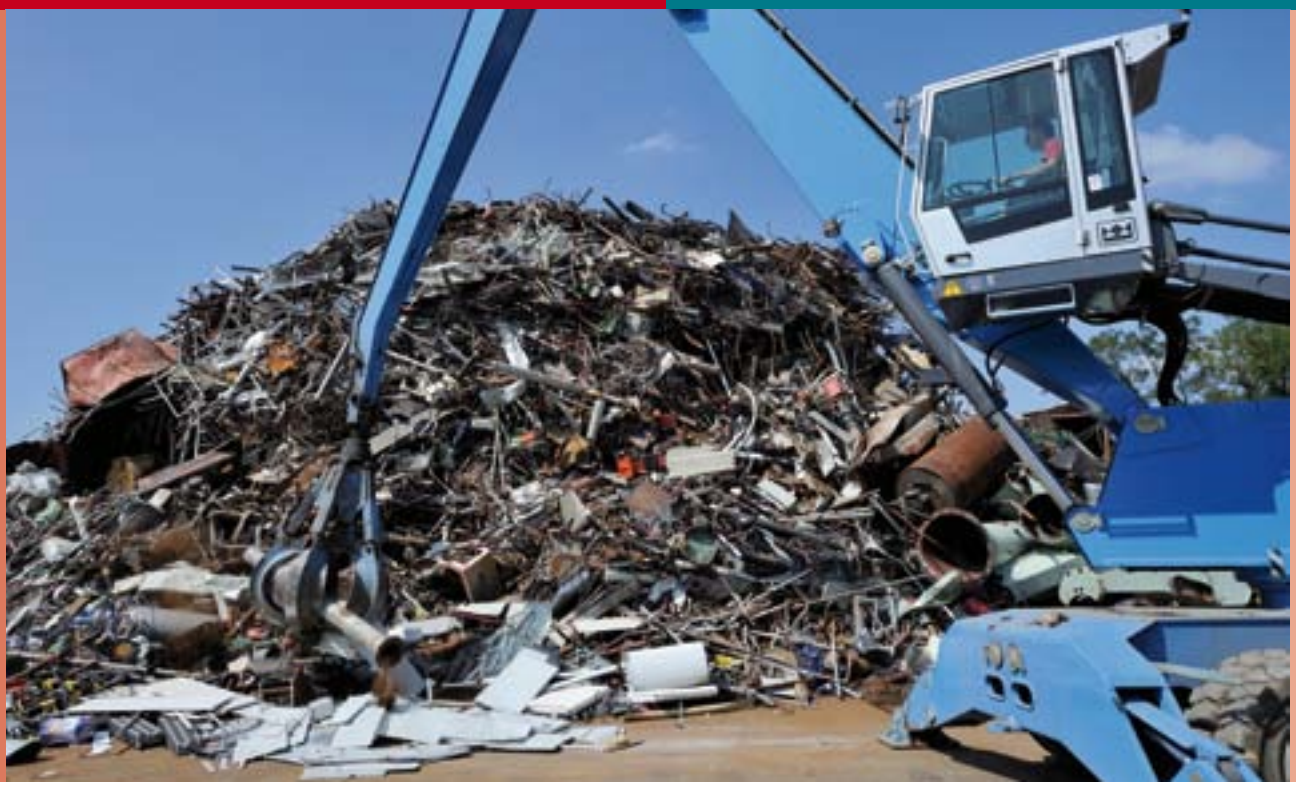
For supplies of regrowable raw materials, Germany will also be dependent in the foreseeable future on imports, in many cases from developing and newly industrialising economies, and it thus bears a share of responsibility for their sustainable production. The desired increase in the use of regrowable raw materials in Germany must therefore be seen in the context of a globally sustainable development policy as well. In expanding the use of biomass, greater consideration must be given in particular to impacts on food security, traditional employment opportunities and the health of the local population, biodiversity, natural assets such as rainforests and bogs, and resources such as soil and water which may often be of great regional importance. When producing and using regrowable raw materials it is essential to ensure that this is done in a sustainable and hence environmentally sound and nature-friendly way: it must not endanger food security, must permanently involve the local population in the value chain, and must, on an overall view, help to achieve the objectives of resource conservation. A sustainable improvement in agricultural structures in emerging and developing economies opens up market opportunities for domestic processing of biomass and participation in the international trade in biomass.

For this reason the German government's policy for safeguarding Germany's supply of resources is also designed to ensure sustainable development in the

47 See also the diagram for the indicator "Domestic Materials Consumption" (DMC) per capita under 3.2.
48 www.unep.org/pdf/pcdmb_policy_01.pdf

supplier countries. Germany will continue to make every effort to prevent armed conflicts for resources by addressing the root causes, and will promote the use of resources on a sustainable, peaceful, socially responsible and nature-friendly basis in the interests of the supplier countries' development.

When it comes to the conservation and sustainable use of the natural basis of life, every country should be empowered to develop transparent and participatory concepts appropriate to its individual situation that bring about permanent improvements in the living conditions of the people concerned. The German government supports its partner countries in this work. At the UN Conference on Sustainable Development in 2012 ("Rio+20") one of the main themes will be "Green Economy in the context of sustainable development and poverty alleviation". In the lead up to the conference the German government is arguing for a transition to an economically sustainable, resource-conserving and socially acceptable management approach that gives developing and newly industrialising economies the opportunity to achieve prosperity for broad sections of the population while conserving resources.



Guiding principle 3:

Gradually making economic and production practices in Germany less dependent on primary resources, developing and expanding closed-cycle management

The development, production and use of long-lasting, reusable, maintenance-friendly and readily recycled products makes it possible to increase economic output while reducing resource consumption. Further use and reuse, cascade use and recycling are increasingly making secondary raw materials available to German industry and consumers and are helping to cut costs. For example, the use of secondary raw materials in Germany has reached considerable levels – 45 percent for steel, about 50 percent for nonferrous metals and up to 94 percent for glass – thereby helping to achieve substantial reductions in the demand for newly extracted resources.

Product design that uses easily dismantled elements to make up complex products can make recycling considerably easier. Research efforts can bring further advances in technologies that reduce resource requirements or open up opportunities for substitution. An increasingly important aspect is the development of technologies that permit recycling of critical materials which have hitherto been unusable because they were only present in minute quantities or composite materials.

A sector of central importance because of the large quantities involved is the construction industry. Refurbishment and modernisation of existing homes can achieve efficiency gains in the consumption of energy resources and thereby make an important contribution to climate protection. On the other hand this requires additional inputs of materials, for example thermal insulation material. The necessary energy-saving refurbishment of existing homes should therefore be taken as a reason for combining energy and resource efficiency.

An approach must be taken to the planning, construction and selection of suitable products that considers their entire life cycle – including use and conversion – and thus ensures that structures, products and appliances not only deliver the necessary performance during the in-use phase, but also lend themselves to efficient reuse or recycling even after repair or dismantling so that the materials remain in the economic cycle.

In the case of regrowable raw materials used as material and the resulting products, cascade use represents a major step on the way to closed-cycle management. Regrowable raw materials can be used efficiently by ensuring that they pass through several use cycles before their final use for energy purposes.

Guiding principle 4:

Securing sustainable resource use for the long term by guiding society towards quality growth

"The 21st century will require us to rethink our ideas about growth. It is not just a matter of the classic economic growth parameters, but of growth that safeguards sustainable prosperity. In this context criteria such as security, quality of life, health and sustainable use of resources will play a crucial role. We must learn to redefine the concept of growth for the 21st century."

[Federal Chancellor Dr. Angela Merkel][49]

Gains in resource efficiency are not always enough to achieve a reduction in resource inputs and the associated environmental pressures. It is possible that lower costs due to efficiency gains may lead to increasing demand for resources and consumer goods, and may thereby be cancelled out or even over-compensated ("rebound effect"). Measures to improve resource efficiency must therefore be accompanied by a paradigm change that no longer equates prosperity with quantitative growth in the sense of "having more", but is concerned with better satisfaction of human needs, id est shifts the focus to "qualitative growth".

To bring about a long-term change in public consciousness of the necessity for sparing and efficient use of resources and facilitate the development of sustainable lifestyles, there is a need to raise consumer awareness of resource-conserving products and their sustainable use and subsequent disposal. To this end consumers must be provided with suitable information. In many cases demand for products can be satisfied by services involving considerably lower consumption of resources – for example through "loanership, not ownership". This can give rise to new and innovative business models – such as exchanges, carsharing or the example of a tyre manufacturer that offers tyre mileage as an alternative to buying tyres outright.

In addition, resource efficiency and conservation of natural resources should be more closely integrated in all stages of education.

49 Federal Chancellor Dr. Angela Merkel, video podcast, 6 February 2010, www.bundesregierung.de/nn_670562/Content/DE/Podcast/2010/2010-02-06-Video-Podcast/2010-02-06-video-podcast.html.

3.2 Indicators and objectives for decisions directed at efficiency

Indicators play a role of central importance when it comes to pursuing an active policy on resources. Successful monitoring and development of targets is only possible if meaningful parameters underpinned by reliable data exist.

In its National Sustainability Strategy, the German government has made a commitment to resource conservation. The sustainability strategy uses the indicator of resource productivity, the ratio of gross domestic product to material input[50], to measure resource efficiency. Resource productivity relates to abiotic raw materials. In the sustainability strategy the German government laid down the target of doubling resource productivity by 2020 compared with 1994.

The German government will continue its efforts to improve resource productivity beyond 2020. The Parliamentary Advisory Council for Sustainable Development has made a recommendation[51] that targets for the development of resource productivity to 2030 and 2050 be established in the course of updating and improving the sustainability strategy.

With these quantitative targets, Germany is playing a pioneering role on the international front. The German government welcomes the fact that the European Commission intends to use the German National Sustainability Strategy as a guide when developing indicators and targets for resource efficiency. It will play an active part in the process of developing and giving concrete shape to the indicators at European level.

The Federal Statistical Office regularly determines resource productivity and updates the time series. The indicator is thus an important frame of reference for this resource efficiency programme.

However, the indicator does not reveal all relevant aspects of resource efficiency. For the purpose of determining and assessing improvements in resource efficiency, there is a need for further suitable indicators which permit a representation of practical relevance free of inconsistencies and at the same time adequately reflect the framework conditions in Germany as an industrial and production location and the special situation of the value chains that are built on its basic industries. Here it is necessary to take account of aspects such as availability, ecological relevance and opportunities for closed-cycle management.

In order to ensure better representation of the trends and driving forces of resource use and better identification of the reasons for developments that produce changes in resource efficiency, additional indicators should therefore be observed on a supplementary basis. These should permit a reliable assessment of the direction of trends. They should provide an adequate reflection of effects due to imports, exports and relocation. They should be compatible and comparable on an international basis from company to national level, and the development of any relevant indicators at international level must also be taken into account. Differentiation of the indicators by sectors (for example construction sector) and resource types (energy resources, construction minerals, metal ores etc.) makes it possible to identify important contributory effects, trace sector-specific and substance-specific developments and achieve greater accuracy in shaping resource efficiency improvement policy.

To ensure that the indicators are comparable with and can be linked to the work of international bodies and institutions, there is a need for a basis of harmonised data structures in the official statistics. Harmonised basic data of this kind are provided by the Environmental Economic Accounts with their consistent

50 Other resource-relevant indicators in the National Sustainability Strategy include energy productivity and land take. www.bundesregierung.de/nsc_true/Content/DE/__Anlagen/2006-2007/perspektiven-fuer-deutschland-langfassung,templateId=raw,property=publicationFile.pdf/perspektiven-fuer-deutschland-langfassung.

51 "With regard to the further horizon up to 2050 which is mentioned in the report, the Parliamentary Advisory Council on Sustainable Development recommends to the Federal Government that, in the course of updating and improving the National Sustainability Strategy in the Progress Report 2012, it should, in the case of those indicators and objectives where longer-term planning going beyond the existing targets makes sense, extend the concrete targets to the year 2030 and outline its ideas for the period to 2050. On the one hand these longer-term targets should be realistic, so that they can be more or less achieved with the existing instruments. On the other hand they should be sufficiently ambitious to provide an incentive to develop new instruments." Deutscher Bundestag, Drucksache 17/1657, page 3, 7 May 2010. dipbt.bundestag.de/dip21/btd/17/016/1701657.pdf.

links to the National Economic Accounts. The German government is supporting this work through its active participation in European and international processes for resource indicators and the establishment of the basic data.

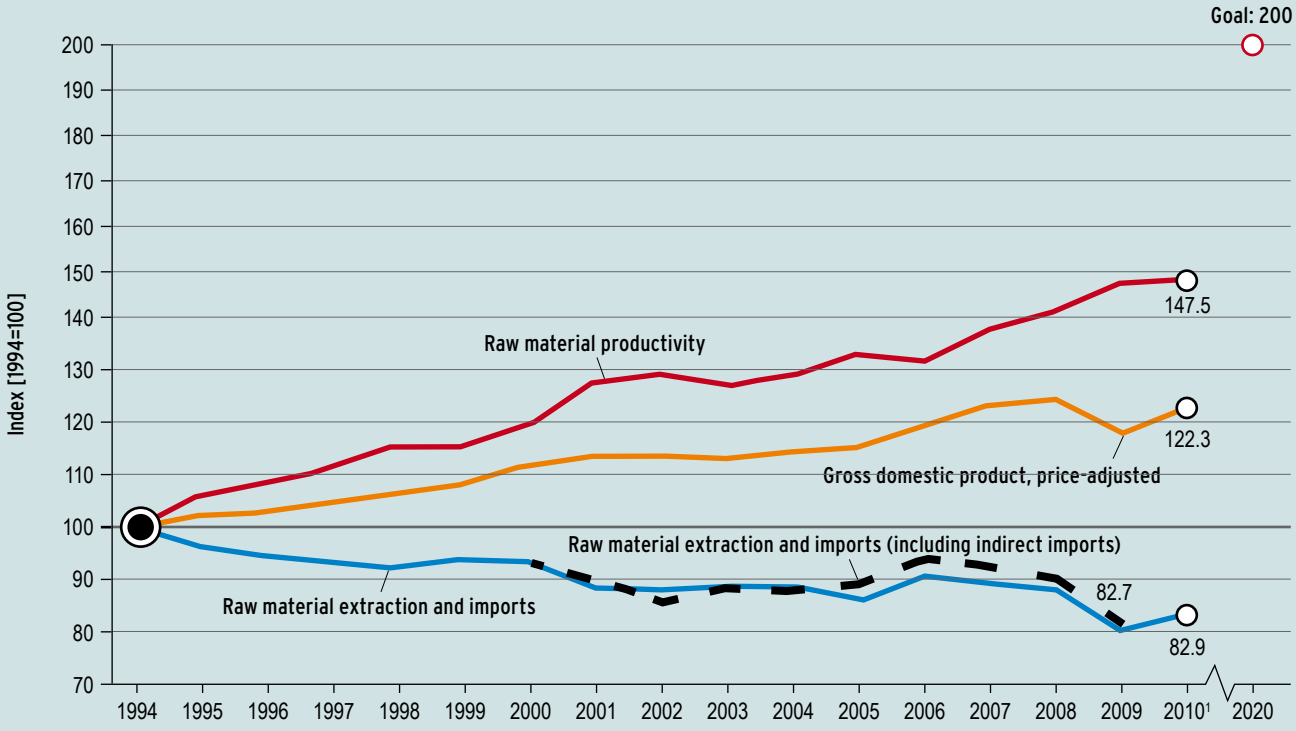
As a basic principle it is desirable to ensure differentiated integration of specific ecological impacts and social and economic aspects in the set of indicators. Intensive discussions are taking place at European and international level about the design of indicators and ways of improving the data situation, and Germany is playing an active part in these discussions.

Inclusion of raw materials equivalents of imports

Resource productivity for the purposes of the Sustainability Strategy looks at the ratio of gross domestic product (GDP) to material input (DMI=Direct Material Input[52]) in physical units (tonnes). It is thus analogous to labour productivity and capital productivity and serves as a measure of efficiency of the production factor "raw materials". The DMI in the denominator of the indicator is expressed in units of weight and includes not only the raw materials extracted within the country, but also the net weight of imports of raw materials, finished and semi-finished products.

52 Direct Material Input (DMI) comprises exploited domestic extraction of raw materials and imports of goods for economic activities such as production and consumption. DMI includes both abiotic and biotic raw materials and goods; source: Statistical Office of the European Communities (Ed.) (2001): Economy-wide material flow accounts and derived indicators – A methodological guide, Luxembourg 2001.

Figure 4: Raw material extraction* including indirect imports



Source: Federal Statistical Office

* Abiotic; ¹ Preliminary results

However, looking at resource productivity alone can lead to misinterpretations. In this indicator, imports are only considered at their net weight and are thus given less weight than purchases of domestic resources. For example, it does not include materials needed for the production infrastructure or any waste that remains in the exporting countries. Where processing or production processes take place in the exporting countries, the distortion is even greater when comparing exports with production in Germany: No account is taken of material flows caused by production abroad: the imported product is merely included at the weight that crosses the border.

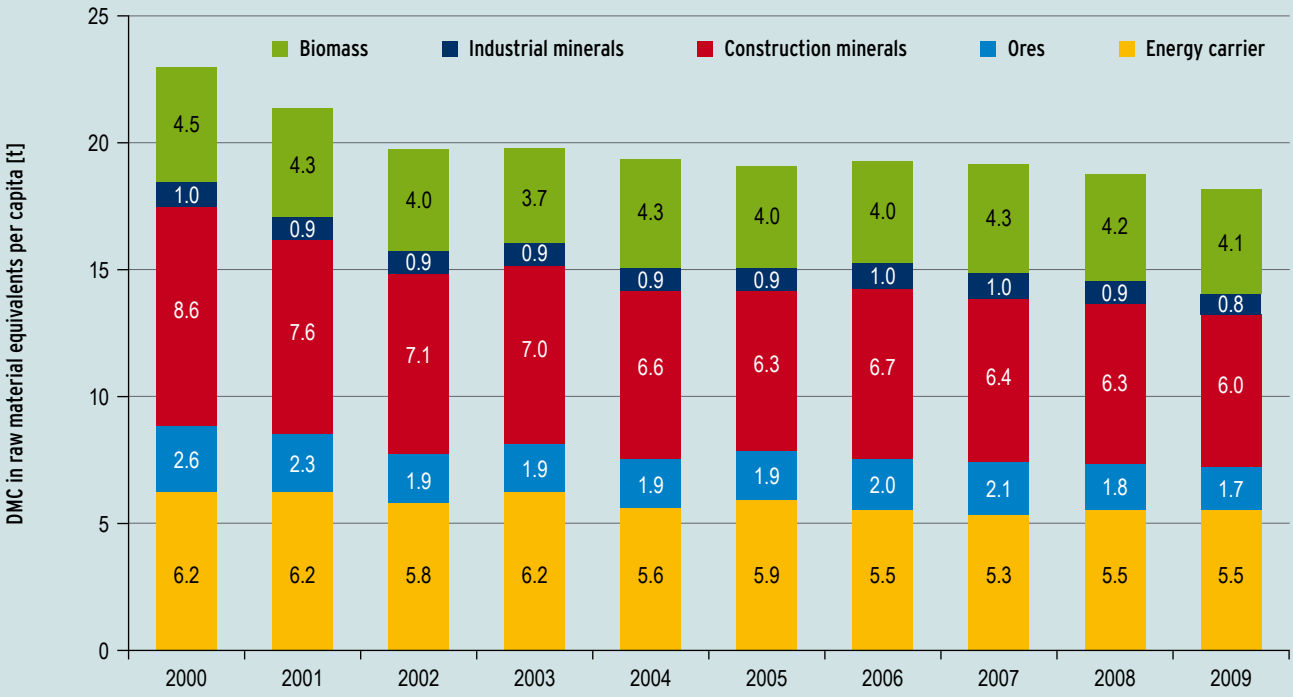
Thus an apparent reduction in resource input and hence an apparent increase in resource productivity can result from resource-intensive processes being shifted abroad, id est there is a reduction in domestic extraction and imports of raw materials, and instead the country imports more highly processed finished and semi-finished goods. The indicator shows an increase in resource productivity although production stages are merely shifted abroad, but not necessarily made more efficient.

Such misinterpretations of structural relocation effects which result from the growing international division of labour can be taken into account by recalculating the imports as raw material equivalents (RME). This weights all goods with those raw material flows used directly or indirectly for economic purposes that are necessary for their manufacture. The supplementary indicator “Resource productivity in raw material equivalents” is therefore included in the reporting.

Consideration of per capita domestic resource consumption

Simple input indicators such as DMI or DMI in raw material equivalents (DMI_{RME}) cannot be totalled across countries, as this results in items being counted twice: material transported from one country to another is counted again as “input” every time it crosses a border. For example, the result for the EU as a whole would not be the same as the total of the individual Member States. For this reason input indicators are not suitable for inter-country comparisons. To represent absolute raw material input without any overlaps and take account of international produc-

Figure 5: DMC per capita (in raw material equivalents)



Source: Federal Statistical Office

tion patterns and Germany's export-oriented economic structure, domestic material consumption in raw material equivalents (DMC_{RME}) can be used as an indicator.[53] At the same time this adequately reflects the imports and exports in raw material equivalents. To ensure that international comparison is possible, DMC_{RME} per capita is selected as the indicator. Calculations of DMC_{RME} are available for Germany for every year since 2000. Eurostat is currently implementing the indicator for the EU27, based on the preliminary work by the Federal Statistical Office. In line with international practice, biomass consumption is included in this indicator.

Mapping unused material extraction

The extraction of raw materials and their conversion in the course of the economic process give rise to large quantities of spoil, mining rubble and excavated material. These are known as "unused extraction", because they do not find their way directly into production processes. The amount of unused extraction is primarily dictated by the type of deposit (opencast activities) and the efficiency of exploitation of the raw material deposits. Unused extraction causes relevant harmful effects on the environment, especially during the exploitation phase, for example as a result of adverse influences on geological formations and natural habitats, changes in land use and unfavourable effects on the water balance. Irreversible long-term changes which continue beyond the extraction phase and which only permit inferior ecosystem use compared with the original condition, are adverse environmental impacts that may persist far into the future.

It is therefore an important step to also collect data on unused extraction at home and abroad (for example spoil from raw materials extraction, excavated material from construction work), thereby permitting a better picture of the overall impacts of raw material extraction and flows. Unused extraction is recorded in Total Material Consumption (TMC).

53 DMC (Domestic Material Consumption) is determined by deducting exports from DMI (Direct Material Input) – "How much is actually used within the country?".

Filling operations at the Hoheward tip in Herten

The Federal Statistical Office already determines at regular intervals the unused extraction associated with raw materials extraction within Germany. Data for other countries are also available, and intensive work is in progress on expanding the basic data. The German government is seeking to ensure collection of the necessary data in the EU, and it will support relevant initiatives at international level, partly as a means of assessing the sustainability of mining operations.

The German government will investigate appropriate ways of assessing the sustainability of mining operations. If exploited land and spoil tips are converted to equivalent or superior ecosystems after the end of the extraction phase, this may reduce the adverse environmental impacts mentioned above. Mining of a largely sustainable nature provides for a remediation/recovery plan developed in accordance with ecological criteria to be implemented after the end of the extraction phase.

If unused extraction data of sufficient quality can be provided and updated by the official statistics, they can be use without any overlaps in the calculation of raw material equivalents. DMC_{RME} can be supplemented by a sub-indicator for unused extraction making it possible to show the TMC (Total Material Consumption) per capita. The German government will then include this indicator in its reports. Further validation and harmonisation work on this is needed at European and international level.

In general, the "rucksacks" of individual raw materials for calculating DMI_{RME}, DMC_{RME} and TMC are checked at regular intervals, since changing production conditions mean that changes may also take place in the "rucksacks" of individual raw materials.

Contribution of closed-cycle management: Consideration of cascade use and recycling

The indicators should make it possible to see the contribution made by closed-cycle management, because efficient high-quality management of raw materials in the form of use as material – preferably by re-use or recycling and, where use as material no longer makes sense, by use for energy purposes – makes a considerable contribution to conserving resources. Recycling and cascade use increase the productivity of raw materials input and are thus an important approach for sustainable management of natural resources. The use of secondary raw materials and

fuels means that primary raw materials are replaced and the associated rucksacks they cause at home and abroad are reduced, sometimes by considerable amounts. Cascade use approaches also help to reduce the consumption of material, water, energy and land associated with the production processes. Here too, however, special attention should be focused on the efficiency of the recycling. Exports of waste to third countries with low recycling and environmental standards, followed by the "repatriation" of only a small proportion of the raw materials (usually the most valuable ones) have to be assessed differently from environmentally sound and comprehensive recycling within Germany. The various recycling processes should be compared with each other and with primary raw materials extraction as regards their environmental impacts and maximisation of the recovery of all materials contained.

Efforts are therefore being made to use indicators to help determine the sectoral contributions made by cascade use, but discussion of the necessary methodology has only just started. The German government will push ahead with this in the context of research projects and the results will be incorporated in the reports on the Resource Efficiency Programme as soon as possible. In this connection the German government will investigate, in consultation with the industries concerned, whether there is a need to collect data on the use of secondary raw materials and define appropriate indicators. It will also examine whether the percentage of total material input accounted for by recycled material might be a suitable indicator for establishing a discernible relationship between the amount of secondary raw materials and raw materials requirements as a whole. This will reveal the contribution made by closed-cycle management to raw material supply and security. Looking ahead, the German government aims to bring about a marked increase in this contribution. To this end it will ascertain the potential of raw materials tied up in long-lasting products and in the infrastructure as secondary raw materials that will be available in the future (urban mining).

PART II: STRATEGIC APPROACHES ALONG THE ENTIRE VALUE CHAIN

1. Securing a sustainable raw material supply

Approach 1:

Implementation and development of the Federal Government's Raw Materials Strategy

Reliable availability of raw materials is of vital importance for German industry with its high-tech and cutting-edge products. Production companies operating in Germany are almost entirely dependent on imports, not only for energy resources, but also for metals and many important industrial minerals.

In its Raw Materials Strategy adopted on 20 October 2010 the German government reacted to the challenges of a raw materials market that is increasingly being affected by trade restrictions, price rises, price volatility and speculation. Among other things, the Raw Materials Strategy places emphasis on efficiency in raw materials extraction and processing, and on strengthening recycling. The German government is gearing the implementation and further development of the strategy to the goal of long-term economic, ecological and social viability and stability of raw material supply.

To this end it is of great importance to push ahead with research and development at all levels (universities and other institutions in the German academic system, industrial research, joint European research) and to introduce the necessary incentives for innovation. In particular, considerable need exists in the field of sustainable extraction processes, substitution of critical and environmentally harmful raw materials, resource and material efficiency, and closed-cycle management with the aid of reuse and continued use and recycling.

A major step here is the establishment, starting in October 2010, of the German Raw Materials Agency (Deutsche Rohstoffagentur – DERA) at the Federal Institute of Geosciences and Raw Materials (Bundesanstalt für Geowissenschaften und Rohstoffe – BGR) in Hanover.[54] DERA is intended to function as a competence centre for raw materials and as a central platform for information and expert advice on mineral

54 www.deutsche-rohstoffagentur.de/DERA/DE/Home/dra_node.html

resources and energy resources for German industry. In addition to providing information on raw materials markets and the diversification of raw materials sources, DERA cooperates with industry and partner countries on projects aimed at identifying new resource potential and resource efficiency potential and developing resource extraction and mining methods.

As a new form of foreign trade cooperation, the raw materials strategy envisages bilateral raw materials partnerships with selected supplier countries. These partnerships will involve not only contractually guaranteed non-discriminatory market access to raw materials on fair and transparent terms, but also an integrated policy package that takes account of the sustainable economic, ecological and social development of the partner countries as well as Germany's interest in security of supply and planning certainty. Compliance with environmental and social standards during the extraction and initial processing of the raw materials in the partner countries is an important object of the agreements. Appropriate bilateral cooperation projects will promote sustainable raw materials extraction and treatment and a resource-efficient management approach in the partner countries. The raw materials partnerships will thus help to discharge Germany's responsibility for the global environmental impacts associated with its raw materials requirements.

Approach 2:

Targeted expansion of the use of renewable resources as materials for production

The use of regrowable resources as raw materials can make a considerable contribution to future sustainable resource supplies in Germany, for example through the wood processing industry and the paper industry. Other possible contributors to saving abiotic resources and securing resource supplies include insulating material made from waste paper and innovative, environment-friendly products, such as biopolymers, natural fibres and wood composite materials, high-performance lubricants made from animal and plant fats, or bio-based products of industrial bioengineering or chemical biomass conversion. The sustainable use of regrowable raw materials can also make a contribution to climate protection.

The use of regrowable resources as material is frequently associated with high added value, which can have a positive impact on the economy.[55] Here it is essential to comply with the criteria for sustainable forestry and good professional practice in agriculture, to avoid creating any additional environmental impacts.

It was against this background that the German government, in September 2009, adopted the Action Plan[56] for the use of regrowable resources as raw materials. The aim of the Action Plan is to develop an overall concept for a substantial and sustainable increase in the biomass share and the efficiency of biomass use in Germany's raw materials supply system. The Action Plan specifies twelve fields of action for supporting the further expansion of biomass use as materials. In addition to research and development, these include market launch assistance, public procurement, and the use of regrowable raw materials in the construction and housing sector. The Action Plan for the use of regrowable resources as materials supplements the German government's Action Plan for the use of biomass for energy. In view of the competition situation for the necessary biotic raw materials, the two biomass use paths are equally important and cannot be considered in isolation.

Regrowable resources can make a significant contribution to transforming the supply system for industrial oil-based raw materials. The "National Research Strategy BioEconomy 2030" therefore treats the industrial use of regrowable raw materials as one of five priority fields of action for the further development of a knowledge-based, internationally competitive bioeconomy.

The extent to which biomass can supplement or replace abiotic raw materials depends among other things on its availability, individual application and technical feasibility. However, in view of the limited crop potential and, in some cases, seasonal availability, efficiency improvements in the use of regrowable raw materials are an important precondition for sustainable resource supplies. Resource efficiency

55 www.bmelv.de/SharedDocs/Standardartikel/Landwirtschaft/Bioenergie-NachwachsendeRohstoffe/NachwachsendeRohstoffe/AktionsplanNaWaRo.html

56 www.bmelv.de/cae/servlet/contentblob/649756/publicationFile/39655/AktionsplanNaWaRo.pdf

can only be achieved by maximising the systematic full utilisation and application of biomass along the entire value chain, including the use of new technologies and processes. Resource wastage is to be avoided as far as possible by closing material cycles, promoting cascade use and recycling. Moreover, long-lasting goods and products are of special value from a resource efficiency point of view. What is more, all methods for the processing and conversion of biomass along the entire value chain must be made resource-efficient with regard to material and energy input and the consumption of environmental media such as water and auxiliary substances.

The German government will therefore step up its support for cascade use of regrowable raw materials, where resources are first put to repeated – preferably high-grade – use as materials, and finally used to generate energy.

This can be illustrated by two examples: Wood, for example, is ideally used first as material in the form of furniture or building material, and only then as a fuel. Although such cascade use is already established in Germany, potential still exists for improving the use of waste wood as material. In Germany, some 30 percent (approximately 2.2 million tonnes) of the 6.9 million tonnes of waste wood collected is used as material.[57] One reason for this is the competition between material use and energy use of waste wood, another is that not all types of waste wood are suitable for use as material because some contain pollutants or have been treated with wood preservatives. Use of untreated waste wood as material typically takes place in the wood products industry.

In the paper sector, cascade use of the cellulose fibres obtained from wood is already functioning very well. The increase in the use of waste paper in the paper industry from 49 to 70 percent (2010) over the last 20 years has resulted in a marked reduction in the specific environmental pressures associated with paper production, such as the consumption of wood, water and primary energy. Although the technology of waste paper recycling in Germany is at a high level on an international comparison, there is still a need for further improvements (for example currently removal of impurities due to printing inks, adhesives, paper adjuvants). In future it will be important to pursue not only quantitative, but also qualitative objectives. In ideal circumstances, paper fibres can be recycled up to six times. These cycles must continue to be utilised to the full.

Intensive research and development work is necessary to open up new areas for the use of regrowable resources as raw materials in the chemical industry. For example, the German government will support meaningful biorefinery plans of the kind that are to be described and assessed in the “Biorefineries Roadmap”. The biorefinery is an integrated overall concept for the production of food and animal feeds, chemicals, materials and energy products (for example motor fuel, biogas, heat) through a variety of conversion processes ensuring the fullest possible resource-efficient use of the biomass.

57 G. Dehoust, D. Schüler, R. Vogt, J. Giegrich: Klimaschutzpotenziale der Abfallwirtschaft am Beispiel von Siedlungsabfällen und Altholz, Öko-Institut e.V. und ifeu, Darmstadt/Heidelberg/Berlin, January 2010 www.ifeu.de/abfallwirtschaft/pdf/OI-ifeu_KuA_BDE-BMU-UBA_Endbericht_20100210_4.pdf.

2. Raising resource efficiency in production

Technological innovation can provide significant support for the shift to a more resource-efficient management approach. The development of resource-efficient and energy-efficient production processes is only a first step. An innovative development has to prove its worth on the market before it can become a competitive and sustainable technology. There are already numerous good examples in Germany for others to follow.[58]

Approach 3:

Boosting innovation and competitiveness by strengthening efficiency advice for companies

Experience made in the last decade shows that consulting permits significant savings in resource costs within the companies. Investments leading to new, more resource-efficient processes in a company often pay off within a short period. A comprehensive consulting approach covers the examination of technical aspects and operational workflows with the aim of reducing consumption of raw materials, energy and water. Constructive involvement of staff plays an important role here. The findings usually identify efficiency potentials which yield direct economic benefits for the companies concerned and which in the long term lead to an improvement in their competitive position. It therefore makes economic and ecological sense to improve resource efficiency in company operations.

The most important instrument for improving the acceptance of consulting services is information. Efficiency checks (for example PIUS-Check (Effizienzagentur NRW), material efficiency self-check (Deutsche Materialeffizienzagentur), EffCheck (Efficiency Network Rhineland-Palatinate) and the resource checks of the VDI Resource Efficiency Centre) give companies a chance to identify initial efficiency potential opportunities. Other tools, like systematisation of efficiency technologies with the aid of process chains using detailed knowledge of technologies and savings potentials, serve to provide knowledge specially tailored to the specific branch of industry. Examples of the basis used here are the work sheets on best available technologies. Moreover, anonymised and abstract descriptions of examples of successful consulting can encourage other companies to think about their own efficiency potential. As support for efficiency consulting, various technical guidelines on resource efficiency are either available or currently at the drafting stage (for example VDI guidelines or DIN standards).

To date, efficiency consulting has been used by only a relatively small number of the potential companies. Nationwide multiplier activities are needed to convince companies of its value. The German government therefore supports efforts to offer consulting services on a nationwide basis and especially to recruit small and medium enterprises as voluntary participants. For example, the Federal Ministry of Economics and Technology (BMWi) promotes the provision of expert advice on improving resource and material efficiency under the programme “BMWi Innovation Bonus – (go-Inno)”. The Federal Environment Ministry supports multi-day training courses for upgrading consultants in the field of operational resource efficiency. These measures are regularly reviewed and, where necessary, updated. Moreover,

58 For example, those resulting from the Material Efficiency Award by the German Raw Materials Agency (awarded until 2010 by the German Materials Efficiency Agency), the Resource Efficiency Network, ZIIM/IGF projects, the Efficiency Factory of the Ministry of Education and Research and the German Engineering Federation (VDMA).

support is also possible for consulting measures aimed at improving operational resource and energy efficiency in the agricultural sector as part of the "Joint Task for the Improvement of Agricultural Structures and Coastal Protection".

There is also a need for joint efforts by the federal and local authorities, trade unions and industrial associations. Cooperation with regional partners is an important precondition for the acceptance of on-site efficiency consulting for companies. The integration of industry-specific and technology-specific trade associations can be a promising way of establishing better contact with small and medium enterprises in the relevant industrial sectors. Together with the social actors, the German government will develop a "Resource Efficiency Dissemination Programme" and use it as a basis for intensive promotion of joint activities.

The German government actively supports the Resource Efficiency Network as a platform for companies, to enable them to share information about the best examples and present them to the public.

Approach 4:

Development and dissemination of resource- and energy-efficient production and processing methods

Assistance programmes such as the German government's "National Research Strategy BioEconomy 2030", the Federal Environment Ministry's Environmental Innovation Programme, the German Federal Foundation for the Environment's technology assistance programme, the Federal Economics Ministry's Central Innovation Programme for SMEs (ZIM), the Federal Education Ministry's key assistance areas "Innovative Technologies for Resource Efficiency r^2 and r^3", the Federal Agriculture Ministry's assistance programme for "Renewable Raw Materials", and programmes run by the Federal Ministry of Transport and the KfW, including the CO_2 Building Rehabilitation Programme and the "Research Initiative Building for the Future", offer a common platform for advancing efficient technologies and processes – for research, pre-competition development and the transfer of results to market application.

Successful implementation in practical operations, the evaluation of resource conservation in the process, and the spread of the technical application across industry borders lead to the establishment of resource and energy efficient production and processing technologies. This improves the competitive position of German companies and gives a boost to the labour market.

The findings gained in the course of such assistance provide a good basis for reviewing the best available technology and updating the relevant legal requirements. This permits higher environmental standards, which can in turn prompt technological innovations that reduce resource requirements.

As a contribution to achieving its resource conservation goals, the German government will continue to provide targeted assistance for demonstration projects and first-time uses with high resource-efficiency potential. This also includes integrated concepts that provide an ideal combination of material and energy uses of regrowable raw materials, such as cascade uses and biorefineries.

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Approach 5:

Information on and promotion of the use of environmental management systems

The German government is aiming for much greater participation by companies in environmental management systems, and especially in EMAS. It is committed to EMAS as the most comprehensive environmental management and environmental audit system for improving environmental performance and increasing resource efficiency in companies and organisations.

The EMAS scheme[59] stands for a high level of systematic corporate environmental protection and includes the objective of constantly improving the company's environmental performance. The EMAS environmental statements published since 1995 confirm that EMAS makes it possible to achieve substantial (cost) savings potential in the field of energy and resource

59 EMAS is the abbreviation for a European Union Regulation on a "Community eco-management and audit scheme".

efficiency. The European Union's EMAS III Regulation of November 2009 further strengthened the existing possibilities. The data contained in the EMAS environmental statements are now to be compiled on the basis of standardised core indicators which use prescribed criteria to represent the company's environmental performance. This achieves even greater transparency and comparability. Core indicators exist, for example, for the fields energy efficiency, material efficiency, water and waste. They require material efficiency, for example, to be expressed as the annual mass flow in relation to the input materials used in each case. The need for such documentation is intended to encourage companies to design their environmental management systems to use the materials concerned in the most sparing and efficient way possible.

EMAS is – particularly for small and medium enterprises – a suitable system for analysing the resource consumption of processes and products, because it has a stringent structure and there are numerous guides, some of them industry-specific, to make the work easier.

This voluntary instrument provided by the European Union for environmental management and environmental audits is open to all industries and all sizes of company, satisfies all the requirements of DIN EN ISO 14001 and, like the latter, can be used worldwide. However, there are important aspects where EMAS has more to offer: registration and logo award only after audited compliance with environmental regulations, concrete improvements in environmental performance, and environmental reporting that provides transparency for all to see. EMAS includes legal regulations on the accreditation and monitoring of the EMAS environmental verifiers and the registration of companies and organisations – including an official inquiry on compliance with the legal regulations. This contributes to the special credibility of EMAS.

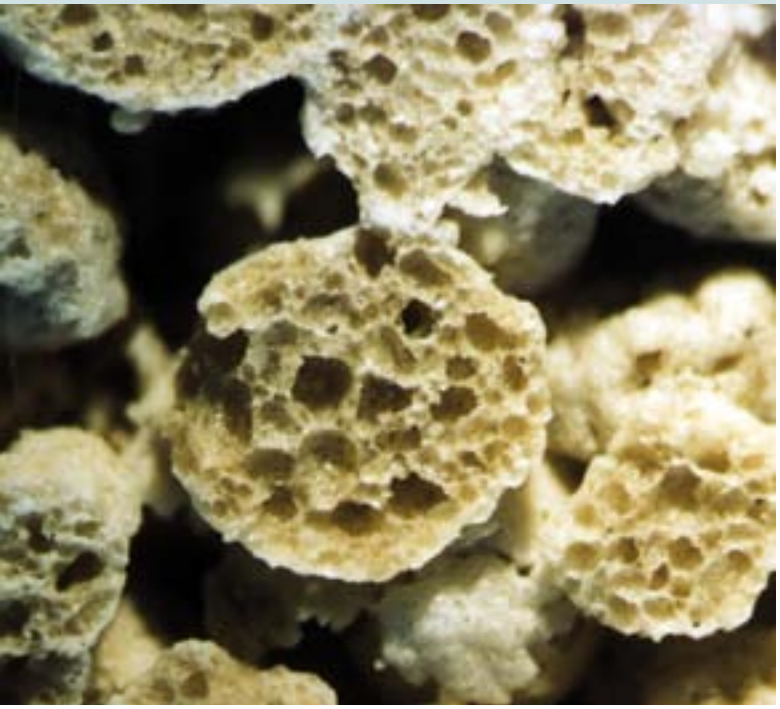
As in the past, only a small number of companies and organisations in Germany (steady at about 2000 sites) take up the challenge of that EMAS presents. However, there are many environmentally aware companies and organisations in Germany, though their activities are often confined to individual environmental measures. This means that the potential for further long-term improvements in resource efficiency by means of systematic EMAS environmental management is far from exhausted.

The federal and Land authorities grant EMAS participants administrative and financial concessions, for example in the form of reduced charges for administrative procedures and simplified monitoring regulations. To exploit the potential of EMAS on a broad basis, there is a need for additional impetus and a targeted EMAS public relations campaign by the federal and Land authorities. Examples include the regular EMAS conferences held in some Länder, awards of certificates by environment ministers at Land level, or the national competition and participant selection procedure for the annual European EMAS Award. The federal authorities are continuing with targeted communication about the possibility of using EMAS participation in the context of resource conservation and energy efficiency requirements, especially since the introduction of resource indicators in the 2009 revision of the European EMAS Regulation (Regulation 1221/2009). In the medium term, this involves EMAS participation by all public organisations at federal and Land level. Their procurement activities should take account of EMAS participation by suppliers and service providers wherever possible.

When reviewing and improving the legal regulations with regard to resource conservation (see Approach 18 below) it will be necessary in each case to examine the extent to which participation in EMAS can in itself be deemed to satisfy certain resource conservation requirements.

Approach 6:

Innovation through the integration of resource efficiency into product design



Reapor® is a non-fibrous material made from waste glass which offers a health-safe and environmentally sound alternative to conventional insulating materials. The material is robust but light in weight, insulates against heat, cold and noise, and can be recycled.

The implementation of ecodesign – in the sense of developing products that are both environmentally sound and in line with market requirements – as a desirable principle of product design calls for regular consideration of resource consumption. But other aspects also have to be taken into account, such as profitability and relevant technical conditions. Lightweight construction, substitution of especially critical materials, increased reuse and further use, recycling-friendly design or the use of recycled and secondary materials are methodological approaches to taking account of resource consumption in product design. In particular, these aspects address the quantity of the resources used, their repeated recyclability (closed-cycle management), and their useful life or total useful life including any subsequent use phases. This approach is also the focus of the external consulting services for SMEs under the "BMWi Innovation Bonus" programme.

For the practical implementation of resource efficiency as a design principle during product development, it will in many areas be necessary to ensure regular collection of data on the production, use and disposal of associated substance streams in the product life cycle and their ecological assessment. This facilitates the design of existing product policy instruments – especially those of the Ecodesign Directive and of eco-labels like the Blue Angel – and in some cases makes them possible in the first place. Considerable technical advances have been made in this field: Recent years have seen the development of the Product Carbon Footprint (PCF) and the Water Footprint, methods which measure consumption of the relevant resource over the entire life cycle and can be used as a voluntary optimisation instrument for product design. The German government will therefore promote further development of methods for taking comprehensive account of resource efficiency in product design and – except where counter-indicated by economic, technical or other aspects – support their extension to all materials and substances. In the construction sector the assessment system "Sustainable Building for Federal Buildings" (BNB) exists at federal level. This takes account of the resource efficiency aspect – and also includes more far-reaching aspects in its assessment scheme. Generally speaking, the development of DIN standards and any guidelines should be in line with this. If it is to acquire practical relevance, its communication in the initial and further training of engineers, technicians and designers is absolutely essential. On the basis of existing initiatives, the German government will step up the relevant support in cooperation with the Länder and interested associations.

Communication of information along value chains, even beyond the first recycling cycle, is of great importance in view of the increasing complexity of substance cycles.

Approach 7:

Integration of resource conservation into standardisation

The German government welcomes the approach that greater consideration be given to resource conservation aspects when drafting national, European and international standards, and that potential impacts on resource conservation be taken into account when reviewing existing standards. For example, the German government promotes initiatives for raising awareness of resource conservation aspects among those involved in the standardisation process. The German government will examine whether there is a need to update the standardisation strategy to take greater account of resource efficiency aspects.

To gain the maximum benefit from the contribution of regrowable raw materials to resource conservation and ensure the sustainability of their use as material, the German government actively supports the work in progress on the standardisation of bio-based products at national and European level, as initiated under the EU Lead Market Initiative “Bio-based products”, for example.

The German government will examine whether there is a need to work towards the development and introduction of specific standards for resource conservation aspects of products and services.

DIN ISO cen European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

3. Making consumption more resource-efficient

Through their purchase decisions, consumers exert influence on the nature and quantity of the resources used. Consumer purchase decisions affect nearly 60 percent of the GDP. Consumers and trade need information and knowledge about environmental protection and resource conservation so that they can take informed decisions. At the same time they should be sensitised to the issue of resource efficiency and motivated to address it.

Approach 8:

Creating public awareness

Educational material on "Waste prevention, disposal and recycling" provided for primary schools by the Federal Environment Ministry

Making behavioural changes that conserve resources and giving preference to resource-efficient technologies calls for information, motivation and qualification. Thus educational measures at all levels are of central importance: from general awareness raising about resource conservation and efficiency (general school system, general adult education) to vocational training (universities, vocational training and (in-house) further education). Environmental communication and consumer information tools can be used to provide further support and momentum for the shift to sustainable use of resources.

In this context, environmental communication and consumer information can build on the strong public awareness that exists in Germany for waste, environment and climate issues.

One important means to this end is the activation of relevant actors, for example teachers, and also consumer advice centres and other citizens' information establishments, as multipliers. The German government will make targeted approaches to key social groups to gain their support and active commitment.

In the course of its cooperation with the Länder, the German government will urge that school education provide a broad basis of information about resource efficiency as a core competence of responsible action. The German government will support this by means of public relations campaigns and through teaching and information material on resource efficiency. For example, the Federal Environment Ministry's Education Service is currently developing teaching material for secondary schools and supporting the dissemination of other suitable material.

The German government, in cooperation with both sides of industry and other actors concerned, such as the chambers of industry and commerce, will also make every effort to ensure that vocational training regulations devote appropriate attention to the necessary work-related aspects of resource efficiency.

At university level, resource efficiency currently enjoys little prominence as an issue in engineering, economics or natural science course or in teacher training. In consultation with the relevant actors, the German government will start initiatives designed to achieve greater integration of teaching about resource efficiency.

As part of its commitment to education for sustainable development, the German government is already taking a wide range of measures to encourage integration of the resource efficiency issue in teaching programmes, and will continue to do so in the future. Training and upgrading courses for sustainability coordinators for the administrative facilities responsible for federal buildings are already being run as part of the assessment system "Sustainable Building for Federal Buildings" (BNB). The topic of resource efficiency is an integral part of the teaching plan.

Initial and further training courses for resource efficiency consultants need reliable quality standards which ensure that training courses are comparable and qualifications are equivalent. The German government supports relevant initiatives on qualification measures for resource efficiency consultants.

Approach 9:

Resource efficiency as a criterion for trade and consumer decisions

The (distributive) trade is the link between producers and consumers. It therefore has a special responsibility.

The German government will work to ensure framework conditions that make it easier for consumers to behave in resource-efficient ways. To this end it will:

- step up its efforts to encourage the trade sector as a central actor to implement measures to improve resource efficiency,
- seek increased cooperation on consumer information (for example regarding awareness of labels or return systems),
- make efforts to ensure that environmentally relevant product information systems and consumer information are reflected better in the field of e-commerce,
- try to gain consumer support for considering the resource requirements of a product from purchase through use to disposal.

The "Blue Angel" eco-label can play an important role here. The Blue Angel is the world's oldest environment-related label for products and services. The first six award criteria were established by the eco-label jury in 1978. Today some 11,500 products in 90 different product groups from around 1,050 companies bear the Blue Angel.

The "Blue Angel" is a brand with considerable value for guidance purposes and enjoys great credibility as a state-recognised label. Consumers can be sure that only the best products within an product group are awarded the Blue Angel, and that all important environmental impacts are taken into account.

DER BLAUE ENGEL
JURY UMWELTZEICHEN
schützt
MENSCH UND UMWELT

The Blue Angel is also a system for setting standards with the participation of stakeholder groups. The Blue Angel criteria for each individual product group are discussed and agreed with representatives of all major social groups. This ensures that all decisive factors such as environmental properties, fitness for use and consumer safety are taken into account. Manufacturers and trading companies are also involved in the work processes.

Resource efficiency aspects have been clearly communicated ever since the introduction of protection objectives: since 2008, products and services of a particularly resource-conserving nature have borne not only the legend “Because made from recycled paper”, but also the information “Conserves resources”.

The German government will

- step up further development of the category “Conserves resources” in the Blue Angel eco-label system and also its promotion of the eco-label through cooperation and publicity measures,
- step up the development of standards for resource efficiency in the field of products and services.

The German government will furthermore:

- promote further development of consumer-friendly and meaningful product information systems for increased integration of resource conservation aspects, for example in existing labels,
- support the formation of networks between different actors in the field of resource-efficient consumption,
- maintain and increase public competence in the field of waste separation and prevention (for example through campaigns in cooperation with local authorities),
- support the expansion of on-site consumer advice (for example efficiency consulting as a direct follow-up to energy consulting) as an important field of activity for federal, regional and local authorities,
- step up advice and communication on regrowable raw materials and resource-efficient bio-based products to facilitate their market introduction,
- continue building material information systems that provide information about ecological aspects of building materials and products (WECOBIS and Ökobau.at).

Non-governmental organisations (NGOs) and grass-roots initiatives can act as drivers and multipliers in raising awareness of sustainable use of resources.

The German government will:

- increase financial assistance for suitable measures by NGOs and grass-roots initiatives as multipliers for a culture of sustainable resource use (for example in the context of the National Climate Initiative),
- promote cooperation arrangements and networks relating to new use concepts wherever this makes sense (for example exchange circles, car-sharing organisations or second-hand suppliers),
- step up promotion of pioneering projects run by civil society initiatives for sustainable lifestyles (for example advisory systems and community education in Web 2.0).

Approach 10:

Introduction of new certification schemes, greater use of existing schemes for raw materials

Certification measures are an instrument which is receiving growing attention for greater transparency and for enforcing sustainability standards. Whereas the development of certification measures is already well advanced in the forestry or food industries, for example, such measures are less common in the abiotic raw materials sector or in connection with resource efficiency.

Access to acceptable raw materials sources is not only a question of corporate social responsibility for industry, but is increasingly also a necessity to minimise the risk of barriers to market access or to comply with statutory requirements. For example, the Dodd-Frank Act of 2010 in the USA requires companies to provide evidence of the conflict-free provenance of raw materials.[60]

Since the G8 summit in Heiligendamm, Germany has supported efforts to ensure greater transparency in the raw materials sector. One major objective is to strengthen sustainable resource management while safeguarding human rights and complying with internationally recognised social and ecological minimum standards. The German government therefore provides, through Germany's development cooperation, political and financial support for the Extractive Industries Transparency Initiative (EITI), in which resource-rich countries commit themselves to disclose state revenue from raw materials. In addition, the Federal Ministry of Economics and Technology and the Federal Ministry for Economic Cooperation and Development are jointly funding a pilot project for the certification of mineral resources in Rwanda. Moreover, the Federal Institute of Geosciences and Raw Materials (BGR) developed a reliable standardised procedure for analytical identification of the origin of coltan. This method constitutes an important building block for monitoring in a certification system for abiotic raw materials.

The German government supports the development of such certification systems and aims to further expand such systems to take account of comprehensive sustainability criteria, especially through greater integration of criteria on environmental impacts and the social impacts of resource extraction and treatment.

In the further expansion of the use of regrowable raw materials it has to be borne in mind that the demand for biomass for use as material is in competition with the food sector and energy production. Stepping up biomass production can contribute to securing incomes in rural areas and – especially in developing countries – to poverty alleviation. However, it can also have adverse ecological and social impacts. To demonstrate the sustainability of biomass use from production through processing to use, there is a need for WTO-compatible sustainability criteria and acceptable certification systems that are suitable for worldwide application. At least for the production of regrowable raw materials, existing certification systems for heating bioliquids or in the forestry sector can be used as a basis.

The German government will therefore advocate, at European and international level, an increase in certification of abiotic and biotic raw materials and the examination of a system for certifying foreign recycling facilities on the basis of sustainability criteria. Such investigations will also include examination of the extent to which the criteria and certification mechanisms can be integrated in appropriate systems of labels that permit rapid and reliable identification of the sustainability of a raw material at the time of purchase.

60 www.bgr.bund.de/DE/Gemeinsames/Oeffentlichkeitsarbeit/Pressemitteilungen/BGR/DERA/dera-bgr-110520.html

Approach 11:

Increased use of public procurement as an instrument of resource efficiency

The total volume of public procurement activities – albeit spread over a large number of public purchasers and individual orders – comes to around Euro 260 billion per annum, and is thus of considerable economic importance. The public procurement sector therefore offers potential for supporting resource-efficient products and hence also for sustainable development and climate protection. The public sector can take advantage of the resulting opportunities to strengthen the position of such products and services on the market.

Systematic attention to life cycle costs when ascertaining the "most economic offer" in order placing procedures makes it possible to optimise the decision from an economic and ecological point of view.

The German government regards standards as an important aspect of public procurement. For example, standards can support the efficient use of materials and energy and can thereby contribute to the sustainable use of natural resources.[61]

Against this background the German government, in its own procurement activities, will push ahead with reducing the associated direct and indirect adverse environmental impacts while observing the principle of cost-effectiveness. In addition to energy efficiency[62] greater attention will be devoted, where possible, to the material efficiency of product and services, for example by raising the input share of recycled paper to at least 90 percent by 2015.[63]

The Joint Decree by the Federal Economics Ministry, the Federal Environment Ministry, the Federal Ministry of Agriculture and the Federal Ministry of Transport on the Procurement of Timber Products[64], which obliges the Federal Administration to use only timber products from legal and sustainable forest management, can serve as a further example of how criteria or requirements can be implemented in the context of public procurement. Under this decree, the bidder is to provide evidence by presenting a certificate from the FSC, PEFC or a comparable certificate, or in the form of individual proofs.

In addition, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) provides information through the project "NawaRo-Kommunal" about the possible uses and benefits of products made from regrowable raw materials at local authority level as well.

The German government intends to recommend its procurement offices to ensure that specifications in public procurement are more closely geared to the use of more resource-efficient products and services, while observing the economic principle laid down by the legislation on budget and award procedures.

61 Cf. Normungspolitisches Konzept der Bundesregierung (Federal Government's Standardisation Concept) (2009), Goal 5. www.bmwi.de/BMWi/Redaktion/PDF/M-O/normungspolitisches-konzept-der-bundesregierung,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf.

62 Cf. "Allgemeine Verwaltungsvorschrift zur Beschaffung energieeffizienter Produkte und Dienstleistungen" (General administrative guideline on the procurement of energy-efficient products and services) of 17.01.2008, AllgVV, and first amendment to AllgVV of 18.01.2012.

63 Federal government's "Sustainability Measures Programme" of 6.12.2010, No. 6. c), www.bundesregierung.de/Webs/Breg/nachhaltigkeit/Content/_Anlagen/2010-12-6-massnahmenprogramm-nachhaltigkeit-der-bundesregierung.html.

64 GMBl (Gemeinsames Ministerialblatt) (Joint Ministerial Journal) 2010, page 1786 www.bmelv.de/cln_173/SharedDocs/Rechtsgrundlagen/H/HolzbeschaffungErlass.html.

4. Enhancing resource-efficient closed-cycle management

Resource efficiency calls for thinking in terms of material flows from a life-cycle perspective that takes account of the entire global value chain right from initial resource extraction. Thus in addition to material efficiency in production and sustainable consumption of goods, closed-cycle management makes a substantial contribution to conserving natural resources. In 2009 the supply of secondary raw materials met more than 13 percent of the raw materials requirements of German industry, and the trend is upward. Some 63 percent of municipal waste in Germany was recycled in 2009, and including use for energy purposes the rate was as high as 77 percent.[65] Substitution of primary raw materials also reduces the environmental pressures caused by their extraction. For example, the concentration of gold in one tonne of high-grade printed circuit boards is 40 to 60 times higher than in primary ores.[66] Recycling and closed-cycle management also reduce German industry's dependence on imports. There are gains in planning certainty due to the cushioning of volatile market prices for primary raw materials.

Every raw material that is obtained from nature and goes into production and consumption ultimately becomes waste.[67] Some 359 million tonnes of waste were produced in Germany in 2009, including 48.5 million tonnes of municipal waste and about 192 million tonnes of construction and demolition waste. Environmentally sound recycling and disposal represents a great challenge from a technical, organisational and economic point of view with long-term impacts on the environment, resource conservation and climate protection.

The waste management industry in Germany has taken up this challenge and has undergone substantial changes since the 1980s. Supported by the strict legal requirements of the Closed Cycle and Waste Management Act of 1994, its sub-statutory regulations and in particular the political framework conditions for product responsibility in the fields of packaging, end-of-life cars, batteries, electrical appliances, graphic waste paper and construction waste, the step from waste disposal to closed-cycle management is an important development. The latest revision of the Closed Cycle and Waste Management Act will further advance this development of the waste management industry to a resource-conserving and environmentally sound materials flow management system. A significant element in the revision is the implementation of the new five-stage waste hierarchy from the European Framework Directive on Waste. This gives waste avoidance and the preparation of waste for re-use priority over recycling, other uses of waste and environmentally sound disposal.

Reuse comprises processes through which products or components are used again for the same purpose for which they were originally intended. Preparation for reuse comprises measures for testing, cleaning or

65 Federal Statistical Office (2011): Abfallbilanz 2009 (Waste balance 2009). www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Navigation/Statistiken/Umwelt/UmweltstatistischeErhebungen/Abfallwirtschaft/Tabellen.psml Online survey of 11 July 2011.

66 Assumptions: Gold content of high-grade printed circuit boards around 200–300 g/tonne, gold content of ores around 5 g/tonne. Figures based on Christian Hagelüken (2010): Recycling von Edel- und Sondermetallen als Schlüsselbeitrag zur Rohstoffsicherung – Möglichkeiten, Herausforderungen, Grenzen, Konsequenzen. Euroforum Frankfurt, 21.–22.09.2010.

67 Apart from gaseous or liquid emissions, which are not covered by the definition of waste in the Closed Cycle and Waste Management Act.

Compressed bales of tinplate and scrap metal stacked ready for recycling.

repairing waste, so that it can be reused without any further processing.[68] As a rule, preparation for reuse is not very energy intensive. However, in view of the varying framework conditions in the different product fields it is only practised on a relevant scale in the case of waste types for which a market exists for the resulting products. Examples include furniture or automobile components.[69]

The limits to reuse are essentially dictated by a process of balancing interests in which the resource requirements, the environmental impacts and the economic input needed to prepare for reuse have to be set against production from scratch (taking account of recycling). Indirect impacts arising from the use of products or components which are no longer state of the art – for example with regard to energy consumption – must not be ignored. The aspect of guaranteeing the technical safety of equipment also places limits on reuse. However, the reuse of products can be improved considerably if the relevant requirements are taken into account at the product design stage.

The number of waste types and the quantities involved are considerably greater for recycling than for reuse. The aim of recycling is to generate resource-relevant streams of substances and materials by concentration or by separating pollutants and foreign matter. Important measures for recycling are separate collection, high-grade sorting if necessary, and allocation to suitable treatment processes. Material flows of special relevance include wood, mass metals, technological metals, plastics, fibres and minerals, which can in particular be extracted from waste such as scrap, end-of-life electrical equipment, end-of-life vehicles, packaging, paper, textiles and mineral construction and demolition waste. The list also includes fermentation residues and compost obtained from bio waste, and phosphates from municipal sewage sludge.

At the latest, the limits of recycling are reached when the associated expenditure and emissions exceed those arising from extraction of the primary raw material, or when the recycled material fails to meet the quality requirements. Waste-specific life-cycle assessments can help with this balance of interests. It is also necessary to consider the potential pollutant levels in the waste material used and their importance for the new alternative use, which places limits on the use of the resources.

“Other uses” comprises all other utilisation options. In particular, it includes the use for energy purposes of alternative fuels from high-calorific waste which can be used to replace primary energy resources.

68 Rebecca Prelle (2008): Begriff und Bedeutung der (Vorbereitung zur) Wiederverwendung im Abfallrecht. Abfallrecht 5/2008, page 220 ff.

69 Depending on the quality of the products, the terms “refurbishment” or “remanufacturing” are also used in this context.

Approach 12:

Reinforcing product responsibility

Waste management-related product responsibility is a core instrument for increasing material efficiency through waste management. To comply with product responsibility, products must as far as possible be designed to minimise the waste created during their production and use. After the in-use phase, producers are responsible for environmentally sound recycling and disposal. This creates an incentive to avoid waste – for example by using returnable packaging material – and to ensure recycling-friendly design of products. The most important instruments of waste-sector product responsibility are obligations on the user to return products that have become waste and to keep them separate, obligations on the producer to accept returned items, and specified quotas for collection and recovery. Product responsibility in the waste management sector is already implemented through various regulations, for example the Packaging Ordinance (*Verpackungsverordnung*), the Electrical and Electronic Equipment Act (*Elektrogesetz*), the End-of-life Vehicles Ordinance (*Altfahrzeugverordnung*), the Batteries Act (*Batteriegesetz*) and the Waste Oil Ordinance (*Altölverordnung*).

To ensure that product producers and waste generators meet the product responsibility requirements in practice, it is necessary to create specific incentives for individual waste streams and, where necessary, to take other suitable steering and control measures. To this end the German government will in particular make further use of the powers conferred by existing ordinances to impose requirements on product design, development, production and marketing.

The German government also intends to continue developing the existing waste management rules on product responsibility from a resource conservation point of view. In particular, the Packaging Ordinance is to be developed into a general set of rules for recyclables. The aim is to make greater use of the recycling potential of recoverable substances in residual waste by introducing a standardised nationwide collection system for recyclables (“recyclabling bin”).

With special reference to critical metals, the German government is investigating the possibility of more targeted collection of products rich in specific recyclables.

Approach 13:

Optimising collection and recycling of resource-relevant bulk wastes

Bulk metals such as iron, steel, copper or aluminium scrap and bottle-bank glass can be recycled with virtually no loss of quality. There are already well functioning markets for such material flows. To further strengthen these secondary raw material markets, the German government has for example supported the efforts at European level to introduce a regulation with criteria defining the end of waste status for iron, steel and aluminium scrap (compare Example 1: Bulk metals). In addition, it is supporting the European Commission with the development of comparable criteria, which are initially planned for the fields of copper scrap, waste glass, waste paper and plastic, and treated bio waste. The legally binding quality criteria laid down there can considerably increase the acceptance of the substances concerned and hence also the demand for them.

The recycling of municipal waste is also to be stepped up. The current revision of the new Closed-Cycle Management Act (Kreislaufwirtschaftsgesetz) lays down an initial recycling rate of 65 percent by weight, which is well above the EU level and is to be achieved by 2020. The new waste hierarchy, the reinforcement of separation requirements, and – not least – the introduction of the standardised recyclables collection serve as instruments for improving recycling. The recovery of bio waste is also to be stepped up. The draft

Recycling of mobile phones

of the Closed-Cycle Management Act includes a basic requirement for separate nationwide collection of bio waste, starting not later than 1 January 2015. Although the amount of bio waste collected separately already exceeds 100 kilograms per capita of the population and Germany is one of the worldwide leaders when it comes to separate collection of bio waste, there is still further optimisation potential in this field. For example, only about half the population are currently covered by a bio waste bin system.

Biogenic residues from food production and processing can be used for both material (feedstuff and fertiliser production, fat chemicals) and energy purposes, or as input materials for motor fuel production, and extensive use is being made of the existing potential. Further potential for optimisation still exists, for example in phosphate recovery.

With an annual average of around 192 million tonnes, construction and demolition waste is Germany's biggest waste stream in terms of volume. In 2008 this was used among other things to produce 66.6 million tonnes of recycled building materials, covering 11.5 percent of the total amount of aggregate needed in 2008.

To open up other areas of application, the German government is investigating what targeted measures could lead to increased acceptance of recycled building materials (compare example: Sustainable building and housing). The quota of 70 percent by weight laid down by the new Waste Management Act for the use mineral waste as material is currently far exceeded, with a figure of around 90 percent. The high recovery rate in this sector is to be safeguarded on a long-term basis.

Approach 14:

Ban on illegal exports, support for waste recovery structures in newly industrialising and developing countries

Illegal exports of waste containing special amounts of waste and pollutants (particularly end-of-life electrical and electronic equipment) to countries outside the European Union tend to result in a loss of resources, as this waste rarely undergoes efficient recycling in the receiving countries. In many receiving countries it also involves considerable risks for man and the environment where these countries do not have efficient collection, processing and recovery structures and protection standards. From the point of view of resource conservation and environmental and health protection there is therefore a need for stricter monitoring of waste exports. To prevent illegal exports of end-of-life electrical equipment, it is also important to create a clearer distinction between end-of-life electrical equipment and functioning equipment. A clarification of the legal position is planned in connection with the revision of the Waste Electrical and Electronic Equipment (WEEE) Directive. In future it will be the exporter's job to show that the items in question are functioning equipment.

In developing and newly industrialising countries there is a need to develop sustainable structures adapted to local conditions for the collection of waste products and to install or provide recovery facilities for resource-relevant materials and substances, especially to ensure that product waste in the country in question is treated in the best interests of global resource conservation. This would at the same time cater for social aspects, such as widespread child labour or health risks due to unprotected contact with toxic materials.

Germany supports the establishment of a suitable waste management infrastructure in the developing countries through offers of cooperation, communication of information, technology transfer and discussion in international bodies (for example under the E-Waste-Africa Initiative, the Basel Convention partnership programmes for mobile phones and computers, or the RETech Initiative).

In particular, the German government will advocate and encourage voluntary and self-commitment activities by producers and the introduction of legal regulations.

5. Using overarching instruments

To develop Germany into one of the world's most resource-efficient economies, there is a need for suitable institutional framework conditions of a political, economic and legal nature that provide appropriate incentives for resource-efficient activity and create the basis for the actors concerned to cooperate and share information and experience.

Approach 15:

Strengthening instruments for improving market penetration of resource-efficient products and services

There must be faster market penetration of resource-efficient products and services. This calls for a policy that creates transparency about the resource efficiency of production processes and products, gives companies the necessary incentives and, where necessary, support for putting resource-efficient products and services on the market, and also creates trust in the market.

The Ecodesign Directive could be one possible lever for supporting faster market penetration of resource-efficient products. The Directive makes it possible to lay down minimum efficiency standards for selected products. If the standards are not satisfied, the products may no longer be marketed on the single market. Together with other instruments such as voluntary product labelling for particularly resource-efficient products, resource consumption labelling, and the coupling of resource efficiency aspects to the award criteria for public procurement, it would be possible to develop an instrument mix that supported market penetration of resource-conserving products on the lines of the Top Runner approach. An intelligent instrument mix could create incentives for companies to step up their efforts to develop and market resource-conserving products.

As a first step, the German government will continue to advocate that the European Commission examine more closely whether and to what extent greater use can be made of the instruments of the Ecodesign Directive for the objectives of resource conservation. The German government is following the relevant scientific method study commissioned by the EU Commission.

Instruments such as indicators and benchmarking systems that provide information about resource requirements and company resource efficiency can also help to increase public and business awareness of resource efficiency. They could also become increasingly important in company financing, as resource efficiency is likely in future to play a much more important role in a company's competitiveness and profitability than it does today.

The German government therefore actively supports the introduction and further development of regulations and measures that ensure a better basis of information and resource transparency.

Among these measures are the development of standards for labelling requirements and consumer information in order to permit comparable, easily understood and transparent labelling, including requirements for the quality of the underlying data base.

The German government will also support the provision of precise, easily understood, standardised and relevant information via suitable access routes (for example Internet, radio, TV).

The German government therefore welcomes activities by the consumer advice centres and Stiftung Warentest to step up consumer advice on resource efficiency.

White trainers from fair trading

In some areas the market launch of resource-efficient products and services will only be successful if it is supported by appropriate promotion instruments. Such an approach is needed in particular to pave the way for innovation leaps and system innovations which would be beyond the capacity of individual companies because of their limited influence on the market.

In many cases, system innovations are only possible if information on improving resource efficiency is shared. To this end there is a need to improve co-operation between various actors. The German government therefore intends to bundle or revise existing assistance programmes to cater better for resource efficiency aspects and improve interchange and cooperation between the actors.

The German government will furthermore examine whether an improvement in resource efficiency (for example product durability) can also be achieved with the aid of consumer protection instruments.

Approach 16:

Using economic instruments and dismantling subsidies which encourage resource consumption

The situation on the raw materials markets in recent years has to some extent been one of substantial price fluctuations at short intervals. This places burdens on consumers and especially on German industry, which is dependent on raw materials imports for its very existence. In the field of production and consumption, resource efficiency calls for a high rate of innovation in product design and consideration for resource input when taking purchase decisions. In the field of closed-cycle management, revenue structures and price signals are important factors for exploiting reuse and recycling potential.

The German government will therefore examine how incentives in the form of suitable framework conditions and economic instruments, and also innovation promotion programmes, can contribute to improving the resource efficiency of German industry having regard to its position in international competition. In its choice of instruments, the German government will pay attention to competition-oriented design from both a domestic and an international point of view, give incentives and voluntary solutions preference over governmental regulations, and avoid burdening industry with costs that make the use of resources more expensive.

A similar situation applies in the field of subsidies. Subsidies can directly or indirectly increase the incentive to extract resources and thereby run counter to resource efficiency. The German government has set itself the goal of reducing environmentally harmful subsidies. On the basis of the Federal Government's Subsidies Report it will therefore examine whether subsidies that provide direct or indirect incentives to increase resource extraction can be reduced or replaced by assistance measures which do not have adverse impacts on the conservation of resources and the improvement of resource efficiency.

Approach 17:

Strengthening research and improving the knowledge base

The German government will continue and further expand the assistance for applied research to increase resource efficiency.

The Federal Ministry of Education and Research (BMBF) is currently drawing up a national research and development programme for new resource technologies ("Strategic industrial resources for Germany as a high-tech location"), which is due for publication in the second quarter of 2012. The aim is to ensure better networking of existing research facilities and to gear current and future research assistance to increasing resource efficiency. This will bundle research power to improve the supply situation in Germany. The focus of the programme is on non-energy strategic industrial resources, especially metals which are of great relevance to the development of key technology and offer great leverage for Germany as an industrial location. In many branches of industry there is still considerable potential for improving resource and material efficiency. Industry in particular has potential for working more systematically than in the past to exploit existing efficiency potential in product design and production and in the field of services. Research needs to focus on identifying and exploiting resource efficiency potential along the entire value chain, from resource extraction and processing through the use phase to recycling. The programme is also to strengthen the supply side, id est the extraction of primary raw materials and the recovery of secondary raw materials for the production of goods. The German government will investigate the need for research into life-cycle analyses (data collection and provision) for products of central importance.

The Helmholtz Institute for Resource Technology (HIF), established in 2011 with assistance from the Federal Ministry of Education and Research and the Land of Saxony, will advance the development of new technologies for efficient resource exploitation along the entire value chain from exploration to recycling, and also research into possible substitution options.

Through various measures within a strategic process for industrial biotechnology, the Federal Ministry of Education and Research will develop important basic technologies for a new generation of bioengineering processes. It will also use the “Industrial Biotechnology Innovation Initiative” to activate the as yet unexploited potential for applying biotechnology methods to other industrial processes. Further measures are in preparation.

Through its initiatives, the Federal Ministry of Education and Research is seeking to establish resource efficiency and resource conservation more firmly in the practical world and, taking advantage of synergies, also in vocational training and academic education with the aim of further reinforcing the competitive strength and innovative power of companies.

This calls for the transfer of research findings into the world of practical operation and product design, so that the resulting efficiency potential can exert its full effect. Resource efficiency is frequently a complex topic for companies: there are deficits in information and perception, or a lack of know-how for implementation. Small and medium companies in particular often see financial and technical obstacles to this transfer. For this reason the German government aims to advance the increased use of resource-efficient processes and products by developing and expanding support in the form of financial assistance, expert advice, initial and further training, improved communication and cooperation, and the establishment of networks.

There is a specific need for research in the case of bioengineering methods used in industrial production processes, and also nanotechnologies. From an economic and ecological point of view, the use of many bioengineering methods in industrial production processes offers a number of advantages, such as low-energy design of production processes or the increased use of renewable raw materials. Whether the bioengineering methods implemented do in fact offer environmental benefits is something that can only be judged in the individual case by means of an extensive life-cycle assessment taking account of the upstream agricultural chain, for example.

Nanotechnology products often contain scarce metals and precious metals as “nanoactive” components. Particularly for high-technology products in the IT and communication sector, the use of such metals is seen to offer opportunities. The products themselves frequently display advantages compared with conventional applications, for example savings in energy and resources. Here too, however, the sustainability of the products can only be assessed by an overall consideration of the entire life cycle which also looks at alternatives (such as other technical solutions, comparisons with products which do not contain nanomaterials, savings options, recycling options). The German government is therefore continuing the broadly based assistance for research and development of innovative sustainable processes which it initiated as part of the high-tech strategy, which also considers the field of raw material preparation of by-products in the mining sector.

Approach 18:

Considering resource efficiency in the further development of the legal framework at national level

Measures to make sparing and efficient use of natural resources and to avoid environmental pressures associated with the extraction and use of raw materials need a suitable legal framework that gives the actors involved rules for guidance and legal certainty in their activities. To varying degrees, the provisions of German law currently in force already contain rules for resource conservation, for example the Closed-Cycle and Waste Management Act (*Kreislaufwirtschafts- und Abfallgesetz*) (compare Approach 12 above), the Federal Immission Control Act (*Bundes-Immissionsschutzgesetz*) (especially operators' obligations), the Environmental Assessment Act (*Gesetz über die Umweltverträglichkeitsprüfung*), the Environmental Audit Act (*Umweltauditgesetz*), the Federal Mining Act (*Bundesberggesetz*), the Federal Regional Planning Act (*Raumordnungsgesetz*), the Federal Building Code (*Baugesetzbuch*), and the legislation on awarding contracts in the public sector.

The German government will examine the possibility of greater integration of the resource conservation concept in appropriate fields of law. Making the existing provisions and instruments more specific and developing and supplementing them could help to establish a broader base for the idea of resource efficiency, and their implementation could make for more efficient use of resources and more sparing use of raw materials. Here consideration must also be given to informal means of control (for example through voluntary commitments), economic instruments (Approach 16) and concessions associated with the use of environmental management systems (Approach 5).

Approach 19:

Technology and knowledge transfer, expert advice

Environmental technology transfer plays a key role in tackling global environmental problems. Environmental technology transfer takes place at national and international level. It embraces not only the transfer of technological processes, goods and services, but also the transfer of knowledge about (new) technical and organisational solutions in the field of environmental protection.

A major challenge here with regard to the efficiency of technology transfer is knowledge management and coordination of the actors, since lack of transparency and inadequate communication often result in similar projects being planned and implemented in isolation from each other. This results in failure to exploit the potential of a concerted effort with a much greater (external) impact. Experience made in the field of waste technology transfer shows that there is great demand for material flow specific or installation specific "best-practice knowledge", for example.

Environmental technology transfer at international level pursues two goals: By building capacity it is intended to improve the environmental situation and/or environmental knowledge in the partner country and support exports by German environmental technology companies. Institutional examples include German development cooperation within the purview of the Federal Ministry for Economic Cooperation and Development, the German chambers of foreign trade and commerce, export initiatives such as RETech for innovative recycling technology, or environmental technology portals such as "cleaner production germany".

In the context of bilateral development cooperation by the Federal Ministry for Economic Cooperation and Development (BMZ) and the International Climate Initiative of the Federal Environment Ministry (BMU), the German government will step up its bilateral projects to promote resource efficiency in developing and newly industrialising countries. In the interests of bundling and coordinating the many and various activities, the German government is also looking into the possibility of creating a "Resource Efficiency Export Network".

Approach 20:

Further developing the political and legal framework at EU level and in an international context

The German government welcomes the increasing focus of European environmental policy on resource conservation. It supports the development of suitable indicators for assessing and investigating resource efficiency at European level. Germany is actively accompanying the process of evaluating the Thematic Strategy on the Sustainable Use of Natural Resources and the further development and fleshing out of the lead initiative of the EU strategy "Europe 2020" and the EU Commission's "Roadmap for a resource-efficient Europe".

At European and international level as well, Germany is campaigning for the continued development of the regulations relating to resource conservation. This will help to expand the pioneering role of European companies and strengthen their competitive position.

The German government supports the investigation into the extent to which the EU Top-Runner approach that has proved its worth in the field of energy efficiency can be used to increase the resource efficiency of products. The approach comprises minimum requirements under the Ecodesign Directive, obligatory and voluntary product labelling, and the coupling of public procurement to environmental criteria. The government is playing an active part in examining the possibility of laying down ambitious resource-specific product requirements and information in implementation measures, legal acts and award criteria.

The German government will make every effort to lay the foundations for a sustainable and resource-efficient materials flow management system at European and international level. The aim here is to encourage activities that reduce adverse environmental impacts throughout the entire life cycle and help to conserve the natural basis of life.

Manufacture of bio-cotton T-shirts for export, India

Among other things, this includes increased certification of raw materials or trade chains on the basis of sustainability criteria and the establishment of extra-territorial sustainability requirements in the interests of resource conservation.

At international level, resource conservation must be established more firmly as a task of governmental precautionary policy. The German government intends to maintain Germany's engagement in international bodies, for example the International Resource Panel (IRP) under the United Nations Environment Programme (UNEP), at a high level. Germany will push for international agreement about the goals and content of a resource efficiency policy. To this end a broad policy dialogue about resource conservation measures should be held with producing and consuming countries, among other things in connection with the raw materials partnerships decided in the German government's raw materials strategy. The dialogue should also examine the question of the future institutional home of resource conservation at international level.

It is the German government's goal to integrate the principle of resource conservation in existing bilateral or multilateral agreements, especially in the field of world trade law. Moreover, the German government advocates the creation of an international convention on the conservation of natural resources. In the field of development policy, the conservation and sustainable use of resources remains a priority issue, both in cooperation with development partners and in the dialogue with multilateral organisations, with the aim of fostering sustainable use of resources at a global level as well.

PART III: SPECIFIC EXAMPLES

1. Sectoral examples

Example 1:

Bulk metals

With an annual output of around 46 million tonnes of crude steel and about 2.8 million tonnes of nonferrous metals and nonferrous alloys, the German metal industry is the largest producer of steel and nonferrous metals in the EU. The same applies to the German foundry industry with an annual output of 4.8 million tonnes of cast iron and steel products and 1 million tonnes of cast nonferrous metals. Apart from their top position from a technological point of view, the special strength of the German steel, nonferrous and foundry industries lies in their proximity to their customers, whom they supply with individually adapted and constantly upgraded intermediate and finished products. The main customers for these products are automobile and mechanical engineering and the construction and electrical engineering sectors.

The rising prices for iron ore, scrap steel and nonferrous metals are a burden on the manufacturing industry. Between 2000 and 2007, dollar prices for raw materials on the world market tripled. In spite of the sharp drop in prices in the wake of the financial crisis, there is reason to expect that raw materials prices will rise again in the medium term.

Recycling of bulk metals, id est metal production on the basis of scrap, makes an important contribution to resource conservation: for example, extracting one tonne of copper from the primary ore gives rise to about 3.4 tonnes of CO_2. By contrast, recycling copper from scrap copper using state-of-the-art technology uses 30 percent less energy than primary production and leads to a corresponding reduction in CO_2 emissions. Producing aluminium from scrap saves as much as 90 percent of the energy input needed for primary production from ore. In view of the associated cost reductions, nearly all metal scrap arising in Germany is recycled. Nevertheless, scrap only meets about half the requirements of Germany's entire production of metals and cast components. There are several reasons for this:

- the high level of exports of machines, vehicles and components produced in Germany,
- the steady increase in the amounts of metal tied up on a long-term basis in existing buildings and infrastructure,
- the high worldwide demand for metals and scrap – Germany's net exports of ferrous scrap in 2009 came to around 15 percent of the traded quantity,
- illegal exports of waste containing metals (for example end-of-life electrical and electronic equipment) in disregard of waste-related regulations on the movement of waste.

Against this background, primary production of bulk metals on the basis of mainly imported ores and ore concentrates will continue to be of great importance for the foreseeable future – both in economic terms and as regards resource input.

Primary production, however, involves greater environmental pressures than production from secondary raw materials: pressures such as greenhouse gas emissions and pollution of soil and water with acids and toxic substances. In particular, the preparation processes (breaking, grinding, grading) are very energy-intensive. Estimates indicate that currently about 7 percent of global energy consumption is needed for extracting, preparing and processing metals.[70] Of this, about 50 percent is due to the

70 MacLean, H. L., F. Duchin, C. Hagelücken, K. Halada, S. E. Kesler, Y. Moriguchi, D. Mueller, T. E. Norgate, M. A. Reuter, and E. van der Voet (2009): Stocks, Flows, and Prospects of Mineral Resources. In Linkages of Sustainability, edited by T. E. Graedel and E. van der Voet. Cambridge: MIT Press.

grinding of crude ore. The high water requirements of mining are also largely due to preparation processes such as washing and wet comminution and grading processes (flotation). Dewatering operations affect the local water balance. Furthermore, erosion of the exposed surfaces can give rise to increased sediment loads and adverse effects on the oxygen content of adjacent waters.

Where the mineral content is low or the deposits are very deep, large quantities of spoil and rubble are produced during extraction and dressing. Landfill of this "dead rock" uses up land, unless the rock is used for backfilling.[71] If such mining waste is not properly deposited, reactions with rainwater and atmospheric oxygen can give rise to acid mining water, which may mobilise heavy metals and salts in the spoil tips and ultimately lead to contamination of groundwater and surface water. Treating metal by means of chemical leaching methods gives rise to large quantities of toxic wastewater or sludge (for example red mud from bauxite extraction). In the absence of correct plant operation and deposition this can also lead to serious pollution of the environment.[72]

As explained, resource conservation calls for thinking in terms of material flows from a life-cycle perspective that considers the entire global value chain from resource extraction through use to recycling. In addition to quantitative improvements in resource productivity through using material-efficient products and processing methods, and environmentally sound recycling of as many materials as possible, minimisation of adverse environmental impacts due to resource extraction can also be achieved by means of qualitative ecological optimisation of treatment processes and environmentally sounder handling of the waste and wastewater from mining operations.

71 Wotruba 2011: "Die Aufbereitung als Teil der Prozesskette zur Versorgung mit mineralischen Rohstoffen: Herausforderungen an eine zukünftige Aufbereitungstechnik", paper at the First Freiberg Resource Technology Symposium, 14/15.2.2011.

72 See, for example, Mudd 2007: "The Sustainability of Mining in Australia: Key Production Trends and their Environmental Implications for the Future", Research Report No RR5, Dept of Civil Engineering & Mineral Policy Institute, Monash University, Australia.

Improvements in material and energy efficiency and reductions in pollutant emissions during production and processing should be achieved by using lower-CO_2 methods for producing crude iron, nonferrous metals and cast components. These include replacing energy-intensive manufacturing methods involving large material losses (for example milling, turning and cutting) with shaping and casting methods that approximate to the final shape in appropriate fields, and "single-heat" metal production and processing (id est without repeated heating). And finally improvements should be made in waste heat recovery, especially in the low temperature range.

Similarly, optimising material combinations and using new materials, including regrowable raw materials, can reduce material input without sacrificing functionality. In the case of goods that are moved (vehicles, containers etc.) lightweight construction can also be used to reduce energy consumption during the use phase.

With a view to increasing material and energy efficiency, the German government supports the development of high-grade recovery options for waste that is currently put to low-grade use or even disposed of completely. This includes the recovery of additional quantities of nonferrous metals by means of new, efficient separation techniques, for example in the treatment of waste incinerator ash and the optimisation of separate collection and processing of various types of scrap (especially stainless steel).

The German government is therefore stepping up its assistance for the development and large-scale application of material-efficient and energy-efficient production, processing and recycling methods by

- giving greater publicity to and increasing expansion of the programmes for identifying and improving material and energy efficiency in companies,
- improving the market conditions for material and energy efficient products, for example through market incentive programmes and eco-labelling,
- ensuring closer integration and a stronger focus on material and energy efficiency in the training of future qualified personnel in vocational schools and universities and promoting the training and upgrading of the existing workforce,
- promoting cross-sectoral interchange of knowledge and information with a view to using synergies,
- revitalising the recycling markets by participating in the development of criteria for defining when bulk metal scrap ceases to be treated as waste.

Example 2:

Rare earths and critical metals

Hafnium ingots in a wooden crate. Rare earths are indispensable for many products such as mobile phones or display screens.

Critical metals such as neodymium, germanium, indium, tantalum or lithium are currently a focus of public and political discussion, especially from the point of view of secure supply of raw materials, because Germany is almost entirely dependent on imports when it comes to primary supplies of metals. The critical nature of raw materials is assessed by means of supply-side criteria such as the concentration of extraction on a small number of countries or companies, the political stability of the source countries, the reserves contained in known deposits, and the recycling rate. Demand criteria include predicted increases in demand for future technologies, and the extent to which substitution is possible. If metals satisfy the supply criteria mentioned, and if they cannot – or cannot readily – be replaced for specific applications, they are referred to as critical metals.[73] If the focus is on expected increases in demand for modern applications, they are also referred to as strategic or high-tech metals, since they are essential in the high-tech sector in particular (for example indium in LCD displays, tantalum and niobium in capacitors for mobile phones). Strategic metals are also needed for numerous environmental technologies (for example platinum and palladium in catalysts, indium and gallium in photovoltaic systems). They continue to be indispensable as alloying elements in high-strength steels (for example titanium, molybdenum).

From an environmental point of view, however, it is also necessary to classify as critical those metals which give rise to great environmental pressures from a life-cycle perspective (for example metals which only occur in small concentrations in the ore and are not produced as by-products). Rare earths are a special challenge, because their extraction and processing frequently involve extensive interference with the environment because of their low concentrations in the relevant ores. Although they are only produced and used in relatively small quantities, their extraction causes substantial environmental pollution in the producing countries.

For example, the frequent association of rare earths with thorium and/or uranium means that their extraction often involves the problem of disposing of radioactive waste and the problem of preventing radioactive dust. As a result of the low environmental and safety standards that have prevailed until recently, many extraction sites in the People's Republic of China, where rare earths are sometimes produced by small mining operations, display radioactive contamination.

The trade in ores of critical metals from regions of conflict (for example coltan) acquires a political dimension, because the revenue is often used by the conflicting parties to finance armed conflicts. German development cooperation projects have supported the summit decisions of the International Conference on the Great Lakes Region (ICGLR) held in Lusaka in 2010 and have assisted its principal member states (especially the Democratic Republic of the Congo and Rwanda) with the establishment of certified trade chains for conflict resources and more reliable certificate of origin of the ores extracted (fingerprinting). The aim is to help curb the production of illegally extracted resources and hence also the financing of armed conflicts without discriminating against legal mining operations. The production of gold in technically inadequate treatment plants frequently gives rise to sludge containing cyanide. The breach of a dam at the gold production plant at Baia Mare in Romania in 2000 resulted in a serious environmental disaster with adverse effects on drinking water supplies.

73 There is as yet no generally recognised definition of the term "critical" in connection with resources.

In some cases, strategic metals are produced as by-products of bulk metals which are more important from an economic point of view (for example indium as a by-product of zinc, gallium as a by-product of aluminium). The disadvantage: their extraction cannot necessarily be stepped up to cope with rising demand, and a sharp drop in demand for the main product exacerbates the situation. Another aspect is that in many cases these metals are only used in very small quantities (for example rare earths in mobile phones), so it takes a great deal of logistical and technical input to recover them and return them to the substance cycle. At present, therefore, some of them are still mostly lost by dissipation.

Nevertheless, the use of rare metals in many environmental technologies offers considerable efficiency benefits and thereby makes for better resource conservation in other fields.

It therefore makes sense to take measures which encourage the replacement of primary rare and strategic metals by secondary raw materials or by resources that involve a lower level of environmental pressures. To reduce losses of these metals by dissipation it is necessary to ensure that the substance cycles are closed as far as possible at the end of the use phase. At the same time there is a need to support the development of environmental and health standards in primary extraction countries.

Low-energy houses in the Vauban quarter of Freiburg

To this end the German government is taking the following measures and/or supporting relevant initiatives by social partners:

- Promoting research to minimise material losses and environmental pressures in the extraction, processing, use and recovery of rare metals;
- Intensifying research into the possibility of replacement by less critical/environmentally dubious resources;
- Optimising the collection logistics and treatment of scrap containing alloys that are rich in precious and special metals;
- Examining and where appropriate implementing ways of optimising the collection logistics and treatment of end-of-life electrical and electronic equipment, to make it possible to recover larger amounts of precious and special metals in the future;
- Promoting research and development for new recycling methods (for example pilot plant for lithium-ion traction batteries);
- Fostering worldwide transfer of knowledge and technology to increase the recycling of end-of-life products containing precious and special metals (for example end-of-life electrical and electronic equipment, catalytic converters).

From a resource efficiency point of view, rare earths and other strategic metals offer great potential for technological, product and process innovations.

Example 3:

Sustainable planning, construction and use of buildings and structures

In Germany and worldwide, the construction sector is one of the most resource-intensive sectors of the economy, and uses large quantities of mineral resources in processed form. Large areas are claimed by building and civil engineering to meet the needs of society, safeguard prosperity and secure Germany's position as an industrial location. This gives rise to environmental pressure – sometimes temporary – due to raw materials extraction and land take. The instruments of regional planning, urban development and environmental protection are used to restrict such encroachments to the necessary level and ensure an appropriate balance of environmental interests. The growing spread of comparatively thinly populated urban fringe settlements results in a disproportionately large consumption of raw materials and land, and also leads to a high specific traffic density. The sector is also important because of its direct energy consumption during the buildings' use phase for space heating, cooling, lighting and ventilation. Space heating alone accounts for 30 percent of total final energy consumption in Germany.

Existing structures are also a significant repository of resources which are mostly sent for recycling and reuse. In the year 2000 the total quantity of mineral resources tied up in the entire inventory of structures in the building and civil engineering sector in Germany, in other words buildings, bridges, tunnels, roads, car parks or supply and disposal infrastructure facilities, came to some 50 billion tonnes.

In 2008 the building sector used about 580 million tonnes of gravel, sand, broken quarry stone and industrial by-products. To this must be added some 67 million tonnes of recycled mineral building materials, about 28 million tonnes of cement and large quantities of metal (including 5.5 million tonnes of steel alone). Some 170 million tonnes of mineral building materials are used every year for replacement and refurbishment measures in infrastructure systems, three quarters in the transport sector and one quarter in the drinking water and wastewater sector. An estimated two thirds of Germany's annual sawn timber production of over 22 million cubic metres goes to the construction sector. Improving resource efficiency (for example lightweight timber construction without sacrificing quality), avoiding waste and closing substance cycles (especially reuse/recycling of waste wood products and waste paper), and stepping up "cascade use" (not using timber products for energy until they have reached the end of their useful life as materials), remain important challenges for research, development and innovation.

During the period 2007 to 2010, the land area freshly claimed for building and infrastructure projects averaged 87 hectares per day. More than a third of this land has a sealed surface. The German government's Sustainability Strategy aims to reduce land take for housing and transport purposes to 30 hectares per day by 2020. In cooperation with the Länder and local authorities, the objective is to strengthen their internal development and make it easier to reuse existing sites.

Demolition or decommissioning at the end of the life cycle of buildings and infrastructure systems give rise to large quantities of waste – including many potential secondary raw materials. Extensive use is already being made of these where this is economically and technically possible. According to the waste statistics for 2008, construction and demolition waste, at 192 million tonnes, accounted for 54 percent of all German waste; the figure includes about 107 million tonnes of excavated soil, stone and other excavated material. The industry's statistics for 2008 show that the mineral resources "building rubble and road construction rubble" accounted for 71.8 million tonnes, including 58.2 million tonnes of building rubble. In 2008 an average of 89.5 percent of the 192 million tonnes of construction and demolition waste was recovered.[74]

The construction sector is characterised by very long time horizons and consequently long investment periods. The great challenge here lies in serving the demand side, id est citizens' needs, by means of efficient settlement concepts while at the same time making further improvements in resource efficiency on the supply side.

The demand side offers great potential. The increase in absolute resource consumption for housing is primarily a result of the steady increase in living area per capita. This is true of both new and existing buildings and is due to the growing number of homes with a diminishing number of persons per household, for example after family changes such as the children moving out (remanence effect) or through the increase in the number of single-person households. Another contributory factor is the general increase in prosperity and the resulting demand for more living space.

Demolition work

In practice, sustainability aspects are not usually considered when meeting the demand for additional living space. Observations show that despite the fall in population numbers, new settlements are still being built for which new infrastructure systems have to be created at great financial and material cost. This is inefficient compared with compact inner-city settlements. In view of this it is already foreseeable that the number of empty homes and buildings will continue to grow. What is more, the predicted decline in the population of Germany and the ongoing migration away from economically disadvantaged regions means that parts of the existing infrastructures will no longer be needed and will have to be dismantled. This could affect the wastewater infrastructure in particular.

In its white paper on city centres (*"Weißbuch Innenstadt"*), the Federal Ministry of Transport, Building and Urban Affairs has outlined ways of making city centres more attractive and achieving more sustainable utilisation of existing settlement areas, avoiding empty buildings and under-utilisation, and ensuring that affordable accommodation in cities remains or is made available for families and older people as well. The German government – on the basis of the European Union's thematic strategy on the urban environment – will continue to examine ways and means of making better use of the potential of municipal infrastructure development and physical development planning to increase resource efficiency. To this end it will

- step up research and development relating to life-cycle management of buildings and infrastructures and entire urban districts;
- organise, in conjunction with the Länder and the local government associations, an interchange of experience on best-practice examples, innovative technologies and efficient methods or forms of organisation;
- in particular, improve the integration of the impacts of demographic change and internal migration within Germany in the designation of building zones.

Moreover, the 30-hectare target of the National Sustainability Strategy is also intended to counteract the inefficient expansion of settlements and infrastructures and make a contribution to resource conservation.

74 Kreislaufwirtschaft Bau: Bericht zum Aufkommen und Verbleib mineralischer Bauabfälle im Jahr 2008 (Report on quantities and destinations of mineral construction waste in 2008).

On the supply side, the German construction is already in a very good position as regards technical safety, the energy efficiency of new buildings, and the recovery rates for the massive substance streams arising from decommissioning and demolition. Contributory factors here include the large number of programmes and regulations, such as the German government's Energy Saving Ordinance, and also the efforts made by German industry. Nevertheless, the German government will – together with the parties concerned – continue to closely examine the potential that still exists for improving resource efficiency in the production of building materials and in the planning, construction, use and demolition of buildings.

The focus of the current German resource efficiency programme is on raw materials that are not used for energy. In the field of "sustainable construction", however, it makes sense to look at energy efficiency and resource efficiency together, because of their complex interactions.

In terms of the entire life cycle, a building's greatest energy requirements arise during the use phase. As regards the energy and climate balance, therefore, it is usually economically worthwhile in the medium or long term to install additional thermal insulation for the building envelope and to modernise the heating system and, where appropriate, the refrigeration system (despite the associated consumption of new raw materials). A holistic approach to optimisation should always include a life-cycle assessment and social quality-of-life aspects. Such approaches are facilitated, for example, as part of the German certification systems for Sustainable Construction (DGNB[75] and BNB[76]).

Another means of reducing consumption of non-renewable resources in the construction sector is to use regrowable raw materials where this makes sense. There are already a large number of building products based on regrowable raw materials which are becoming increasingly well established in the building sector. They range from timber, as a traditional building material, to modern composite materials. On the one hand they make it possible to expand existing uses within the building trade, while on the other they facilitate innovative construction methods.

The use of timber in the construction sector for new buildings and in the modernisation of existing buildings has taken a marked upward turn in the last two decades. The trend towards timber construction continues. The timber construction rate has roughly doubled since 1990. In the housing sector the share of timber construction in 2010 was around 15.5 percent. The timber construction share in non-housing construction was around 20 percent. A total of more than 20,000 timber-construction buildings are completed every year. However, compared with the timber construction figures for the USA (90 percent), Austria (33 percent) and Sweden (50 percent) the percentage of new timber buildings in Germany is lower. Depending on pollutant and impurity levels, waste wood arising from the demolition of a building can first be recovered for use as material and finally used for energy purposes.

Extending the useful life of buildings as a result of a life-cycle assessment can be a resource-efficient strategy, unless replacement by a new building offers greater benefits from a sustainability point of view.

Today many modernisation projects on existing buildings can be carried out on the basis of passive house standards, thereby producing very substantial and long-term reductions in energy requirements and climate impacts. Here too, however, it is necessary to consider economic aspects which could militate against this.

In the context of its "Sustainable Building" assessment scheme (BNB), the Federal Ministry of Transport, Building and Urban Affairs is already introducing a building-specific assessment document that also records the building materials and components used.

75 Deutsche Gesellschaft für Nachhaltiges Bauen e.V. (German Association for Sustainable Construction).
76 Assessment system "Sustainable Building for Federal Buildings".

In concrete production, for example, primary raw materials could be replaced by using recycled aggregate, provided this is not ruled out on technical grounds or restricted for legal reasons. The German government will therefore examine whether existing obstacles to the use of recycled concrete can be reduced. Another question to be examined is whether further efficiency and substitution potential can be mobilised in the cement industry by stepping up the use of secondary raw materials in the clinker firing process and by using clinker substitutes. In future it may be possible to use innovative processes for cement production, such as Celitement, to achieve further reductions in CO_2 emissions and resource inputs.[77]

The German government will make considerable research funds available for mobilising such potential, for example in the Federal Education Ministry's research programmes (r^2 and r^3), the Federal Transport Ministry's research initiative "Building for the Future", the German Federal Foundation for the Environment's research projects, and the Federal Environment Ministry's environmental research programme (UFOPLAN). The German government will also investigate ways and means of taking better account of resource aspects in determining the best available technology for the production of building products.[78]

The German government will continue to make every effort to ensure that the production of necessary primary raw materials can be reconciled in a meaningful and balanced way with competing different land uses such as settlement and infrastructure planning, agriculture and forestry and areas reserved for nature conservation and environmental protection. This approach will consider all sustainability issues, in other words the economic, ecological and social aspects.

For many years it has been possible to obtain certification for the sustainability of structures. In addition to the widespread international certification systems LEED, BREAAM and others, the system of the German Association for Sustainable Construction (Deutsche Gesellschaft für nachhaltiges Bauen e. V.) is becoming increasingly important.

All recognised certification systems are agreed in making their assessment on the basis of the structure, not the building material. The performance of a building product is only visible (and usable) if it is used in line with its intended purpose. By means of environmental product declarations (EPDs) the building products industry is also helping to improve market transparency at the building product level, in order to give planners an opportunity to take resource aspects into account at an early stage in the planning and assessment process.

77 www.r-zwei-innovation.de/de/726.php

78 The European Sevilla Process on the basis of the European Industrial Emissions Directive (IED) relates to industries that are important for the production of building products, such as the cement, steel and glass industries.

With the introduction of the extensively updated Guide to Sustainable Building (Leitfaden Nachhaltiges Bauen) by the Federal Ministry of Transport, Building and Urban Affairs (BMVBS), the German government is setting an example by implementing its requirements in the field of federal buildings. To this end the Sustainable Building assessment scheme (BNB) has been put into force as a binding requirement for the field of new office and administration buildings; modules for laboratories and school buildings and for outdoor facilities are in preparation. In addition to ecological, economic and sociocultural quality, this planning-based assessment system also takes account of technical, functional and process aspects. Further regulations on building products will also be taken into account in future. The supplements currently being prepared on "Using and Managing" and "Measures for Existing Buildings" will present comprehensive instructions for action in the field of sustainable building.

In connection with putting ecological quality into practice, the Guide to Sustainable Building describes the protection targets "Impacts on the local environment" and "Resource conservation". The aim is to achieve optimised use of building materials and building products, a low level of land take, and a reduction in the consumption of environmental media (for example heat, power, waste and wastewater).

The Sustainable Building assessment system takes account of and documents all necessary energy and material flows from extraction through processing and transport to installation and de-installation, and also the global and local environmental impacts due to the energy consumption associated with the building materials or use of the building. It is necessary to make use of various analyses, for example risk analysis, material flow analysis, material analysis or life-cycle assessment.[79] A crucial factor here is that the assessment is made at the level of the structure, taking account of all building materials and components.

The assessment system "Sustainable Building for Federal Buildings" (BNB) exists at federal level. It takes account of the resource efficiency aspect – and also includes more far-reaching aspects in its assessment scheme. Most building products are used together in a single system, the building. The environmental product declarations document resource consumption and environmental emissions over the entire production process. The life-cycle assessment method is used to prepare an ecological assessment of a structure on the basis of the declarations for the individual building products. A life-cycle analysis takes account of the entire life of the building: the construction phase, the use phase and any changes of use, and demolition and disposal. It makes it possible to show the contribution that the building products make to energy efficiency or other aspects of sustainable management of a building, and also resource efficiency. It also gathers information on technical properties that is needed for assessing the performance of the building product in the building, such as operating life, heat and sound insulation, or influence on the quality of the indoor air. The BNB will be continuously developed and improved in the light of practical experience.

The German government supports the use of regrowable raw materials in the building sector, where this makes sense. The "Sustainable Building for Federal Buildings" assessment system (BNB) will therefore take appropriate account of the use of innovative building products such as insulating materials or interior finishing products that have advantages over conventional building products based on non-regrowable raw materials. The German government also promotes campaigns to provide information on the benefits of healthy and resource-conserving building products and construction methods.

These activities are supplemented by the research into energy-optimised construction (ENOB) funded by the Federal Ministry of Economics and Technology. The goal is buildings with minimal primary energy requirements and high user convenience combined with moderate capital cost and a marked reduction in operating costs. This involves extensive documentation not only of innovative new buildings, but also of modernisation projects. One focus of the assessment scheme is research and development in the fields of building technology and technical building equipment. Another is scientific evaluation, including a cost-effectiveness assessment of energy-optimised buildings.

79 See BBSR Berichte KOMPAKT: Nachhaltiges Bauen, Strategien-Methodik-Praxis; 14/2010; ISSN 1867–0547.

Hemp as insulating material

End-of-life photovoltaic modules, solar cells and wafer production residues are no longer simply disposed of as waste. Complicated technological processes give them a new life.

Both the Guide to Sustainable Building and ENOB offer owners and planners the opportunity to implement innovative and resource-conserving building projects on the basis of tried-and-tested best-practice examples, and thus increase the demand for resource-efficient building products and construction methods. The German government and the actors concerned are making every effort to ensure that this experience permits widespread implementation of integrated planning and process management during construction. These objectives are also pursued by the German Association for Sustainable Construction (*Deutsche Gesellschaft für Nachhaltiges Bauen e. V.*) with the DGNB label.

By means of extensive further training measures for the persons involved in the construction process, especially the planners, the Federal Ministry of Transport, Building and Urban Affairs is promoting training and hence the broader application of Sustainable Building for Federal Buildings. To this end the German government will

- provide stronger support in future for the initial and further training of engineers and architects, with a view to further improvements in resource conservation in planning and construction;
- step up research funds for the study of suitable measures for mobilising further resource-efficiency potential in the construction sector.

Example 4:

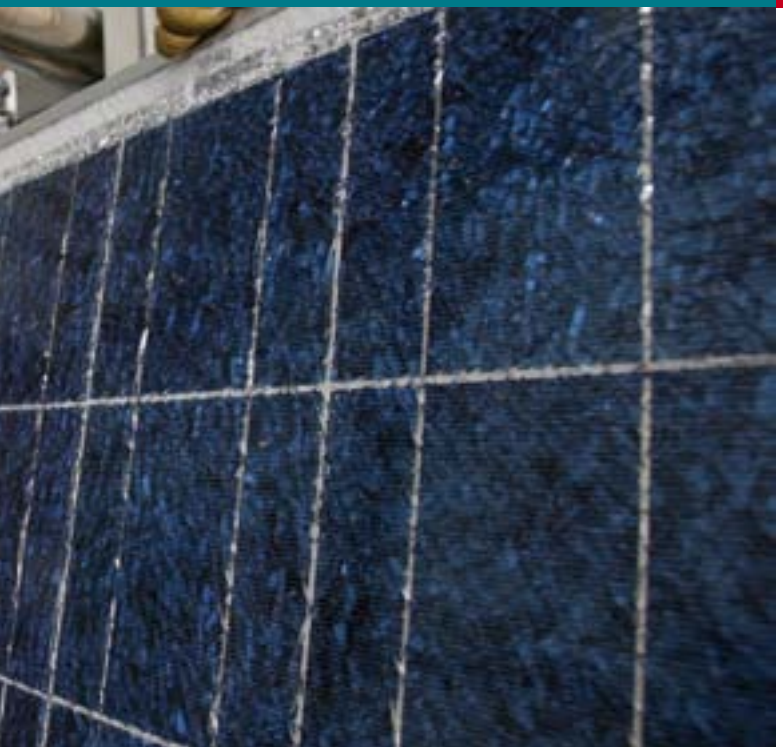
Resource efficiency in future technologies – the example of photovoltaic systems

The photovoltaic industry is growing fast. Whereas installed capacity worldwide came to around 40 Gigawatt-Peak in 2010, estimates predict that this figure will rise to 200 Gigawatt-Peak by 2030.

The increase in production of solar cells is creating an increase in demand for raw materials. As well as materials such as aluminium, glass and silicon, metals such as indium, silver and gallium are indispensable for the production of photovoltaic modules. Indium, silver and gallium have to be classified as particularly critical.[80] In 2007, for example, worldwide demand for indium for the production of solar cells was around one tonne. In 2020 it is expected to be around 50 tonnes, and by 2030 as much as 285 tonnes (out of a total worldwide demand for indium of more than 1,900 tonnes). By contrast, worldwide production of indium stood at 510 tonnes in 2007.[81]

To be able to reduce the demand for such raw materials, there is a need for improvements in material efficiency in the production sector, improvements in

80 ec.europa.eu/enterprise/policies/raw-materials/files/docs/report-b_en.pdf
81 Fraunhofer Schlussbericht: "Rohstoffe für Zukunftstechnologien" (Raw Materials for Technologies of the Future), page 326 (www.isi.fraunhofer.de/isi-de/suche/index.php?numberOfResults=10&page=1&searchTerm=Rohstoffe+f%C3%BCr+Zukunftstechnologien&lang=en).



the efficiency of the cells, for example through multi-layer cells, and recovery of the raw materials by recycling the modules at the end of their useful life.

As regards improvements in resource efficiency during production of the modules, there are already many approaches at the various stages of production which have been put into practice in demonstration projects and need to be scaled up where successful. These approaches include alternative processes for the production of polycrystalline silicon and optimisation of slicing techniques and doping in wafer production. Efficiency potential also exists in the field of cell manufacture, for example by developing and using new coating methods, reducing layer thicknesses in thin-layer cells, and optimising soldering processes. Potential also exists in the field of passivation and insulation processes.

Another important element for increasing resource efficiency is recycling raw materials from recovery of end-of-life modules. Nationwide collection and high-grade recycling of old photovoltaic modules are essential to ensure that the positive environmental effects of photovoltaic technology are not only achieved at the level of climate protection, but also in the field of material resources.

Companies in the photovoltaic industry have launched the “PV Cycle” initiative to establish a voluntary return and recycling programme for end-of-life modules. The German government welcomes this initiative, which has so far been joined by 184 of the players on the European market. There are plans to establish a full-coverage collection network and adequate treatment capacity. Since the disposal situation will not become acute for at least five to ten years, PV Cycle has the opportunity to make a significant contribution to responsible waste management of end-of-life PV modules. This will require an ambitious programme (for example the establishment of a full-coverage collection network, adequate treatment capacity, an ambitious collection rate and substance-specific requirements for particularly valuable and rare or strategically important materials).

The German government is promoting the further development of the established processes for the treatment and recycling of silicon and thin-layer modules, with a focus on recovery of rare metals. The German government is also supporting projects for increasing process-integrated recycling rates, for example through the recovery of silicon from cutting residues or the recycling of process solutions.

Example 5:

Resource efficiency in future technologies – the example of electromobility

Electrification of the drive systems of cars and light commercial vehicles in particular offers prospects of efficient integration and use of renewable energy, and hence of reducing CO_2 emissions in the transport sector as well. Whereas there are currently only about 2000 electric vehicles on the road in Germany, the German government, together with actors from industry, research and civil society, has set itself a target of one million vehicles by 2020 under the National Electromobility Development Plan and the National Electromobility Platform (NPE). All actors in the NPE are agreed on an intelligent combination of vehicle and electricity from renewable energy as a precondition for the climate benefits. Many other industrialised countries – and some newly industrialising economies – have equally ambitious targets.

To maintain the German automobile industry's leading worldwide position, there is a need for further efforts on the market and in the global competition for electric mobility. The market potential is enormous: for example, the hybrid drives sector alone (combination of electric motors and combustion engines) is expected to display annual growth of 9 percent.[82]

One important precondition for large-scale implementation of electric mobility is a secure, ecologically and economically sustainable long-term supply of important resources for this innovative industry, such as nonferrous, precious and special metals that are essential for various technical components of the system (for example battery, electric motor).

The central component of an electric vehicle – as regards both value added and market prospects – is the traction battery. One of the most important resources here is lithium. Estimates of the worldwide reserves of this element differ widely. However, total reserves cannot be taken as a basis for assessing the future availability of lithium for traction batteries. It is also necessary to take account of time-related factors, such as how quickly annual production capacity can potentially be expanded in response to demand, both in vehicles and in mobile communications devices. In view of the expected demand in non-automobile applications in combination with the future demand by the electric vehicle industry, it is very difficult to predict whether a shortage of lithium will in fact arise in the short term, as current developments on the lithium market suggest.

Nevertheless, high-grade recycling with the aim of recovering lithium, cobalt and other metals used in traction batteries is important from an ecological and industry-specific point of view.

At present there are no recycling processes in place that are designed specially for traction batteries. However, forecasts put the percentage of lithium alone in traction batteries at 3 to 5 percent of a battery weight of around 200 kilograms. There is currently no recycling process available which reliably satisfies the criterion of 50-percent recycling efficiency in accordance with EU Directive 2006/66/EC and also recovers lithium. Most of the processes currently under investigation are still at a very early stage in their development, are geared to lithium-ion batteries for portable electronic devices and take no account of lithium as a material of limited availability.

The Federal Environment Ministry is therefore using funds from the Economic Policy Package II to support two pilot plants with the aim of high-grade recycling of traction batteries. Following evaluation of the

82 BMU, Ed. (2009): GreenTech made in Germany 2.0. Umwelttechnologieatlas für Deutschland (Atlas of Green Technology for Germany) Verlag Franz Vahlen GmbH, page 183, quoted by Roland Berger.

Mainframe computer system at Max Planck Institute

results of this project, which ran until the end of 2011, there are plans to upscale the installations.

The Federal Environment Ministry is also supporting a research project aimed at identifying resource-related shortages in the electric mobility system as a whole. Initial findings indicate that as well as battery materials such as lithium, the situation regarding availability of the rare earths used in the permanent magnets of electric motors, such as dysprosium and neodymium, is critical.

The Federal Ministry of Economics and Technology supports research projects that examine the suitability of new battery technologies for use in automobiles. These technologies manage without using rare earths and with smaller quantities of scarce raw materials such as lithium, nickel and cobalt.

The Federal Ministry of Transport, Building and Urban Affairs is to demonstrate the combination of building planning and electric mobility in a project in which buildings are used as power plants and electric vehicles as buffer storage for the energy generated.

Example 6:

Green IT: Resource efficiency in information and communication technology (IT)

Information and communication technologies are consuming more and more energy at national and international level. The share of Germany's electricity consumption accounted for by the IT sector is already more than 10 percent. Computer centres in Germany alone doubled their power consumption between 2000 and 2008. If no countermeasures are taken, annual power consumption by computer centres will rise to more than 14 terawatt hours by 2015.

The expansion of the infrastructure is also inevitably giving rise to growing consumption of materials. What is more, IT products have very short innovation cycles and are frequently replaced after a useful life of only a few years. The materials tied up in the approximately 53,000 German computer centres total nearly 40,000 tonnes. Over 70 percent of this is due to the bulk metals iron, copper and aluminium. To these plastics, glass, ceramics and other inert substances must be added. Although precious metals play a relatively minor role in terms of weight, they are of enormous economic and ecological importance.

Waste recovery of end-of-life equipment

In view of the growing energy efficiency of IT devices – such as PCs and notebooks – and the short replacement intervals, manufacture of the products is coming to play an increasingly important role in life-cycle assessments compared with the use phase. For example, a life-cycle study commissioned by the Federal Environment Agency revealed that if a notebook is replaced by a more energy-efficient model during a normal operating life of only a few years, this does not save any energy in the overall balance. Not only the extraction of primary resources involves high energy consumption, but above all the production of important components such as chips. This demonstrates the importance of the expandability and modular construction of devices, the ease with which they can be repaired or dismantled, and the ease with which they can be recycled or reused, when it comes to making more efficient use of energy in the IT sector in the future.

At the same time information and communications technologies belong to the key technologies for using better networking to exploit great energy and resource efficiency potential in other sectors of the economy, for example mobility, household, logistics, communication and power grids. The German government is therefore supporting "Green IT", in other words the efficient operation of IT and its environmentally sound use, with a bundle of measures. In 2010 the principal fields of activity and measures were summarised and laid down in the German government's IT strategy "Digital Germany 2015".[83]

Example 7:

Example 7: Renewable raw materials in the chemical industry

One major user of regrowable raw materials is the chemical and pharmaceutical industry. In 2008 the chemical industry used an estimated 2.7 million tonnes of regrowable raw materials (approx. 80 percent of the total biomass of around 3.6 million tonnes used by industry). This means that as much as 13 percent of the organic raw materials used here are regrowable raw materials.[84] Regrowable raw materials are often used in cases where their natural synthesis performance is at least partially preserved in the desired product: for example, oils and fats are processed to obtain surfactants, biolubricants, polymers or paints and varnishes; starch and sugar are converted into plastics or increasingly into basic chemicals; chemical cellulose forms the basis for cellulosic synthetic fibres.

For its production of organic compounds, the chemical industry is dependent on raw material sources containing carbon. At present some 87 percent of carbonaceous raw material sources of fossil origin still take the form of naphtha, natural gas, oil and coal. These sources are finite, however, and in most cases their extraction is not sustainable and gives rise to ever-increasing interventions in nature, sometimes with massive adverse effects on existing ecosystems. The only renewable sources of carbon available at present are regrowable raw materials.[85] At the same time the sustainable use of biomass as material in the chemical industry can make an important contribution to resource conservation and to achieving the environmental targets of the German Sustainability Strategy. However, it has to be mentioned that in recent decades the increase in regrowable raw materials for use as material in the chemical industry has been on the low side. This is partly due to the fact that the traditional areas of application for regrowable raw materials are already developed, and that a good deal of research and development is needed to exploit new applications. Companies in the chemical industry are working hard on researching and developing new processes that permit greater use of regrowable raw materials.

83 The German government's IT strategy of 10.11.2010: www.bmwi.de/BMWi/Navigation/Technologie-und-Innovation/Digitale-Welt/IKT-Strategie-Nationaler-IT-Gipfel/deutschland-digital-2015.html.
84 FNR, Ed. (2010): Nachwachsende Rohstoffe in der Industrie (Regrowable raw materials in industry), page 23.
85 A possible future option is the use of CO_2 as material.

Biotechnology: Algae as an energy source of the future

In view of the fundamentally limited potential for crop production and use and the risk of adverse ecological and social impacts arising from an uncontrolled increase in biomass extraction from ecosystems, efficiency improvements combined with attention to sustainability are of great importance in the production and use of regrowable raw materials as well. The German government therefore supports the development of innovative ideas for maximising the exploitation of all components of regrowable raw materials by means of linked uses and in bio refineries. Bio refineries are an integrated overall concept which uses biomass as a versatile source of raw material for producing a broad spectrum of intermediate and finished products (for example chemicals, materials, bioenergy) while making maximum use of the biomass. To improve the efficiency of biomass use, the German government also supports high-grade, multi-tier forms of cascade use and the use of bioge-nic waste streams as material.

The imported share of regrowable raw materials for the chemical industry currently stands at an estimated 60 percent.[86] This means that further expansion of the use of regrowable raw materials as material in the chemical industry also has to be seen in the context of sustainable global development cooperation. The production of regrowable raw materials can make a contribution to rural development and poverty alleviation in the exporting countries. But one cannot rule out the possibility that the production of regrowable raw materials could cause adverse environmental impacts such as increased greenhouse gas emissions through direct or indirect changes in land use, or adverse effects on biodiversity, soil quality and water quality. Consideration must also be given to the possibility of adverse effects on the local population and on food security. The German government will step up its efforts to bring about the creation of internationally valid sustainability standards and advance their development and practical implementation.

86 FNR, Ed. (2010): Nachwachsende Rohstoffe in der Industrie (Regrowable raw materials in industry), page 9.

2. Examples of material flows relevant to resource conservation

Material flow 1:

Phosphorus

In view of its vital significance, phosphorus is an important resource. The agricultural sector in particular relies on fertilisers containing phosphates. Phosphorus is also necessary for a wide range of industrial processes.

In nature, phosphorus only occurs in the combined state, especially in the form of phosphates. It accounts for 0.1 percent by weight of the Earth's crust. Usable phosphate rocks occur in various types of deposits containing roughly 10 to 35 percent phosphate. Some phosphate deposits contain heavy metals, for example cadmium, and radionuclides which can give rise to risks for man and the environment during extraction. This can limit the availability of low-pollutant primary phosphate reserves. Extraction in open-cast mining operation has the same impacts on the environment and landscape as the extraction of other near-surface resources (for example lignite). The German government considers that the geogenic contamination of the crude phosphate extracted presents risks to man and the environment. It therefore advocates appropriate pollutant limits at EU level, to ensure a standard of protection comparable to that existing in Germany.

Owing to the geological conditions, the greater part of the world's production of crude phosphate is concentrated in five countries. The producing countries China (60.2 million tonnes), USA (27.2 million tonnes), Morocco (18.31 million tonnes), the Russian Federation (9.54 million tonnes) and Tunisia (7.41 million tonnes) account for 75 percent of global production.

No acute shortage of phosphorus as a raw material is expected in the next few years. On a longer-term view, however, resource shortages and price increases could occur. Current estimates put total phosphate deposits at around 65,000 million tonnes; production in 2009 stood at around 160 million tonnes. However, phosphate extraction capacity is expected to increase in the future.

The agricultural sector in Germany depends on imports of phosphate to maintain its yield levels and to safeguard soil fertility in the long term. This takes place directly via imports of crude phosphates and the resulting mineral fertilisers, and indirectly via the phosphorus contained in imported foods and animal feeds. In recent years annual consumption in the form of mineral phosphate fertilisers has averaged around 115,000 tonnes of phosphorus. In addition, about 290,000 tonnes of the phosphate required in Germany are returned to the nutrient cycle through organic manure.

In spite of the crude phosphate deposits that still exist, there is a need to develop alternative forms of extraction. On an international comparison, Germany is one of the leading countries when it comes to researching and developing phosphate recovery from residual material and waste. A variety of technologies are currently being researched and developed. However, further efforts are needed to permit their energy-efficient and cost-effective use on a large scale.

The greatest potential for phosphate recovery lies in wastewater and in sewage sludge that has not hitherto been used directly as fertiliser. Through its assistance programmes, the German government is making every effort to step up research and development work on technologies for recovering phosphate from wastewater and sewage sludge. For example, it is speeding up the equipment of sewage treatment plants with suitable recovery technologies.

Other material flows, such as organic manure (for example slurry or fermentation residues), offer relatively little potential for phosphate recovery, as their content of other plant nutrients (apart from P) means that they are in any case used directly as fertilisers. Another aspect to be investigated is the extent to which further progress can be made with large-scale treatment of ash from iron and steel production. In view of its phosphate content, animal meal is also a potential candidate for phosphate recovery. On the other hand, animal meal is currently used almost entirely for other purposes or is required to be disposed of under EU legislation, which means there is little potential left for recovering phosphate from animal meal.

To be able to make effective use of the phosphate in sewage sludge in cases of energy-efficient incineration, it has to be burned separately in mono-incineration plants and the ash treated to ensure low pollutant levels and high bioavailability in accordance with fertiliser legislation. The possibility of recovering phosphate from ash resulting from co-incineration in lignite power plants should also be examined.

In view of the raw materials present in sludge incineration ash in particular (not only phosphate, but also important metals), such ash should be stored for future use where it cannot at present be treated directly for agricultural use. It should be stored in special landfill sites or separate sections of landfill sites to ensure that the ash can be reclaimed and subjected to further treatment. Here too, pollutant levels and high bioavailability will be important criteria.

Adding recycled phosphates to phosphate fertilisers in line with the quantities available, and also various promotion instruments can help to improve the market prospects of the new recycled products. Recycled products frequently contain lower levels of heavy metals than fertilisers made from sedimentary crude phosphates.

Furthermore, there is a need to optimise the use of phosphate in the agricultural sector, mainly by improving the bioavailable shares of all phosphate fertilisers and by promoting suitable crop systems, in order to conserve phosphorus as a raw material resource and prevent undesirable ecological impacts (for example eutrophication of water bodies). In addition, efforts should be made to replace phosphates with other substances in industry as well, for example by using products (for example cleaners) that manage with much smaller levels of phosphate or none at all. Here too, the aim should be to maximise the use of recycled phosphate. This requires cost-effective recovery methods.

The German government, in conjunction with the Länder, will examine and evaluate the following measures:[87]

- Agricultural and landscape-oriented use of safe sewage sludge should be continued and expanded, since this permits effective return of phosphate to the cycle.
- Assistance should be provided for research and development work on the recovery of phosphate from relevant material flows (for example wastewater, sewage sludge, slurry, fermentation residues, ash) where these are not used directly as fertiliser.
- The possibility of adding recovered phosphate to conventional phosphate fertilisers should be developed jointly with the chemical industry.
- Sewage plant operators should investigate the possibility of switching to processes that provides bioavailable phosphorus products, where this is cost effective. This should include examination of the impacts on all environmental media.
- Greater consideration should be given to mono-incineration of sewage sludge where this is justifiable in economic terms and from the point of view of energy consumption.
- Efforts should be made to ensure retrievable storage of ash ("mono-landfill") from mono-incineration of sewage sludge, until its treatment to produce bioavailable low-pollutant forms of phosphorus can be guaranteed.
- The possibilities of recovering phosphorus from existing sewage sludge stores/landfill sites ("urban mining") should be investigated.
- The possibility of creating additional incentives to use recycled phosphorus (for example by means of support instruments) should be investigated.
- Efforts should be made to optimise the use of phosphates in industry and agriculture.

These measures are first important steps in response to the longer-term depletion of phosphate resources. They should be coordinated both within Europe and worldwide.

87 Mandate of the 75th Conference of Environment Ministers: the Joint Commissions of the Federal States (LAGA, LAWA and LABO) are also to examine and evaluate selected measures.

Material flow 2:

Indium

Indium is used in thin-film coatings, alloys, solders and semiconductors. Its use in thin-film coatings is becoming increasingly dominant. Demand for indium will increase sharply by 2030. The growth in technologies of the future such as thin-film photovoltaics, LCD displays and white LEDs is forecast to make demand rise from 234 tonnes in 2006 to over 1,900 tonnes in 2030.

Since indium is usually obtained as a by-product of zinc ore, its production is coupled to that of the main product.

Economic extraction is possible if indium accumulates at certain points in the production process. This is the case, for example, with fly ash that occurs during the roasting of zink, and with residues formed during electrolysis the wet process for zinc production. Loss of material cannot be ruled out. Seventy percent of all foundries that could theoretically extract indium produce it as a by-product. Thirty percent do not produce this by-product, either because it is not economically worthwhile to separate it or because the producers currently regard the global market for indium as too small. About 50 percent of the raw materials is lost during preparation, which means that in the end about 35 percent of the theoretically available quantity of indium is actually produced.

In view of the complicated market situation it is difficult to estimate indium reserves from the indium content of the ores. On the whole, information about reserves and the reserve base of indium is subject to marked fluctuations over time; these are due above all to the great volatility of indium prices. As a result of this structural scarcity, the great demand for indium for future technologies and the limited replacement options, there is a great risk of shortages, especially if demand for the principal product declines. For this reason, indium is frequently regarded in current discussions as one of those metals where there is a risk of temporary shortage.

The findings of current studies indicate that the environmental impacts of the extraction and treatment of the ores are largely due to the principal product. The main environmental pressures during the life cycle arise from the foundry process.

To date, the indium substance cycle is not closed: around the world, less than 1 percent of the indium from electronic scrap is recycled. In most cases, the diffuse nature of its use means that it is not cost effective to recycle indium at present prices. Production waste ("new scrap"), by contrast, averages recycling rates of around 70 percent and makes a major contribution to the total production of indium.

The German government will therefore

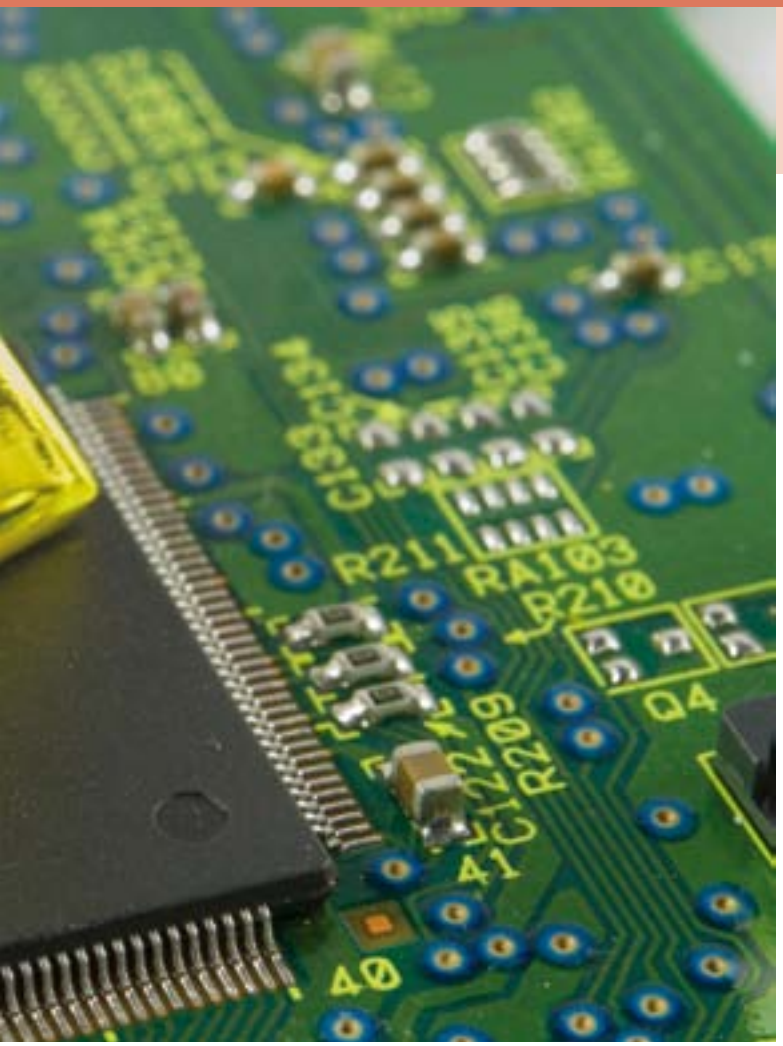
- Advocate further optimisation of the collection of end-of-life electrical and electronic equipment and compliance with the manufacturer's product responsibility under the Electrical and Electronic Equipment Act (*ElektroG*),
- Promote the development of treatment processes with the aim of concentrating indium sufficiently to make recovery from suitable secondary materials competitive with extraction of indium from primary material,
- Step up recycling of indium and research into suitable substitute materials and avoidance options.
- Promote research and development work on processes that permit resource-conserving, efficient and economic extraction of indium from crude ores.

Material flow 3:

Gold

In 2010, worldwide gold reserves stood at around 51,000 tonnes – and in the same year production came to 2,500 tonnes. Significant deposits are found in the USA, Canada, Australia, India and the CIS countries.

In addition to its traditional use in jewellery and for investment purposes, gold is increasingly being used in the electronic sector because of its physical and



chemical properties. Its use in short-lived consumer goods such as mobile phones and computers is particularly relevant to resource conservation. Whereas demand for gold in the jewellery sector has fallen by about 30 percent since 2004, the electronic industry has increased its use of gold by about 12 percent in the same period.

Admittedly gold is currently classified as non-critical on the basis of supply security criteria. But gold is of great relevance to resource conservation because of its complicated extraction process and the associated environmental impacts.

Together with silver and the metals of the platinum group, gold has a special position among the environmentally relevant material flows. The main environmental pressures during its life cycle arise during extraction and treatment. Ore extraction is dominated by the large quantities of material (cumulative resource usage[88] of the order of 1 million tonnes per tonne of gold) and the land take involved. The resource intensity of gold production can also be seen in the extremely high energy requirements and the associated CO_2 emissions. The extraction of gold also involves the release of heavy metals and, during treatment in small-scale mining operations, the emission of mercury and cyanides. Although the quantities extracted in small-scale mining are only of minor importance, the use of mercury means that they account for a disproportionate amount of environmental pollution.

Other relevant losses of material occur at the end of the life cycle of products containing gold. Despite high recycling rates for bulk materials (metals, plastics), there are deficits in the recovery of trace metals from electrical and electronic products in particular. Where shredder equipment is used without prior separation of circuit boards, which contain significant amounts of trace metals, a large proportion of the gold present is irretrievably lost to the iron fraction. Furthermore, small high-quality mass products such as mobile phones are often disposed of as household waste or kept in the home indefinitely, thereby immobilising the trace metals.

The German government will therefore make every effort to

- ensure worldwide dissemination of the best available technologies for extraction and treatment with the aim of reducing emissions,
- improve efficiency within the global recycling chain, and
- optimise the collection of products containing precious metals and special metals, and recover the precious and special metals from such end-of-life devices.

88 Specific cumulative resource usage, includes all resources used during the extraction phase of a raw material.

Material flow 4:

Plastic waste

Some 4.93 million tonnes of plastic waste was generated in Germany in 2009 (post-consumer and production sector). Of this, 2.06 million tonnes was used as material. About 2.73 million tonnes was mostly used to generate energy in waste incineration plants and cement factories. The overall recycling rate was around 97 percent. This figure is largely due to the high level of recycling for energy purposes (55 percent of the total quantity of plastic).[89]

Thanks to its ambitious waste management policy and the high level of environmental awareness, Germany plays a leading role in technologies for separation and recycling. High-tech processes are available for these purposes today, and enjoy worldwide demand. Examples include optical and sensor-based identification methods for rapid recognition and sorting of various plastic fractions. German companies have a world market share of 64 percent in the field of technologies for automatic material separation. The worldwide market prospects for such technologies are excellent: technologies for automatic material separation are expected to display annual growth of 15 percent until 2020. Expectations for installations in the "waste and recycling" sector are still around 3 percent per annum.[90]

From a resource conservation point of view it is necessary above all to reduce the percentage of plastic waste burned in waste incineration plants and to direct more waste plastic streams into high-grade recycling as materials.

89 Consultic, (2010): Produktion, Verarbeitung und Verwertung von Kunststoffen in Deutschland 2009 (Production, processing and recycling of plastics in Germany in 2009).

90 BMU, Ed. (2009): GreenTech made in Germany 2.0. Umwelttechnologieatlas für Deutschland (Atlas of Green Technology for Germany) Verlag Franz Vahlen GmbH, page 134–141.

The German government will therefore make further efforts to:

- Maintain and optimise the separate collection of plastic waste. Early separation of preferably homogeneous plastic fractions is a precondition for high-quality recycled material and its saleability as a secondary raw material on the market.
- Ensure more effective materials flow management. In particular, there is a need to identify further waste plastic streams from the commercial and private consumer sectors that are suitable for recycling as materials and to continue optimising their collection.
- Improve the treatment processes for plastic waste.

Plastic waste – as an alternative to imports of petroleum[91] – is an important domestic raw materials source. Additional efforts must be made to advance the development of new technologies for increasing the recycling rate. In particular, the identification and sorting methods already introduced need to be developed and improved to permit high-grade recycling of plastic waste that has hitherto been incapable of recycling as material. Incentives for this could be based on an ambitious legal framework, for example the introduction of a uniform nationwide collection system for recyclables ("recycling bin").

Residual plastic material from packaging accumulated during the production of biogas from waste food

91 Between 4 and 6 percent of worldwide oil and gas consumption is used for producing plastics (source: PlasticsEurope Deutschland e. V.).

PART IV: APPENDIX

1. Activities of Federal Government Ministries

(Overview based on contributions from the individual ministries)

1.1 Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

Activities developed by the Federal Environment Ministry to improve resource efficiency include the following:

a) From 2007 to 2010 the research project Material Efficiency and Resource Conservation (*MaRess*; 31 project partners, managed by Wuppertal Institute, expert support by the Federal Environment Agency [UBA]) investigated the potential for improving resource efficiency in various branches of the manufacturing industry, and also measures designed to exploit that potential and their macro- and micro-economic effects. A major conference on October 5, 2010 gave an important boost to further work in this entire field. A follow-up project is examining the impact of individual instruments proposed. Ways are also being examined for stepping up the implementation of these and other instruments.

b) Since 2007 the Resource Efficiency Network, established under MaRess, has been very successfully disseminating know-how and experience relating to resource-conserving production, products and management. It is aimed at companies, associations, trade unions, scientific circles and educational establishments. This work is being continued.

c) The Centre for Resource Efficiency (VDI-ZRE), founded in 2009 as a cooperation between the Federal Environment Ministry and the German Engineers' Association (VDI), acts as a "technology radar" and information platform for innovative efficiency technologies and as an information transfer centre, mainly for SMEs. There are many empirical examples of impressive economic benefits resulting from expert advice on and implementation of resource efficiency, especially in SMEs.

d) Under its "Environmental Innovation Programme", the Federal Environment Ministry has been supporting exemplary efficiency projects in small and medium enterprises in particular since 1979.

e) Until April 2011 the educational unit of the German Trade Unions Federation (DGB) developed, at the request of the Federal Environment Ministry, a further education concept on the subject of resource efficiency for employees and executives. A follow-up project will further improve in-house integration of the resource efficiency idea among employee representatives.

f) In the interests of improving environmental communication, the Federal Environment Ministry has introduced and communicated resource efficiency aspects as a protection target of the "Blue Angel" eco label since 2008.

g) The Federal Environment Ministry promotes the Öko-Institut's *Optum* project with the aim of making a comprehensive study of the resource aspects of all components of the electric mobility system, including recycling options and potential. The idea is to identify potential resource bottlenecks in the electric mobility system as early as possible and to develop strategies and specific suggestions for avoiding or eliminating them.

h) In the joint project *LiBri* the Federal Environment Ministry is supporting the development of a practicable, environmentally sound recycling concept for the high-performance batteries of future electric vehicles on the basis of pyrometallurgical processes.

i) In the joint project *LithoRec*, the Federal Environment Ministry is supporting the development and testing of recycling technologies for lithium-ion batteries on the basis of hydrometallurgical processes. The construction of pilot plants for recover-

ing electrode materials and producing supporting lithium electrolytes forms the basis for establishing industrially viable reuse and disposal paths.

j) In the field of environmentally sound recycling of traction batteries, the Federal Environment Ministry is intensifying its dialogue with China and supporting it at expert level as part of the International Climate Initiative.

k) In the field of closed-cycle management, where the Federal Environment Ministry has the role of lead ministry, resource efficiency has been legally established as an objective since 1994. A revision of the Closed-Cycle Management Act in 2011 gave a further boost to the implementation of this idea.

l) Innovative recycling technology for the international market is also supported as part of the export initiative RETech.

m) In the context of various research projects and association projects, the Federal Environment Ministry is looking into ways and means of increasing resource efficiency by means of economic or regulatory instruments and improving progress measurement by developing further suitable indicators.

n) The Federal Environment Ministry plays an active part in the "International Panel on Resources (IPR)", which comes under UNEP. The Federal Environment Ministry represents the German government on the steering committee. The establishment of the Panel dates back to the EU Commission's Thematic Strategy on Resource Efficiency in 2005, and the Commission actively supports the Panel's work. Following the example of the IPCC, international experts from industrialised, developing and newly industrialising countries make analyses and recommendations about more sustainable use of natural resources.

1.2 Federal Ministry of Economics and Technology (BMWi)

Activities developed by the Federal Ministry of Economics and Technology to improve resource efficiency include the following:

a) In autumn 2010 the German Raw Materials Agency was set up at the Federal Institute of Geosciences and Raw Materials (BGR) in Hanover (see Approach 1).

b) Via the German Materials Efficiency Agency (demea), the Federal Ministry of Economics and Technology (BMWi) provides assistance for qualified advice for individual SMEs on improving their material efficiency (potential analysis, in-depth consulting) under the "go-Inno" programme. In spring 2011 the content of the programme was extended to include resource efficiency and recycling and put on a voucher basis.

c) The Federal Ministry of Economics and Technology (BMWi) also promotes nationwide provision of expert advice on resource and material efficiency to SMEs in the manufacturing sector by authorised qualified consultants under the "go-Inno" programme. The aim is to identify potential for saving resources and material during production or product use and to indicate measures for improving the situation. The companies advised save an average of more than Euro 200,000 a year in material costs alone.

d) The Federal Economics Ministry's technology-neutral research and development programmes support small and medium enterprises on an individual or industry-wide basis with the development of new resource-conserving or resource-efficient technologies or services. The Federal Economics Ministry's funding through the Central Innovation Programme for SMEs (ZIM) or Cooperative Industrial Research (IGF) ranges from resource efficiency, though recycling and avoidance or substitution of special substances in production and maintenance, to remediation of harmful environmental impacts.

e) Through the ERP Environmental and Energy Saving Programme, the Federal Ministry of Economics and Technology also supports general environmental protection measures, major companies' measures aimed at efficient energy generation and use, and energy-saving measures by small and medium companies. The special fund for Energy Efficiency in SMEs which was set up in cooperation with the KfW first identifies energy-saving potential through funded energy consulting, and suggests economically sensible measures for exploiting this potential. The KfW provides the SME with low-interest loans so that it can implement these measures.

f) The use of renewable energy is also supported by the market incentive programme "Use of renewable energy sources in the heating market" (Federal Environment Ministry) and the KfW's Renewable Energy Sources programme. In addition to specific support for environmental and energy efficiency measures – depending on the project – there are also many other industry-neutral funding options and instruments for making economic use of scientific findings. These include in particular the ERP Start-up Fund, the EXIST programme ("Start-ups from science"), the High-Tech Founder Fund or the ERP Innovation programme (for other assistance programmes see www.foerderdatenbank.de)

g) The Federal Ministry of Economics and Technology is also active with a wide range of assistance programmes in the field of increasing resource efficiency. For example, the European Metrology Research Programme (EMRP) of the European metrology institutes was developed with intensive participation by Germany to coordinate metrological research and development needed to address global challenges in the fields of health, energy, industry, environment and new technologies. The Federal Economics Ministry with its departmental research facilities PTB (Federal Institute of Physics and Metrology) and BAM (Federal Institute for Materials Research and Testing) is actively engaged in this programme.

1.3 Federal Ministry of Transport, Building and Urban Affairs (BMBVS)

Among other things, the Federal Ministry of Transport, Building and Urban Affairs (BMVBS) has initiated the following activities to improve resource efficiency:

Establishment of the Federal Institute for Research on Building, Urban Affairs and Spatial Development to increase the efficiency of policy-oriented research, especially in the fields of resource efficiency and sustainable planning and building in regional policy, urban development and the building sector. The fields of action are as follows:

A. Urban and regional planning

At regional, urban and municipal level the focus is on energy-saving urban renewal and the use of open spaces in urban areas. The assistance programme "Experimental Housing and Urban Development" (ExWoSt) supports fields of action such as small-scale energy-saving measures in building refurbishment and new buildings at building level, efficiency-improvement measures relating to central energy generation and supply facilities at urban or regional level, energy optimisation of traffic flows in urban areas, energy optimisation of regional material and management cycles, and integration of renewable energy systems in urban and regional development processes.

The German Energy Agency's project "Energy-efficient local authorities", which is supported by the Federal Ministry of Transport, Building and Urban Affairs, assists local authorities by developing an action guide and an Internet portal and by providing advice on introducing a municipal energy management system.

In the regional planning sector, mention must also be made of investigations into the global and regional distribution of biomass potential and of the potential for using biomass on recycled land.

B. Housing and homes

Sustainable building first became measurable in 2011 with the Guide to Sustainable Building and the "Sustainable Building for Federal Buildings" assessment scheme (BNB). The BNB also describes resource efficiency.

The information portal "Sustainable Building" provides expert information such as basic data on ecological impact balances of building products via the database "Ökobau.dat" (in future with a resource parameter).

WECOBIS, the web-based ecological building materials information system, supplements the information with ecological and health background material.

The expert information is supplemented by the working aids on recycling, soil and water conservation, and wastewater.

For years the Round Table on Sustainable Building has served as a transparent and open platform for discussing sustainability issues.

Through the research initiative "Building for the Future", the Federal Ministry of Transport, Building and Urban Affairs promotes technical, cultural and organisational innovations via the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). In the term of parliament ending in 2010, around Euro 42 million was made available.

Numerous research projects are directly or indirectly concerned with resource efficiency. The following research clusters are representative examples:

- Use of new, energy-saving materials and products
- Material combinations leading to greater efficiency and recyclability
- Material-saving construction methods
- Solutions designed to avoid construction waste, analysis and sorting of building site waste by waste categories, improvements in recyclability
- Improving durability/adapting the selected building products, systems and designs to the planned useful life
- Suitability of buildings for other uses
- Techniques and processes that result in greater operator-friendliness, greater ease of maintenance and greater ease of dismantling, combined with increased efficiency
- Studies on resource efficiency in the construction sector, strategies for optimising substance cycles
- New developments and technical solutions for mobilising existing buildings

C. Saving energy

Energy Saving Ordinance: Steady increase in stringency of requirements since the start of the Thermal Insulation Ordinance 1984 with the aim of minimising the consumption of energy resources for the supply of heating and cooling

Extensive assistance programmes help to implement the requirements:

- 120-million programme: The programme helps to finance constructional and plant-oriented measures in existing federal buildings that considerably exceed the minimum requirements of the Energy Saving Ordinance.
- Energy-saving refurbishment roadmap for federal properties. The roadmap has been commissioned and is to be available by the end of the term of parliament.
- German Energy Agency's model project "Low-energy house": Under the German government's CO_2 Building Rehabilitation Programme assistance is being provided for various model projects in the field of refurbishment and new housing. On average they exceed the requirements of the Energy Saving Ordinance for comparable buildings by 50 percent. In 2011 a competition – "On the way to Efficiency House plus" – was held. This embraced both refurbishment and new building projects that could serve as models for climate-neutral housing of the future.
- KfW assistance programmes for energy-efficient building and refurbishment: Since 2006 assistance has been provided for more than 2.5 million homes (as of September 2011). The funding criteria go far beyond the requirements of the Energy Saving Ordinance and are thus preparing the market for high energy efficiency building and refurbishment and the use of renewable energy. November 2011 saw the start of the pilot phase for the KfW assistance programme "Energy-saving urban renewal", which will cover up to five pilot projects per federal state.

1.4 Federal Ministry of Education and Research (BMBF)

Activities developed by the Federal Ministry of Education and Research (BMBF) to improve resource efficiency include the following:

By promoting research and development work on new technologies and services along the entire value chain, the Ministry of Education and Research – together with trade and industry – makes a substantial contribution to improving resource efficiency (raw materials efficiency). The best suggestions from research establishments and trade and industry are assisted, on a competitive basis, under public promotion notices. The following are examples of some topical key assistance areas:

a) r^2 – Innovative technologies for resource efficiency – Resource-intensive production processes: The focus is on high-input industries closely connected with primary resources, as these can achieve great leverage for the purposes of the German Sustainability Strategy (doubling resource efficiency by 2020). Items assisted include projects in the metal and steel industries, and the chemical, ceramic and building materials industries.

b) r^3 – Innovative technologies for resource efficiency – Strategic metals and minerals: Assistance is given to joint projects by industry and science with the aim of making leaps in resource utilisation efficiency. Against the background of increasing scarcity of resources, the focus is on improvements in resource efficiency, recycling and substitution of scarce strategic resources. Another key area is "urban mining", which aims to recover valuable raw materials from the decommissioning of infrastructure or existing landfill sites and feed them back into products and production.

c) SME innovative: Resource and energy efficiency: Small and medium enterprises, as suppliers of business-oriented products and services, have a special role to play in the development of innovative efficiency technologies. The assistance area is therefore aimed specifically at innovative SMEs seeking to establish themselves or strengthen their position on the market for efficiency technologies.

d) CLIENT – International partnerships for sustainable climate and environmental technologies and services: The aim of the assistance measure is to initiate lead market developments in this field by means of solution-oriented model R&D projects, primarily with Brazil, Russia, India, China, South Africa and Vietnam. In addition to technological aspects, the focus is on socio-economic issues and good governance aspects, and on integrating relevant actors at an early stage. One key area of this assistance measure is technologies and service innovations in the field of resource utilisation.

e) Technologies for sustainability and climate protection – chemical processes and use of carbon dioxide as material: In this key area, assistance is provided for industry-oriented research projects designed among other things to improve climate protection and expand the resource base, and thereby promote more sparing use of fossil resources ("away from oil").

f) MatRessource – Materials for a resource-efficient industry and society: Resource efficiency is a central field of action in the framework programme "Innovative materials for Industry and society – WING". Innovations on the materials front can make a targeted contribution to conserving material and energy resources and reducing environmental pressures. Innovative materials offer great potential for running industrial processes at all value levels so that they produce much increased output with a simultaneous reduction in resource input.

g) Helmholtz Institute for Resource Technology (RIF): As part of the Helmholtz Centre in Dresden-Rossendorf and the TU Bergakademie Freiberg ("University of Resources"), this new research establishment will in future advance research and development in the field of technologies for sustainable resource supply and resource efficiency along the entire value chain.

1.5. Federal Ministry of Food, Agriculture and Consumer Protection (BMELV)

Activities developed by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) to improve resource efficiency include the following: The Federal Ministry of Food, Agriculture and Consumer Protection engages in various measures and activities to promote resource-efficient supply, processing and use of biogenic raw materials:

a) The ministry's assistance programme "Renewable Raw Materials" supports research, development and demonstration work on the use of regrowable raw materials. The aims of the assistance programme include making a contribution to sustainable supplies of resource and energy and relieving pressures on the environment by conserving resources.

b) The Ministry of Agriculture's programme for promoting innovation provides assistance nationwide for projects and innovations in the field of sustainable farming and forestry which are designed to promote resource-efficient crop and forestry management and which contribute to conserving natural resources.

c) Under the German government's Energy and Climate Fund (EKF), there are key assistance areas on adapting plants to climate change, on the humus and nutrient impacts of biogenic residues, and on improving the efficiency of biomass use.

d) The Ministry of Agriculture's departmental research facilities are working on projects for sustainable supplies of agricultural and timber raw materials and for efficient use of biomass.

e) The Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe – FNR) as the central federal coordination unit for regrowable raw materials handles the technical and administrative running of research projects and the provision of expert advice and information on efficient use of regrowable raw materials.

f) Thanks to the "promotion of farm-level consulting measures relating to climate change, renewable energy sources, water resource management, biological diversity and measures to accompany the restructuring of the milk sector" in the 2011 framework plan of the "Joint Agreement for the improvement of agricultural structures and coastal protection" (GAK), agricultural enterprises can, in addition to farm-level energy efficiency consulting, also take advantage of advisory services aimed at one or more of the priorities laid down in Article 16a of the amended EAFRD Regulation on promoting the development of rural areas.

This draws farmers' attention to ways and means of improving the overall ecosystem performance of their operations. Such advisory services may also relate to issues such as ecological and operational optimisation of specific agro-environmental measures or the adaptation strategies that can be adopted to respond to regional microclimate changes. The aim is to provide farmers with aids to decision making in the field of nature conservation, environment protection or climate change. This can bring about a sustainable increase in awareness of the need for resource-conserving production methods.

g) The Ministry of Food, Agriculture and Consumer Protection supports resource-conservation and resource-efficiency measures in the agriculture and forestry sectors in the context of agro-environmental measures which are not only an obligatory component of rural development programmes throughout Europe, but are also an important instrument for achieving environmental objectives under the Common Agricultural Policy. In addition to their contribution to climate protection, these measures are above all aimed at conserving or increasing biological diversity and protecting and improving soil, air and water.

1.6 Federal Ministry for Economic Cooperation and Development (BMZ)

Activities developed by the Federal Ministry for Economic Cooperation and Development (BMZ) to improve resource efficiency include the following:

The conservation and sustainable use of natural resources and climate protection are important objectives of German development policy. Among the activities directly related to the subject and the guiding principles and objectives of this programme, the following deserve special mention:

a) In several developing and emerging economies, the ministry has assisted and is still assisting projects concerned with environmental policy consulting and urban-industrial environmental protection. The main focus here is to improve the institutional framework conditions and capacities for environment-friendly and resource-conserving management in cooperation with governmental and non-governmental actors.

b) Measures to improve resource efficiency are also an integral part of projects concerned with economic policy consulting and the promotion of private enterprise. In this context, for example, partner countries are given assistance with introducing an ecological tax reform and using environmental and resource management instruments in practical operations. The new sectoral concept "Private Enterprise Promotion" will give high priority to the topics "green technologies" and "green jobs".

c) In a number of developing and newly industrialising economies, the Federal Ministry for Economic Cooperation and Development is also promoting the establishment of a sustainable waste management system. All these measures are keyed to the concept of closed-cycle management and make a contribution to resource conservation. They are based on a new ministerial handout on waste management and resource management.

d) A sectoral project run by the GIZ (*Deutsche Gesellschaft für internationale Zusammenarbeit*) in the field of "resource efficiency" is working to consolidate various existing approaches and instruments for promoting resource efficiency in industry to create a coherent implementation concept for development cooperation.

e) The Federal Ministry of Economic Cooperation and Development supports the transfer of environment-friendly and resource-efficient technologies, partly through the instrument of development partnerships with German industry, and partly by fostering an innovation-friendly setting in the partner countries and providing low-interest loans for environmental investments in small and medium enterprises.

f) Furthermore, the Federal Ministry for Economic Cooperation and Development is also active in the field of product certification and the introduction of ecological and social standards. In this context it also takes part in CSR initiatives by German trading companies that are designed to give environmentally sounder and socially acceptable shape to the value chain of the products manufactured in developing countries.

2. Activities of the Länder

The Länder (federal states) and local authorities play a central role in implementing more efficient use of natural resources. Apart from their large degree of responsibility for education, science and culture, the Länder have an important role to play when it comes to enforcement in virtually all policy areas. Federal activities can only make their full effect felt if they are supplemented and supported by measures at Land and local authority level. Major motivating factors here are resource efficiency as a means of protecting the regional environment in which people live and as an instrument for strengthening the competitive position of their regional enterprises. Länder and local authorities are aware of specific regional and local features and can make an important contribution to the successful design and implementation of measures.

The aim of many activities is to help companies make efficient use of resources in the individual Land or in a specific region. The Länder offer expert advice and assistance facilities, and company-driven initiatives and networks also exist. These measures are frequently embedded in the environmental partnerships and environmental and sustainability alliances of the Länder
(see the overview in www.mugv.brandenburg.de/cms/detail.php/lbm1.c.211938.de).

Extensive programmes have been created at Land level which cater for the circumstances of individual companies. The spectrum of offerings ranges from financial assistance, through expert advice, to finding specialists and developing cost-effective solutions. Regional trade associations take part in an intensive interchange of information. They also support technology and knowledge transfer by means of active information sharing and discussions at various events and by making use of modern information facilities. Here local contacts help to establish communication with local individuals or units and provide special information about features specific to the region.

A more detailed description of the activities of some of the Länder can be found below.

Baden-Württemberg

Ministry for the Environment, Climate Protection and the Energy Sector

As a resource-poor region with highly innovative industries, Baden-Württemberg relies on manufacturing high-tech products. In view of this, sparing use of resources is a crucial challenge for the future from the point of view of not only sustainability, but also costs and competition. Baden-Württemberg seeks to position itself as a lead market and a leading supplier of environmental technologies and resource efficiency technologies. It therefore takes targeted measures to support the entire spectrum of environmental technologies and ecological innovations – from research, through development, to distribution and export. These measures are accompanied by the establishment of innovation-friendly technology clusters and environmental networks. The newly founded Baden-Württemberg Innovation and Technology Centre for Environmental Technology and Resource Efficiency (*Innovations- und Technologiezentrum Umwelttechnik und Ressourceneffizienz Baden-Württemberg – INUTEC-BW GmbH*) will play a special role here.

- INUTEC-BW Baden-Württemberg Innovation and Technology Centre for Environmental Technology and Resource Efficiency (founded in September 2011)
- Environmental Technology and Resource Efficiency Competence Atlas Baden-Württemberg (www.umwelttechnik.baden-wuerttemberg.de/umweltportal)
- Information on Resource Efficiency Baden-Württemberg (www.umwelttechnik.baden-wuerttemberg.de/umweltportal)
- ERDF Directive environmental technology (www.um.baden-wuerttemberg.de/servlet/is/45561/)
- Environmental Technology Award Baden-Württemberg (www.umwelttechnikpreis.de)
- Climate Protection Plus programme (www.um.baden-wuerttemberg.de/servlet/is/6155/)
- Consulting programmes ECO+ and ECOfit, convoy programme EMAS (www.um.baden-wuerttemberg.de/servlet/is/9282/)
- Corporate Environmental Protection Platform (www.umweltschutz-bw.de/)

- European Clusters and Regions of Eco-innovation Network Plus ECREIN+ (www.um.baden-wuerttemberg.de/servlet/is/37498/ www.interreg4c.eu/)
- Land network Environmental Technology Platform
- Land Use Management Platform Baden-Württemberg (www.um.baden-wuerttemberg.de/servlet/is/27062/)

Bavaria

The Bavarian government sees sustainable use of resources as an important task for the state, industry and society. Especially with regard to non-energy resources, which are at the focus of ProgRess, its activities include the following:

- Integration of objectives and measures for "conservation and management of natural resources" in the Bavarian **sustainability strategy "For a sustainable Bavaria"** (draft strategy adopted by the Council of Ministers in October 2011 and dialogue process started – see www.nachhaltigkeit.bayern.de).
- "Integrated Product Policy and Resource Efficiency" is a key area of the current **Bavarian Environmental Pact** (2010–2015), the voluntary agreement between the state government and industry (see www.umweltpakt.bayern.de).
- The **Environmental Industry Information Centre** (*Infozentrum UmweltWirtschaft – IZU*) established at the Bavarian State Office for the Environment (LfU) under the Environmental Pact provides general and industry-specific web-based information on resource efficiency (see www.izu.bayern.de).
- The IZU and the LfU are part of the **Environmental Competence Centre** (*Kompetenzzentrum Umwelt – KUMAS*) in Augsburg, whose network also includes **imu augsburg, bifa Umweltinstitut GmbH (bifa), Augsburg University** and the **Bavarian Environmental Cluster** (see www.kumas.de).
- Examples of other Bavarian resource efficiency centres include the **ATZ Development Centre** in Sulzbach-Rosenberg (see www.atz.de), the Nuremberg Chamber of Industry and Commerce (IHK Nürnberg) and the Georg-Simon-Ohm University in Nuremberg (which jointly held the **Second Symposium on "Resource Efficiency and Resource Innovation"** – see www.ohm-hochschule.de) and the **Fraunhofer project group on Recyclable Material Cycles und Materials Substitution** which was set up in Alzenau in 2011 (see www.isc.fraunhofer.de).
- Through the **Bavarian Environmental Consulting and Audit Programme – BUBAP** the state government supports three-day resource efficiency consulting sessions in SMEs (approximately 5,000 sessions to date).
- The state government has set up a **"Resource Strategy" working group** with representatives of the relevant ministries and from industry and science.

On July 20, 2011 the **Bavarian Resource Summit** was held in Munich as a joint event staged by the Bavarian state government and Bavarian industry (for programme and results see www.vbw-bayern.de).

Berlin

By pursuing sustainable procurement and making rigorous use of waste as a resource, the state of Berlin intends to make an important contribution to resource conservation in the years ahead with the following programmes and activities:

Development of high-grade recovery of recyclable materials

The Waste Management Plan 2011 - 2020 approved by the Berlin parliament lays down in binding form the essential steps for developing Berlin's waste management system into a modern closed-cycle management system in the years to come, especially from a resource and climate point of view.

- (www.stadtentwicklung.berlin.de/umwelt/abfall/entsorgung/download/arbeitspaket_klimaschutzkonzept.pdf)

An appropriate programme of measures for achieving the specified targets is currently being drawn up as part of a study assisted by the Federal Environment Ministry which is looking into the establishment of an exemplary climate-friendly waste management system in Berlin state.

- (www.stadtentwicklung.berlin.de/umwelt/abfall/entsorgung/)

This study will be followed by a similar study on the environmental relevance of Berlin's waste.

The purpose of these two studies is, with regard to the biogenic and non-biogenic waste generated in Berlin state, to develop an application-oriented plan for identifying the waste paths with the greatest potential for relieving pressures on the climate and environment and indicating possible ways of exploiting this potential.

Intensifying the use of existing raw material certification systems

The agreement of 15 April 2011 between Berlin state and Vattenfall on the sustainability of biomass procurement contains binding ambitious specifications on the application of environmental and social criteria to the use of wood biomass in Vattenfall CHP plants in Berlin.

- www.stadtentwicklung.berlin.de/umwelt/klimaschutz/aktiv/vereinbarung/vattenfall/index.shtml

Under this agreement, verification of the specified sustainability criteria is basically carried out by means of recognised certification systems (for example Forest Stewardship Council – FSC) that cover the agreed sustainability criteria. In 2013, Vattenfall and the Berlin Senate will prepare and publish a first documentation on compliance with the agreed sustainability criteria, with detailed information about the source, type and places of use of the biomass employed by Vattenfall in Berlin's power stations.

High-grade, climate-friendly recovery of biogenic materials

By making sustainable use of biogenic waste (approximately 1,250,000 Mg/a) to obtain materials and energy, Berlin state aims to exploit relevant annual CO_2 savings of around 250,000 Mg CO_2 equivalent by 2016 at the latest.

- www.stadtentwicklung.berlin.de/umwelt/abfallwirtschaft/de/biomasse/index.shtml

To this end, the Senate's environmental administration conducted a comprehensive biomass study with the aim of determining the amount of biogenic material available. It was also to develop design approaches to the optimisation and early implementation of high-grade, climate-friendly recovery.

Increased use of public procurement as an instrument of resource efficiency

On the basis of its powers under Section 7 (3) of the Berlin law on the award of contracts

- (www.berlin.de/imperia/md/content/vergabeservice/rechtsvorschriften/berlavg.pdf?start&ts=1307536781&file=berlavg.pdf)

the Berlin Senate's environmental administration has drawn up a comprehensive administrative guideline on the application of environmental criteria to procurement of deliveries, construction activities and services (Verwaltungsvorschrift Beschaffung und Umwelt – VwVBU). The administrative guideline contains binding minimum environmental criteria for the most relevant products and services in the form of specification sheets. Among other things, this guideline is intended to make an important contribution to the sustainable planning, construction and use of buildings and the resource efficiency of IT equipment.

The Senate will probably adopt the administrative guideline on green procurement in the summer of 2012.

Optimising collection and recycling of resource-relevant bulk wastes

The nationwide introduction of a standard recycling bin from 1 January 2013 onwards is to ensure collection of not only packaging, but also other items made of metal and/or plastics and channel them into climate-friendly and resource-conserving recovery paths. All in all, the additional annual collection of some 25,000 Mg/a of resource-relevant recyclables in Berlin can make an appreciable contribution to relieving pressures on the climate in the years ahead.

Environmental Relief Programme II

Through its Environmental Relief Programme II, Berlin is providing assistance for various environmental measures during the period 2007 to 2013 with financial resources from the European Regional Development Fund (ERDF) and state funds. Measures to improve energy efficiency in non-residential buildings account for the largest share here, totalling around Euro 100 million. The Environmental Relief Programme II also includes a offer of assistance for environmental management systems in accordance with EMAS and DIN EN ISO 14001. Link to funding rules:

- www.uep-berlin.de/uepmedia/usermedia/files/foerderrichtlinie_uep_080922.pdf

Key areas of energy and climate policy, climate protection agreements

In view of its lack of natural resources for generating renewable energy, Berlin's energy policy and climate protection activities focus on the efficient use of energy, especially CHP for district heating and local heating, and on improving energy efficiency in the use of heat and power. Ambitious and verifiable climate protection agreements have been and will continue to be made with municipal undertakings, housing associations and energy supply enterprises in order to achieve substantial energy savings and CO_2 emission reductions in areas not covered by statutory regulations:

- www.stadtentwicklung.berlin.de/umwelt/klimaschutz/aktiv/vereinbarung/index.shtml

A full overview of activities in these fields in Berlin is provided by the Berlin Information Centre for Climate Protection (*Berliner Informationsstelle Klimaschutz – BIK*) under the auspices of the Berlin Energy Agency (*Berliner Energieagentur –BEA*), whose supporting bodies include the Berlin Senate:

- www.berlin-klimaschutz.de/

Brandenburg

Brandenburg supports the German government's initiative, since the foreseeable depletion of natural resources can jeopardise the viability of the economy and of society as a whole. The Land government therefore seeks to ensure full and timely orientation of its activities to this challenge. By doing so it aims to reduce environmental pressures, preserve the balance of nature, strengthen the competitive position of the domestic economy, reclose regional value-added cycles, and safeguard jobs.

The Land intends to take measures of its own to improve resource efficiency and thereby make a contribution to implementing the national programme. These include:

- Helping companies to introduce a systematic environmental management system (EMAS, ISO 14001); to this end, incentives have been created in the form of simplified procedures in regulatory processes and reduced charges for immission control authorisation procedures. Moreover, small and medium enterprises have opportunities to receive financial assistance for relevant preparatory consulting services.
  www.mugv.brandenburg.de/cms/detail.php/5lbm1.c.146066.de
  www.ilb.de/de/wirtschaft/zuschuesse/management__marketing__messen_und_markterschliessung__m4_/index.html

- Providing assistance for projects run by the Brandenburg Consumer Advice Centre (*Verbraucherzentrale Brandenburg*) that are aimed at resource-saving consumer behaviour;

- Enabling environmental partnerships with the Land which aim to strengthen company responsibility for sustainable and resource-saving management; admission requirements for environmental partnerships are the use of certified environmental management systems or specific operational environmental measures, such as efficient use of resources.
  www.umweltpartnerschaft.de

- Providing support for the environmental economy; to this end the Brandenburg Ministry of the Environment, Health and Consumer Protection conducted a survey in 2010 of potential in this sector, which is to serve as a basis for further measures.
  www.mugv.brandenburg.de/cms/detail.php/lbm1.c.366796.de

- Preparing a Land sustainability strategy, for which the Land government has adopted key points that establish the connection with resource conservation in several areas;
  www.mugv.brandenburg.de/cms/detail.php/lbm1.c.335190.de

Free Hanseatic City of Bremen

Improving resource efficiency and energy efficiency are central policy concerns in Bremen. With the aim of protecting the environment, climate and resources, Bremen supports economic engagement and scientific activities in Bremen state by means of assistance programmes, initiatives, networks, awards and incentive systems. Assistance is provided for research and development work and the use of innovative environmental products, processes and services and for increasing ecological efficiency and corporate social responsibility (CSR) in companies located within Bremen.

The environmental and climate awards 'preis umwelt unternehmen: Nordwest' and 'Klimaschutzbetrieb CO_2-20' are presented in recognition of environmentally active and resource-efficient management, while the 'initiative umwelt unternehmen' (environmental company initiative) together with the 'partnerschaft umwelt unternehmen' (environmental company partnership) provides an important platform for the topic of resource efficiency with campaigns, events and a comprehensive information strategy

- www.umwelt-unternehmen.bremen.de/

Within resource conservation, Bremen has a special thematic focus on wind power for the environment, industry and science. The network wab (wind energy agency) is used by more than 350 companies and research establishments.

Research into resource efficiency is carried on at Bremen University under a separate chair of "Sustainable Management" in the school of economic sciences (www.wiwi.uni-bremen.de/gmc/profil/profil.htm) at the artec – Sustainability Research Centre and at the UFT Centre for Environmental Research and Sustainable Technologies. At the University of Bremen the Institute for Energy, Recycling and Environmental Protection (IKrW) is concerned with the relevant issues.

Assistance programmes:

- Consulting assistance for corporate ecological efficiency and responsible management (BÖE) (www.umwelt-unternehmen.bremen.de/Beratungen.html)
- Assistance programme "Applied Environmental Research" (AUF) (www.umwelt-unternehmen.bremen.de/Angewandte_Umweltforschung.html)
- Programme for promotion of Application-Oriented Environmental Technologies (PFAU) (www.umwelt-unternehmen.bremen.de/Frderung.html)
- Programme for promoting sparing and efficient energy use and conversion in trade and industry (REN) (www.umwelt-unternehmen.bremen.de/Rationelle_Energienutzung_REN_3.html)

Networks:

- 'partnerschaft umwelt unternehmen' (puu) (www.umwelt-unternehmen.bremen.de/partnerschaft_umwelt_unternehmen.html)
- NeMat (Innovative materials) (www.wfb-bremen.de/de/wfb-branchen-materialwirtschaft)
- MultiMat (multifunctional materials and technologies – Bremen) (www.ifam.fraunhofer.de/multimat)
- wab e. V. (wind energy) with germanwind GmbH (project company) (www.windenergie-agentur.de)

Incentive/award schemes:

- 'preis umwelt unternehmen: Nordwest' (www.preis-umwelt-unternehmen.de/)
- Award 'Klimaschutzbetrieb CO_2-20' (www.umwelt-unternehmen.bremen.de/Auszeichnung_Klimaschutzbetrieb_CO2-20_-_Machen_Sie_mit.html)

Free and Hanseatic City of Hamburg

Ministry for Urban Development and the Environment, Office for Nature and Resource Conservation

Hamburg has united various different projects under the umbrella of UmweltPartnerschaft Hamburg (Environmental Partnership Hamburg). At the centre of the Environmental Partnership are the Hamburg companies that are active on a voluntary basis in the field of environmental and climate protection. The Environmental Partnership offers companies numerous possibilities relating to climate protection and resource conservation:

- Free advice on improving company energy efficiency
- Promotion of investments in resource-conserving measures under the programme "Companies for Resource Conservation"
- Advice on and assistance for solar technology, insulation, energy-efficient heating systems, renewable energy sources, energy-efficient building in the programme "Work and Climate Protection"
- Interchange of knowledge and experience in the Environmental Partnership network

further information under
- www.klima.hamburg.de/umweltpartnerschaft

The Hamburg Environment Ministry has also identified the opportunities afforded by Integrated Product Policy, and in summer 2011 it started the project "Green Product Design". Some 80 percent of a product's environmental impacts are determined during its development. This phase includes decisions on the materials and manufacturing input, and also on how long-lasting, energy-intensive or maintenance-friendly a product will be. Under the project, interested Hamburg companies can receive several years' comprehensive support for the development, manufacture, marketing and servicing of their products.

The focus of the activities is on:

- Assistance for company-level advice and implementation measures to ensure viable product design for the future
- Information workshops for expert advisors, and also for industrial designers and engineering offices
- Establishment of a competence network of practitioners, experienced experts and regional research establishments
- A green products competition to be held in 2012.

There are plans to extend the Environmental Partnership for a further five years until 2018.

Hamburg has recently launched a recycling offensive.

(For further information, see www.hamburg.de/start-siedlungsabfall/2697946/recycling-offensiv.html and www.srhh.de/srhh/opencms/privatkunden/wertstoffe/).

Hesse

Hessian Ministry for Environment, Energy, Agriculture and Consumer Protection

- CO_2 calculator for joiners in Hesse, primarily for wooden furniture www.diug.org
- CO_2 base from North Rhine-Westphalia (NRW), especially for timber structures www.co2-bank.de (suggested by the Hessian ministry, but strictly belongs to NRW).
- The Agency for Renewable Resources, project executing agency for the Federal Ministry of Food, Agriculture and Consumer Protection, can provide a wealth of valuable information, including on timber constructions and bioplastics (suggested by the Hessian ministry, but really belongs to the activities of the Federal Ministry of Food, Agriculture and Consumer Protection (see federal activities under IV. 1. 5.).

Hessian Ministry of Economics, Transport, Urban and Regional Development

A. Consulting programme Hessen-PIUS – Cut costs, protect the environment

In 2009 the Hessian Ministry of Economics, Transport, Urban and Regional Development launched the PIUS consulting programme for small and medium enterprises in Hesse. The aim is to ensure efficient use of resources such as energy, water, air, raw materials and consumables by optimising companies' internal processes and thereby reduce costs. Project execution of the PIUS consulting programme is in the hands of RKW Hessen GmbH. Aktionslinie Hessen-Umwelttech coordinates all other activities relating to Hessen-PIUS and is a cooperation partner in Germany's most used PIUS portal www.pius-info.de.

PIUS aims at two target groups:

- Companies with environmentally sound production that want to optimise their value chain,
- Consultants and environmental technology providers that want to take part in the development and provision of cross-sectoral services and wish to support the PIUS process through their know-how.

B. Aktionslinie Hessen-Umwelttech

"Aktionslinie Hessen-Umwelttech" is the central platform of the Hessian Ministry of Economics, Transport, Urban and Regional Development for the environmental technology industry.

It strengthens the competitive position and innovative power of environmental technology manufacturers and service providers in Hesse and serves – especially with regard to production-integrated environmental protection (PIUS) – as an interface with environmental technology users.

It offers information, communication services and cooperation opportunities for environmental technology suppliers and users, for example in the waste technology, wastewater and water technology, energy technology and air quality control segments. It advises companies, promotes technology transfer and presents the competencies of Hessian environmental technology. The "Aktionslinie" coordinates all activities relating to Hessen-PIUS and is a cooperation partner in Germany's most used PIUS portal www.pius-info.de.

Mecklenburg-West Pomerania

Although the Climate Protection Action Plan 2010 essentially focuses on measures to reduce CO_2 emissions, it also considers the opportunities for resource efficiency in this context. In the course of reviewing and updating it will also be necessary to examine the possibilities of covering a broader spectrum of themes. The activities currently concentrate on the following seven areas:

- Energy saving and energy efficiency
- Renewable energy
- Rural areas and agriculture and forestry
- Tourism and the health industry
- Physical development planning and construction
- Transport and logistics
- Research and development, and communication

- www.klimaschutzaktionen-mv.de

The "Environmental Alliance Mecklenburg-West Pomerania" (*Umweltallianz Mecklenburg-Vorpommern*) is a long-term voluntary agreement between the state government and industry in Mecklenburg-West Pomerania with the aim of continuously improving the framework conditions for sustainable and environmentally sound economic development in Mecklenburg-West Pomerania. In order to achieve this, the Environmental Alliance helps its participants to optimise operational workflows and implement environmental protection requirements, and of course to implement measures designed to improve resource efficiency.

- www.umweltallianz-mv.de

Lower Saxony

Since as long ago as the late 1980s, the government of Lower Saxony has been obtaining advice on waste prevention and recycling, product responsibility and closed-cycle management from various "government commissions" in which all socially relevant groups (industry, associations, administration etc.) are represented. The present 6th Government Commission has spent three years closely examining the issue of "energy efficiency and resource efficiency", and a working group has in particular studied the topics of

- Exploiting additional sources of secondary raw materials
- Systematising resource efficiency measures, identifying obstacles
- Inventory of existing advisory and support structures.

The findings of the 6th Government Commission will be presented at a symposium at the end of 2011. From the end of December 2011 the final report can be downloaded from www.umwelt.niedersachsen.de/Themen/Nachhaltigkeit/Regierungskommissionen.

This topic will be studied more closely in a 7th Government Commission to be set up in 2012.

The work of the 6th Government Commission also involved companies from Lower Saxony that were specifically concerned with recycling special raw materials. They are now partners in a "recycling cluster" which is being implemented as the first project of the "Initiative for the future of the Harz region" (IZH).

The starting point for this cluster approach was the finding that the West Harz region plays a leading role in industry and research in the field of industrially used nonferrous metals for the electrical and automobile industries. Moreover, the Technical University of Clausthal possesses outstanding research and technology competence in this field. Together with the application-oriented CUTEC Institute, further developments are being carried on for industrial implementation as part of the Initiative for the future of the Harz region.

The aim of the recycling cluster, which consists of 13 founding members, is to promote science and research in the field of development and industrial application of recycling strategies and processes for "strategic industrial metals". The aim is to ensure the availability of important metals such as gallium, germanium, indium and rhenium.

The principals of the IZH are the rural districts of Goslar and Osterode in the Harz region. The initiative is supported and promoted by the government of Lower Saxony.

The Federal Economics Ministry has commissioned RKW Niedersachsen GmbH, the efficiency improvement and innovation centre for German industry, to initiate material and energy efficiency projects in small and medium enterprises (SMEs). Courses are provided to give consultants and employees qualifications in the field of resource efficiency. In Lower Saxony such projects can also be funded by the European Social Fund.

North Rhine-Westphalia

Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection

As early as the late 1990s, North Rhine-Westphalia (NRW) took tangible steps towards optimising resource efficiency, especially in the manufacturing sector and SMEs. Outstanding examples of important instruments used by the state government include

- The **NRW Efficiency Agency (Effizienz-Agentur NRW)**, founded in 1998, with the task of promoting production-integrated and product-integrated environmental protection. It is based in Duisburg and now has 6 additional branches in NRW (www.efanrw.de),

- The **NRW Resource Efficiency Programme (Ressourceneffizienzprogramm NRW)** successfully implemented as part of the "Ressource.NRW" competition under the "NRW-EU Ziel 2" programme (ERDF) 2007–2013 (www.ziel2.nrw.de, www.lanuv.nrw.de/agrar/foerderprogramme/ressourcen.htm,),

- The state cluster for environmental technologies **"Landescluster Umwelttechnologien.NRW"** installed in 2009 (www.umweltcluster-nrw.de),

- Promoting the **introduction of environmental management systems**, especially ÖKOPROFIT® (www.mkulnv.nrw.de).

- The **environmental economy strategy** currently under development, and

- The structuring of the future activities of NRW with regard to the **lead initiative "Resource-conserving Europe"** under the EU Strategy Europa 2020.

The state government of NRW is using these instruments to provide practical assistance for suppliers and users of environmental technologies – and hence the labour market relevant sector of the environmental economy in NRW – and to promote environmental protection in NRW and the resource efficiency and competitiveness of NRW companies.

Rhineland-Palatinate

Ministry of Economics, Climate Protection, Energy and Land Planning

The government of Rhineland-Palatinate seeks to help companies to improve resource efficiency through a variety of initiatives and projects.

- **PIUS Internet Portal** (www.pius-info.de)

  Joint project by the Länder Hesse, North Rhine-Westphalia and Rhineland-Palatinate in conjunction with VDI ZRE at federal level; co-founded by the special-waste management company for Rhineland-Palatinate (SAM) in 2001, the PIUS portal has been receiving support since then.

- **Effizienznetz Rheinland-Pfalz – EffNet** (www.effnet.rlp.de)

  The efficiency network is the central point of contact for resource efficiency, energy and the environment. It provides expert information and competent contacts. Some 36 network partners are currently active in EffNet. Examples of current EffNet projects include:

  a) **„EffCheck – PIUS-Analysen in Rheinland-Pfalz"**
  Process-oriented material flow analyses for companies and municipal enterprises to identify resource efficiency potential (< 1,000/ > 1,000 employees with/without financial assistance from the Land).

  b) **CHP offensive**
  EffNet actively supports the "CHP Offensive Rhineland-Palatinate" which was launched in 2008.

c) **Support for KfW special fund "Energy efficiency in SMEs"**
EffNet actively supports the regional partners of the KfW special fund "Energy efficiency in SMEs" as a communication and coordination platform.

d) **EffNet event programmes**
Goal: Motivate companies, local authorities and consultants
- "Resource Efficiency Rhineland-Palatinate"/ "PIUS Consultant Event"
- "Energy Efficiency in Enterprises"/ "Energy Efficiency Consultant Days"

▶ **Concepts for typical industries in Rhineland-Palatinate**
Industry-specific studies with regard to resource efficiency and identifying typical resource potential in the industry.

a) **Resource efficiency in wine growing and wine production** (study)

b) **Resource efficiency in the ceramic industry** (research project initiated through EffNet)

▶ **Municipal materials flow management network**
Bundling of municipal activities in the field of resource efficiency and energy efficiency

▶ **Institute for Applied Materials Flow Management (Institut für angewandtes Stoffstrommanagement – IfaS)**
The "In-Institut" of the Trier University of Applied Sciences, located at the Birkenfeld Environmental Campus, is actively engaged in the analysis of materials and energy flows at regional and enterprise level with the aim of identifying optimisation potential and initiating implementation projects.

▶ **IFAG – Information Forum on Waste Management and Materials Flow Management in the Health Sector (Informations Forum Abfallwirtschaft und Stoffstrommanagement im Gesundheitswesen)**
Working group which in particular pursues the ecological and economic advancement of waste management and materials flow management in the health sector and promotes environmentally sound measures in health sector establishments. The second round of the "Energy Efficiency Round Table for Hospitals" started at the beginning of 2012. Numerous practical hints available on the Internet:

- www.mwkel.rlp.de/Kreislaufwirtschaft/Stoffstrommanagement/IFAG/Dokumente

▶ **Various other activities relating to resource efficiency**
- Soil and building rubble exchange
- Series of discussions "Waste transport checks"
- ÖKOPROFIT in several municipalities and in authorities
- State government's sustainability strategy
- Expert advice from professional chambers and associations
- Environmental management in church parishes
- Eco checks in sports clubs
- Promotion of technology consulting by RKW
- Loans programme by ISB (Investitions- und Strukturbank Rheinland-Pfalz)
- Cluster initiatives: Metals-Ceramics-Plastics innovation cluster and Timber Construction cluster

Saarland

Ministry for the Environment, Energy and Transport

▶ **Saar Environmental Pact**
Alliance between state government and industry for more voluntary environmental protection:

- **www.umweltpakt.saarland.de**

The Saar Environmental Pact provides assistance for small and medium enterprises in particular.

Principles to date (selection):
- Support for introduction of environmental management systems
- Support for resource-conserving production methods and behaviour

Objectives for further development (selection):
- Improving the efficiency of resource utilisation

▶ **Energy efficiency network for companies "EEnet Saar"**

- www.saarland.de/71965.htm

▶ **Cascade use of timber**
The master plan for a sustainable energy supply system in the Saar region seeks to ensure that the use of timber as material takes priority over its use for energy:

- www.dassaarlandhandelt.de/masterplan-energie.html

Saxony

State Ministry of the Environment and Agriculture

- Raw materials strategy for Saxony
  Following a resolution by the state parliament of Saxony, the state government is drawing up a raw materials strategy for Saxony. The strategy is currently at the stage of preparation for a Cabinet decision. The strategy for Saxony is based on the federal government's raw materials strategy of 2010 and the EU Resource Strategy 2011. The aim is sustainable and efficient use of natural resources in Saxony, having regard to closed-cycle management.

- Strategy for adapting agriculture to climate change/partly also action plan on climate and energy (outline: synergy effects, soil protection, biodiversity, water resource management, sustainable fertility)

- Renewable raw materials: Priority for sustainability (no use of whole trees in forests, only trunk wood or industrial wood; branch and root material must remain in the forest –nutrient cycle compare medieval use of litter and podzolisation...; ensuring annual crop rotation in the agricultural sector).

- Systematic use and further expansion of renewable energy sources: Wind, sun (also, with reservations, water) and geothermal energy (currently 1–2 deep geothermal pilot projects planned) to reduce consumption of regrowable raw materials (reducing competition with food uses) and fossil fuels

- Raise renewable energy as a proportion of gross electricity consumption in Saxony to at least 24 percent by 2020

- Land saving target based on federal target (broken down for Saxony: <2 hectares per annum)

Saxony-Anhalt

- Under the state's consultancy assistance programme, SMEs have the opportunity to obtain partial funding from Saxony-Anhalt for consultancy services to improve resource efficiency (up to 75 percent depending on the programme) (knowledge and technology transfer):

- www.ib-sachsen-anhalt.de/foerderprogramme/wissens-und-technologietransfer.html

  and consultancy assistance programme Saxony-Anhalt:

- www.ib-sachsen-anhalt.de/firmenkunden/investieren/beratungshilfeprogramm.html.

- Organisation of assistance for waste management measures relating to the development of innovative projects for recycling of waste as material and energy with a view to conserving natural resources; promotion of integrated product policy; development of new product concepts; and promotion of product-integrated environmental protection

- (www.landesrecht.sachsen-anhalt.de/jportal/portal/t/yn8/page/bssahprod.psml?doc.hl=1&doc.id=VVST-VVST000003522%3Ajuris-v00&documentnumber=70&numberofresults=375&showdoccase=1&doc.part=F&paramfromHL=true#focuspoint).

- Measures to improve resource efficiency under the Environmental Alliance

- (www.umweltallianz.sachsen-anhalt.de).

Schleswig-Holstein

Schleswig-Holstein's activities in the field of materials efficiency and resource efficiency are based on the building blocks: consulting, networking and support. Trained innovation consultants provide companies with competent advice on issues such as optimising production methods, assessing research and assistance needs, or introducing new production processes.

For example, the materials efficiency network "Netzwerk Materialeffizienz-Schleswig-Holstein (NeMat)" is already providing 29 companies in various industries with a moderated interchange of experience, courses, workshops, expert advice and information transfer.

The networking activities are essentially supported by accompanying assistance programmes.

▶ The "Environmental Innovations" programme primarily assists small and medium enterprises with the introduction of innovative environment-oriented technologies and processes, which the companies are unable to use or develop without public assistance in view of economic risks. In particular, the programme focuses on:

- optimising the company's use of materials, for example by more sparing use or recovery of materials, use of regrowable raw materials and/or substitution of hazardous substances,
- reducing energy consumption by products and production processes,
- testing methods of recycling/reusing waste for which disposal has hitherto been the only option,
- introducing environmental management on a pro-active basis (for example life-cycle assessments, eco controlling, product line analyses, integrated product policy).

For more information, see:
● www.wtsh.de/wtsh/de/foerderung/programme/UI/index.php

▶ In order to facilitate access to more environmental efficiency and resource efficiency for SMEs and micro businesses and to strengthen their competitive position, assistance is provided to support the introduction of the quality and environmental management system "Quality alliance of environmentally aware enterprises" (*Qualitätsverbund umweltbewusster Betriebe – QuB*).

For more information, see:
● www.wtsh.de/wtsh/de/foerderung/programme/UI/ui_qub.php

▶ The assistance programme "Innovation Assistant" (Innovationsassistent) is designed to give small companies an opportunity to recruit highly qualified graduates (with a degree less than 5 years old) in areas such as research and development, innovation projects, use of new technologies, innovation processes, especially in the field of energy, material and resource efficiency, and thereby improve their competitive position.

For more information, see:
● www.wtsh.de/wtsh/de/foerderung/programme/IA/index.php

Thuringia

Submitted by Thüringer Energie- und GreenTech-Agentur (ThEGA).

Institutions/initiatives in the state of Thuringia:

▶ Thüringer Energie- und Greentech-Agentur (Thuringia Energy and Greentech Agency)
Main competence, advice and information centre for the development of renewable energy and green technologies in Thuringia

▶ Sustainability Pact Thuringia (*Nachhaltigkeitsabkommen Thüringen – NAT*):
- Voluntary agreement between the state government and industry in Thuringia
- The pact partners work together to shape Thuringia as an economic location in accordance with the principles of sustainable development.

● www.nachhaltigkeitsabkommen.de

▶ Bioenergy Consulting Thuringia (*Bioenergieberatung Thüringen – BIOBETH*)
Impartial advice for individual projects, bio energy villages, bio energy regions, further training and public relations and quality management as back-up for bio energy projects, holistic pre-competition advice on/studies for "bio energy projects"

▶ Thuringia Development Bank (*Thüringer Aufbaubank*)
Central point of contact for assistance measures and programmes:
- Assistance for companies and institutions with the use and development of greentech products and processes and relevant research under the Greentech Programme of the Thuringian Ministry of Economics, Technology and Labour (TMWAT).
- Assistance with implementing efficiency measures in companies.
- Promotion of solar energy systems at municipal level.

● www.aufbaubank.de

▶ Participation in the project "30 pilot networks for climate protection and energy efficiency"
Basis for establishing and operating the Thuringian Energy Efficiency Network (ENT)

▶ Resource efficiency roadmap process
1. Cross-sectional technologies of special importance for resource efficiency
2. Resource-efficient production technologies
3. Energy storage

3. Activities of associations and institutions[92]

German Building Materials Association (Bundesverband Baustoffe – Steine und Erden e. V. – BBS)

The companies in the building materials industry make an active contribution to conserving biodiversity by means of environmentally sound extraction management and technology, prompt restoration and recultivation of land used for extraction, and intensive cooperation with conservationists. Targeted management measures make their effects felt during the operating phase. The building materials industry has affirmed its commitment in a declaration on "Resource Use in Germany" issued jointly with the nature conservation association Naturschutzbund Deutschland (NABU) and the trade unions for the construction, agricultural and environmental industries (IG BAU) and for the mining, chemical and energy industries (IG BCE).

To minimise the interference with nature that is necessary to meet resource requirements, the building materials industry has always made every effort to use any secondary materials produced. As long ago as 1995 a cooperative working group of the building materials industry was established (Arge Kreislaufwirtschaftsträger Bau). This plays an active role in supporting closed-cycle management in the building sector. This alliance has given the German government a voluntary commitment to ensure the environmentally sound recycling/reuse of mineral building rubble previously deposited as landfill. Monitoring reports presented to the Federal Environment Ministry at two-yearly intervals have documented success stories in closed-cycle management since 1996. When the voluntary undertaking expired after 10 years, the German government and the building industry were able to report a very favourable trend: Of the average annual quantity of 220 million tonnes of mineral building rubble, around 90 percent, id est about 190 million tonnes, was retained within the materials cycle and sent for environmentally sound recycling/reuse. In individual segments such as road construction rubble the recycling rate is even higher, at nearly 98 percent.

The recycling and recovery structures in Germany have become established at this level. To this day, the data on the quantities and destinations of mineral building rubble which the building industry continues to publish at two-yearly intervals (www.kreislaufwirtschaft-bau.de) document the great extent to which mineral building rubble cycles are kept closed. The latest monitoring report was presented to the Federal Ministry of Transport, Building and Urban Affairs in October 2011.

- www.baustoffindustrie.de

Federal Association of German Disposal, Water and Raw Materials Industries (BDE Bundesverband der Deutschen Entsorgungs-, Wasser- und Rohstoffwirtschaft e. V.)

The association is active at various levels in support of the strengthening and further expansion of closed-cycle management in Germany. Thanks to their high-grade recovery of raw materials, the companies in the closed-cycle management industry function as suppliers of raw materials for domestic industry, thereby making it less dependent on imports and volatile commodity markets.

BDE certificate for operators of Dual Systems

The BDE has reached agreement with the majority of Dual System operators on the introduction of a certificate ("Certificate for ensuring private-enterprise household-related packaging disposal by means of Dual Systems"). The aim is to ensure consistently high ecological standards and economic certainty both for those who put packaging into circulation and for all approved operators of Dual Systems. The certificate makes for greater legal certainty and ensures correct quantity reporting in line with the requirements of the Packaging Ordinance (*Verpackungsverordnung*).

Commitment to extension of product responsibility ("Berlin Declaration" by BDE to mark the association's 50th anniversary)

In the interests of expanding the closed-cycle and recycling industry, the BDE and the private enterprises in the sector are seeking more intensive partnership with industry. In future, waste prevention and raw materials recovery will have to be considered during the development and manufacture of products. Only by expanding product responsibility can we succeed in recovering the precious metals and rare earths from end-of-life electrical and electronic equipment.

92 These descriptions are based on contributions by the associations and institutions, and do not necessarily reflect the German government's views.

High quality standards for end of waste status

One way of raising the acceptance of recycled materials is to release them from waste law to enable them to become products that are freely tradable on the national and international market. Such release from waste law is linked to quality criteria. The BDE is working with European experts and the Commission to draw up criteria that define the end of waste status for various material flows. The BDE advocates a "long" definition of waste with high standards/ criteria for release from the waste regime.

Federation of German Industries (Bundesverband der Deutschen Industrie e. V. – BDI)

The BDI Initiative on Energy-Efficient Buildings

The field of energy-efficient building refurbishment offers great potential with regard to energy saving, and this means it is also a crucial factor in mitigating climate change. The BDI Initiative "Energy-Efficient Buildings" is an alliance of companies and associations whose aim is to bring about comprehensive discussion of building refurbishment, help to shape framework conditions, and identify practical ways of making optimum use of savings potential. Moreover, the members of the initiative want to make a contribution to Germany's position as a pioneer in the field of climate protection. On a broad basis extending across industries and trades, the initiative brings together companies and associations. As the "voice of German industry" it is thus the central point of contact for politics and society in Germany.

Further information can be found on the Internet under

- www.gebaeude-initiative.de

Federal Association of the German Glass Industry (Bundesverband Glasindustrie e. V.)

In 2009 the recycling rate for glass was around 85.6 percent, id est well in excess of the rate of 65 percent by weight laid down in the ministerial draft of the Closed-Cycle Management Act. The precondition for the use of recycled glass is appropriate quality, in other words it must not contain foreign matter and the different glass colours must be collected separately. To provide consumers with guidance on this issue, the Action Forum "Glass Packaging" has launched an initiative called 'Not all glass is waste glass' (www.was-passt-ins-altglas.de). Extensive use of recycled glass reduces the quantity of waste and means it is used as a valuable raw material. On average, about 60 percent of a glass bottle is recycled glass. Green glass bottles may consist of up to 90 percent recycled glass. The use of recycled glass saves raw materials and energy and cuts CO_2 emissions. Using recycled glass reduces energy input, since melting recycled glass requires less energy than melting natural raw materials. Every 10 percent of broken glass used reduces energy consumption by 3 percent and CO_2 emissions by about 3.6 percent.

Federation of German Wholesale, Foreign Trade and Services (Bundesverband Großhandel, Außenhandel, Dienstleistungen e. V. – BGA)

The Federation of German Wholesale, Foreign Trade and Services (BGA) represents the general economic and social interests and the professional interests of 110,000 companies with nearly 1.2 million and employees and about 75,000 apprentices.

The BGA comprises 26 Land and regional associations in the form of employer and business associations and 43 federal professional associations as member associations. They can be broken down into four groups:

- B2B trade associations,
- Consumer goods trade associations (finished products, food, non-food)
- Associations of food and agricultural produce wholesalers, and
- Foreign trade associations

The wholesale trade advocates resource efficiency in many areas. On the one hand this is a matter of stepping up the marketing of energy-efficient products and boosting their sales. To this end a number of initiatives have been formed in the wholesale sector. On the other hand, resource conservation is being achieved by the use of returnable packaging in the wholesale trade. One example here is the deposit association in the chemicals trade, which ensures uniform practice in the provision and take-back of returnable chemicals packaging on the basis of a deposit scheme. And in the wholesale beverages sector, the issue of returnable packs is of great importance for resource efficiency. Five years ago the wholesale beverages sector launched the biggest nationwide

information campaign “Returnable packs protect the climate”.

Resource efficiency also plays an important role in waste management. The automobile components industry, for example, offers an environmental management system that ensures proper recycling/reuse and environmentally sound waste management of products.

In the wholesale sector, resource efficiency is also achieved by means of preventive maintenance or repairs to faulty items of equipment to maintain or increase their value. The aim is to improve efficiency or reduce wear, thereby conserving resources and extending the life of the equipment.

Federal Association for Information Technology, Telecommunications and New Media (Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V. – BITKOM)

The Federal Association for Information Technology, Telecommunications and New Media (BITKOM) represents more than 1,350 companies. Over 1,000 are direct members with a turnover of around Euro135 billion and 700,000 employees. They include providers of software & IT services, telecommunications and Internet services, manufacturers of hardware and consumer electronics, and companies in the digital media sector.

For several years now, BITKOM has been playing an active part in improving resource efficiency in the IT sector (www.bitkom.org/Green-IT). The following are a selection of examples:

- establishing take-back structures for waste management of end-of-life electrical and electronic equipment
- creating a platform for green procurement of IT (www.itk-beschaffung.de)
- Green IT project advice from BITKOM (www.green-it-projektberatung.de)
- running campaigns for IT users (www.bitkom.org/Green-IT) and
- the “Umwelt” series of environmental publications (www.bitkom.org/de/themen/56280.aspx).

The German Federal Foundation for the Environment (Deutsche Bundesstiftung Umwelt – DBU)

The DBU supports innovative and exemplary environmental protection projects with special reference to the SME sector. With a capital of currently around Euro 1.9 billion, the DBU is one of the largest foundations in Germany and is the largest environmental foundation in the world. The DBU supports projects outside of state programmes in the fields of environmental technology, environmental research, nature conservation and environmental communication. The guiding principle for its funding activities is sustainable development. Network projects between small or medium enterprises and research establishments are explicitly regarded as desirable. The DBU also supports projects by institutions and associations, which in their capacity as multipliers are important communicators for putting the results of research and technology into practice. Three essential criteria must be satisfied for support to be given.

1. Innovation: The projects must stand out clearly from the present state of research and technology and must represent a further stage in development.

2. Model character: The innovation should be of interest for broad application, for example an entire industry, and should be capable of speedy implementation under market economy conditions.

3. Reduction in environmental pressures: The innovation should exploit new and additional potential for reducing environmental pressures. The fields of resource conservation and resource efficiency are cross-sectional tasks running through the following funding areas of the DBU:

   – Environmentally sound and healthy processes and products
   – Architecture and construction
   – Applied environmental research
   – Environmentally sound land use
   – Communication of environmental information
   – Environmental education

Up-to-date information on submitting applications and on key assistance areas can be found under

- www.dbu.de/ressourcen

The Confederation of German Trade Unions (Deutscher Gewerkschaftsbund – DGB)

The DGB is convinced that employees play a key role in improving energy and resource efficiency in companies, because they are the people who know their workplace best. Raising employee awareness of the need for sparing and efficient use of energy and raw materials at their workplace and equipping them with the necessary additional qualifications makes it possible to identify potential for improvement at an early stage.

In this connection, the works councils are the point of contact for sustainability and resource efficiency issues. The Works Constitution Act (Betriebsverfassungsgesetz – BetrVG) provides scope for the necessary freedom of action. Under Section 80 subsection 1 the Works Council's tasks include proposing measures that serve the interests of the company and the workforce and promoting measures to improve environmental performance. In all companies with more than 100 employees, an economic committee must be set up. Its members are determined by the works council. Its principal task is to discuss the company's economic situation with company management and to inform the works council. The specific tasks listed in the Works Constitution Act (Section 106 subsection 3) also include in-plant environmental protection. Under Section 80 subsection 3 of the Works Constitution Act, the works council may also call in independent experts. This makes it possible to bring external expertise on resource conservation into the company. In-plant environmental measures may also be governed by a works agreement (Section 88 Works Constitution Act).

To ensure competent handling of the issue of resource efficiency, works councillors and staff council representatives must be able to obtain information and gain qualifications. The cooperation project "Resource efficiency for works council members and other employees (KoReBB)", run by the DGB, the DGB educational unit and the Federal Environment Ministry, is designed to support measures for improving resource utilisation in companies. As part of a further training plan it offers training courses and a certificate for the qualification of "In-house efficiency expert". Further information on KoReBB can be found at

- www.betriebsratsqualifizierung.de/projekte/korebb

German Industry and Trade Council (DIHK), Chambers of Industry and Commerce

For over 35 years the **Chamber of Industry and Commerce Recycling Exchange** (*IHK-Recyclingbörse*) (www.ihk-recyclingboerse.de) has been fostering contact between suppliers of residual materials and companies that can put the residual materials to good use. Metal, rubber, wood or plastic: many substances find takers, and sometimes this leads to long-term business relations.

Company strategies for improving resource efficiency are given in-depth treatment in seminars and workshops offered by an increasing number of Chambers of Industry and Commerce. Since 2009 the initiative has been given a special boost by the **Partnership for Climate Protection, Energy Efficiency and Innovation**, a joint initiative of the Federal Environment Ministry, the Federal Economics Ministry and the German Industry and Trade Council (DIHK) – www.klimaschutz-partnerschaft.de. This sets out to mobilise energy and resource efficiency potential in companies by raising awareness. The project is based on three pillars:

- an **information offensive** in which employers are informed about the issue during company visits by IHK experts and at on-site events
- www.klimaschutz.ihk.de,
- a **qualification offensive** which provides further training for company employees,
- the **Climate Protection and Energy Efficiency Group** of German industry, an excellence initiative of the German government and the DIHK for sustained outstanding performance in the field of in-house efficiency improvement
- www.klimaschutz-unternehmen.de

EMAS EASY Network

EMAS EASY is a network of some 25 consultants or consulting organisations that support SMEs and micro businesses in particular with appropriate and adaptable tools and employee-oriented approaches (www.emas-easy.de). EMAS EASY is a new route to environmental management that is based on its

precursor Ecomapping. It was developed to help small companies to establish an environmental management system on the basis of their inventory. Without sacrificing the simplicity of the approach, EMAS EASY leads to a fully adequate certifiable environmental management system on the basis of EMAS or ISO 14001. EMAS EASY is promoted by a number of Länder (federal states). One typical approach is a convoy system where advice is given jointly to several participating companies. The size, financial means and culture of small enterprises are taken into account here. With its new features, the network helps to satisfy the requirements of ISO 14001 and EMAS and thereby achieve concrete improvements in on-site resource conservation and environmental protection.

European Six Sigma Club Deutschland e. V. (ESSC-D)

Since it was founded in 2005, the European Six Sigma Club Deutschland (www.sixsigmaclub.de/) has played a direct and active part in developing, introducing and improving methods of maximising resource-efficient working in companies in the manufacturing and service sectors (Six Sigma, Design for Six Sigma and the integration of Lean).

ESSC-D promotes research and development work on methods of reducing errors and increasing resource efficiency and the practical application of Six Sigma in the operations of companies in the manufacturing or service sectors. ESSC-D supports national and international cooperation on resource-conserving methods by editing and passing on experience of efficiency improvement with Six Sigma from direct project work in companies. It also provides the participating members with extensive opportunities for best-practice sharing. Dissemination and sector-specific deepening of knowledge about the connection between resource efficiency and the Six Sigma method is ensured by organising and running expert conferences and initial and further training events, and by making targeted awards of grants.

At present more than 400 individuals and numerous well-known companies with a total of more than 100,000 employees are members of ESSC-D and are working to ensure continuous efficiency improvements in all areas of company cooperation.

Germany Trade & Invest

Germany Trade & Invest is the Federal Republic of Germany's economic assistance enterprise. It is promoted by the Federal Ministry of Economics and Technology and by the Commissioner of the Federal Government for Germany's New States under a resolution passed by the German Bundestag. The company informs German enterprises about business opportunities on foreign markets. Relevant information offerings relating to raw materials and resource efficiency include (download from www.gtai.de):

- Internet special "Worldwide resource security"
- Up-to-date reports on the international markets for raw materials, energy/ renewable energy, energy-efficient construction and housing, resource-efficient technologies of the future, and recycling and waste management
- "Branche kompakt" series of publications on the recycling and waste management industry and the construction industry (the latter often with special focus on the efficiency of buildings)
- Information on international projects and invitations to tender

For the export initiative on recycling and efficiency technology – RETech – Germany Trade & Invest, in cooperation with the Federal Environment Ministry (BMU), runs a portal which provides information about all aspects of exporting German technologies and services in the recycling and waste management sector (Internet: www.retech-germany.net).

In addition, Germany Trade & Invest takes care of the international marketing of Germany as an industrial and technological location and advises foreign companies on issues relating to getting established in Germany. In this connection Germany Trade & Invest also provides market analyses and location-specific information about raw materials, energy efficiency, renewable energy and closed-cycle management in Germany.

Central Federation of the German Construction Industry (Hauptverband der Deutschen Bauindustrie – HDB) The construction industry as a source of technological expertise

Resource conservation and climate protection are closely related. The German construction industry plays an active role in these fields, both as a source of technological expertise and at the level of strategic policy. In the field of climate protection:

- The German construction industry supports the march into the age of renewable energy. The transformation of our energy system involves great constructional challenges, such as modernising existing conventional power stations, building wind farms in the North Sea and Baltic Sea, and expanding a network of "power highways", which cannot be met without the great technical competence of construction companies.

- Moreover, the German construction industry is a technological leader when it comes to energy-saving building refurbishment. This applies particularly to thermal insulation for industry. Appropriate thermal insulation in industry makes an effective contribution to conserving resources and reducing CO_2 emissions.

In the field of resource conservation:

- The German construction industry is one of the sponsors of the initiative for closed-cycle management in the construction sector (www.kreislaufwirtschaft-bau.de), which documents the industry's contribution to resource conservation and resource efficiency under a voluntary monitoring system. In the construction sector this stands at an exemplary 90 percent. In this connection it also supports the "Round Table on Sustainable Building" which is hosted by the Federal Ministry of Transport, Building and Urban Affairs.

Metal Workers' Trade Union (IG Metall)

Trade unions and works councils can play an important role in giving new direction to the debate on cost-effectiveness. There is a need to encourage innovations and targeted investments in companies with a view to making better use of resources.

As long ago as August 2006, a joint conference on "Resource efficiency – Innovation for jobs and the environment" organised by the Federal Environment Ministry and the IG Metall with 200 participants from works councils, industry and science not only presented practical examples, but also approved recommendations for action in a 10-point paper.

- www.igmetall.de/cps/rde/xbcr/internet/broschuere_ressourceneffizienz_0022643.pdf

Since then the issues have become increasingly important and have been discussed at numerous events, industry dialogues and works council groups and addressed in individual projects: from the aluminium industry, through "white goods" or construction equipment, to shipbuilding. For more information see

- www.aluminium-ressourceneffizienz.de/ and www.netzwerk-ressourceneffizienz.de/detail/entwd/index.html?no_cache=1&beitrag_id=265&bid=12

- www.igmetall-kueste.de/files/D_98221822.pdf

The guide for works councils on "Improving resource efficiency and safeguarding jobs" is the result of a dialogue process organised by the IG Metall and the Federal Environment Ministry with assistance from the Wuppertal Institute. The guide documents the experience-based know-how of works councillors in workshops and expert interviews with works council chairpersons, and provides information on scientific findings. The guide can help works councils to make use of their information and codetermination rights to ensure a sustainable business policy.

- www.igmetall.de/cps/rde/xbcr/internet/broschuere_ressourceneffizienz_0155751.pdf

KfW Banking Group (KfW Bankengruppe)

As the project funding bank of the federal and Länder authorities, the KfW Banking Group supports sustainable improvements in the economic, social and ecological framework conditions in Germany and around the world. Today, in addition to start-up and SME financing, KfW's most important key assistance area is environmental and climate protection and resource conservation.

Under its assistance programmes within Germany, the KfW provides low-interest loans to finance measures for improving resource efficiency in residential buildings, municipal infrastructure and in businesses: The KfW provides assistance for energy-saving refurbishment under its family of programmes entitled "Energy-efficient building and refurbishment", and for reducing barriers in existing homes under the "Conversion for the elderly" programme. Both pro-

grammes support up-to-date and future-oriented use of existing buildings and help to ensure continued use of the resources tied up in existing buildings (building materials, "grey" energy and space). In its municipal infrastructure programmes the KfW also provides assistance for the (energy-saving) refurbishment of non-residential buildings belonging to local authorities and non-profit establishments. Through its environmental programmes for industry, the KfW supports companies wishing to invest in resource efficiency, provided the measures contribute to significant improvements in the environmental situation. Funding can also be provided for investment in waste prevention and spoilage reduction, recycling as material, and reducing water consumption.

The KfW also offers support in the field of research and development. Under the ERP innovation programme, assistance is possible for market-related research and development work on new products, processes or services that are more resource efficient. Assistance for first-time large-scale implementation of such developments can be applied for under the Federal Environment Ministry's environmental innovation programme, the administration of which is handled by the KfW.

PlasticsEurope Deutschland e. V. (PED)

Plastics as a material can contribute to resource efficiency. There are numerous examples of this. Using plastics to replace heavier materials makes vehicles lighter and more economical. Houses insulated with plastics use considerably less energy and thereby help to achieve marked reductions in greenhouse gas emissions. Plastic packaging is light, and protects the contents from damage, dirt or spoilage. Plastics play an important part in renewable energy technologies: the rotors of wind turbines are made of plastic, and no solar cell can manage without plastic. Between 4 and 6 percent of worldwide oil and gas consumption is used for producing plastics. Plastics save resources during the use phase of their life cycle. It is important to take a differentiated view of the resource conservation potential of plastics. Especially in the case of short-lived products such as packaging, or energy-driven products in the electrical or automobile sector, the potential for conserving resources must be ascribed primarily to the use phase (source: denkstatt 2010). Plastics manufacturers support an eco-efficient waste management system with a recovery mix of all types of waste treatment, whether it be for use as material, raw materials or energy.

There is no uniform system for dealing with plastic waste in the 27 EU countries; some countries are far ahead, others are dragging behind. Whereas the European average for plastics recovery in 2009 was around 54 percent – 46 percent of plastic waste is dumped as landfill – Germany, with a recovery rate of 97 percent, occupies a leading position in Europe along with Switzerland, Denmark and a small number of other countries. PlasticsEurope has established a knowledge transfer project to promote approaches and developments aimed at recycling/reuse, especially in France, the United Kingdom, Poland and Spain, and to improve the situation there.

PlasticsEurope Deutschland e. V., the Central Federation of the Plastics Processing Industries in Germany, and the Mining, Chemical and Energy Trade Union (IG BCE) have launched a joint initiative to contribute even more resource efficiency to the plastics industry. The initiative is also integrated in the national Resource Efficiency Network.

Further information is available from

- www.plasticseurope.de/kunststoff-ist-nachhaltig/ressourceneffizienz.aspx

Efficiency Improvement and Innovation Centre of German Industry – RKW Competence Centre (RKW) (Rationalisierungs- und Innovationszentrum der Deutschen Wirtschaft e. V. – RKW Kompetenzzentrum)

RKW is a network that is active nationwide. For more than 90 years it has been promoting cost-effectiveness in the SME sector. RKW helps small and medium enterprises (SMEs) to improve their competitive position – through information, advice and further training – and its network's nationwide activities provide local services in all regions.

As part of the German government's Energy Concept, RKW is conducting up to 10,000 kick-off discussions on energy efficiency in industrial SMEs and the craft trades by 2014 under a multi-year project funded by the Federal Ministry of Economics. In this project, RKW will motivate business people to design and implement individual resource efficiency improvement measures. The coordinated nationwide approach will help to expand the information available on company-level savings potential and on opportunities for assistance at both national and Land level.

This offer of kick-off discussions provided free of charge is aimed at SMEs that have hitherto done little or nothing to improve their energy efficiency. The main target group is companies in the manufacturing sector, in most cases with more than 20 active employees, including the craft trades.

General resource efficiency related services offered to companies by RKW:

- ▶ Fact sheets and guides
- ▶ Best practice
- ▶ Information events
- ▶ Resource efficiency consulting
- ▶ Training of resource efficiency consultants
- ▶ Regional projects relating to resource efficiency
- ▶ Online platforms and social media offerings

- www.rkw.de and www.rkw-energieeffizienz.de

German Engineers' Association (VDI) (Verein Deutscher Ingenieure – VDI) – Competence in guidelines and resource efficiency

With nearly 150,000 members, the German Engineers' Association is the largest technical-scientific association in Europe. As an independent non-profit organisation it is the central point of contact for technical, professional and policy issues, and a recognised voice of engineers and technicians (www.vdi.de). With more than 12,000 honorary experts the VDI generates and bundles an unrivalled body of knowledge. On the basis of the VDI Guidelines it provides an indispensable foundation that paves the way for practical, scientific and legislative work.

VDI Guidelines are recognised rules of technology and thus provide a guide for communication between manufacturers, processors and users. In many cases they also serve as a basis for European and international standardisation, thereby safeguarding quality standards and comparability.

In June 2009 the VDI, with the aid of funds from the Federal Environment Ministry's Climate Initiative, established a competence centre for efficiency technologies (www.vdi-zre.de). VDI ZRE is a subsidiary of the Berlin-based company VDI GmbH. The core task of VDI ZRE is to provide an easily understood and comprehensive explanation of the integrated use of environmental, resource and climate protection technologies and to promote such integrated use in order to make an effective contribution to the development and implementation of resource efficiency concepts in practical fields of application.

The VDI's Energy and Environment Association (GEU) is currently working with the VDI Resource Efficiency Centre (VDI ZRE) to draw up VDI Guidelines on a methodological basis for analysing resource efficiency in companies. The aim of these VDI Guidelines is to improve awareness and understanding of the idea of "resource efficiency" and to make resource efficiency measurable. This requires nationally accepted definitions, standardised calculation methods, accounting methods, and criteria for assessing resource efficiency.

German Engineering Federation (Verband Deutscher Maschinen- und Anlagenbau – VDMA)

Mechanical engineering is at the focus of those innovation processes which make steadily increasing resource efficiency possible.

Increasing resource efficiency in production is the aim of 31 research projects with more than 200 partners in industry and science that are supported by the Federal Ministry of Education and Research. The topics range from energy-efficient manufacturing and process technology, through energy-efficient machine tools, to functional surfaces. To ensure that the results of these research projects actually arrive in industry, the VDMA and the Federal Ministry of Education and Research launched the "Efficient Factory" initiative in 2009

- www.effizienzfabrik.de

Furthermore, the VDMA is actively working on the "Blue Competence" campaign. This is intended to be the leading initiative for ecological product and production design and for innovative environmental technologies in machinery and plant construction and to ensure targeted communication of this leading role on the global market.

This sustainability initiative bundles strengths and know-how with the aim of establishing its role as technology leader in sustainability issues and maintaining it in the long term. Numerous specialist associations are already taking part in Blue Competence. But member companies can also profit directly as partners.

Further information on what the campaign is about and how to take part in it can be found at:

- www.bluecompetence.net

NRW Consumer Advice Centre (Verbraucherzentrale NRW e. V.)

The Consumer Advice Centre for North Rhine-Westphalia (NRW) provides independent advice and information. It helps consumers to assert their legitimate interests. For consumers, the NRW Consumer Advice Centre acts as advisor, pilot and lawyer in relation to suppliers in industry. It uses judicial means to strive publicly for financial and health-related consumer protection and is committed to better quality of life and sustainable consumption.

For over 50 years the NRW Consumer Advice Centre has been active on behalf of the citizens of NRW. It is the largest consumer advice centre in Germany. Every year some 1.2 million consumers (source: Verbraucherzentrale NRW, Annual Report 2010; May 2011) use the services offered by the 57 advice centres. In addition to public assistance from the Land and federal authorities, the European Commission and local authorities, and its own income, the NRW Consumer Advice Centre is also financed by donations and by resources from the Savings Bank Fund. Donations by industry are governed by the following requirements: not tied to conditions, no sponsoring, publication on the Internet.

Resource efficiency is in particular a focal aspect of environmental advice provided by the NRW Consumer Advice Centre: the key field of "Waste and Resource Conservation" provides advice, education and information on all aspects relating to raw materials and waste separation and raises the awareness of consumers young and old about the raw materials in our everyday products. The energy advice units of the consumer advice centres also give advice on energy efficiency issues.

- www.vz-nrw.de; online portal for young consumers: www.checked4you.de

German Non-Ferrous Metals Association (Wirtschafts-Vereinigung Metalle – WVM)

The business initiative "Metals for the Climate", working under the mantle of the German Non-Ferrous Metals Association, brings together the producers and processors of light metals, nonferrous metals and rare metals. It currently has 21 members, who provide information on how they contribute to resource efficiency, energy efficiency and climate protection by means of efficient installation technology in production, products made of nonferrous metals for climate protection technologies, and modern recycling methods.

The foundations for the initiative were laid in 2007 by leading companies in the nonferrous metals industry. Supported by the companies and working under the umbrella of the WVM, the initiative draws public attention to the achievements and contributions of the metal producing and processing companies in the field of climate protection and resource efficiency. Since 1990 the companies in the nonferrous metals industry with German locations have reduced their specific energy input for every tonne of metal produced by more than 26 percent. This resulted in a similar reduction in emissions of carbon dioxide. Emission cuts of up to 85 percent have been achieved in the case of individual trace gases of special relevance to the climate. As well as successes in the field of production-related climate protection, the industry also makes major contributions to climate-friendly energy and resource efficiency through its high recycling rates. On the basis of selected production examples, the initiative can currently boast annual CO_2 savings of around 670 000 tonnes. In the field of recycling products the CO_2 saving is nearly one million tonnes. The selected best-practice examples in the products sector permit energy and emission savings of between 10 and 50 percent.

The "Metals for the Climate" platform shows how energy and resource efficiency and climate protection are implemented in practical operations.

More information is available from

- www.metalleproklima.de

German Central Association of Craft Trades (Zentralverband des Deutschen Handwerks – ZdH)

The decentralised structures of the German craft-trade chambers are outstandingly well suited to user-friendly establishment of resource efficiency in SMEs in particular. The ZDH (www.zdh.de) and its individual chambers have for years been helping companies in a wide variety of ways to exploit resource efficiency potential. This support is mainly provided via a broad spectrum of advisory services, by mediation between private and public actors, creating networks, competitions for environmental awards, raising awareness of environmental aspects on a broad front, help with the introduction of environmental management systems, and also extensive monitoring and marketing of projects. The activities cover SMEs in virtually all branches of industry. Examples include:

▶ The environmental award of the craft-trade chamber in Chemnitz:

- www.umweltpreise.de/Sonstige/Handwerkskammer_Chemnitz/handwerkskammer_chemnitz.html

▶ The environmental advice programme for the craft trades in Baden-Württemberg: the Environment Ministry's programme actively pursues its successful implementation under the management of the Baden-Württemberg Craft Trade Council (BWHT), the service company *"Servicegesellschaft Beratungs- und Wirtschaftsförderungsgesellschaft für Handwerk und Mittelstand"* (BWHM) and the eight craft-trade chambers in the state. More information from:

- www.um.baden-wuerttemberg.de/servlet/is/3455

The success of this approach can be seen from the detailed accounts in the results reports:

- www.um.baden-wuerttemberg.de/servlet/is/3455/Ergebnisbericht_ECOplus_2008-2009.pdf?command=downloadContent&filename=Ergebnisbericht_ECOplus_2008-2009.pdf

In 2008/2009 each consultation led to annual savings of between Euro 2,000 and Euro 10,000, and a reduction in CO_2 emissions of up to 70 tonnes a year.

▶ The implementation of the ZEWU-mobil project by the Hamburg Chamber of Craft Trades (assisted by the European Social Fund and the Free and Hanseatic City of Hamburg):

- www.zewumobil.de

Central Association of the Electrical Engineering and Electronic Industry (Zentralverband Elektrotechnik- und Elektronikindustrie e. V. – ZVEI)

Resource efficiency in the electrical industry

The electrical engineering and electronic industry represented in the ZVEI has made extensive investments in researching and developing resource-saving and energy-intelligent technologies. The electrical industry has the entire industrial value chain in view, including the return of end-of-life equipment and waste batteries.

By using intelligent automation technology it is basically possible to save 10 to 15 percent energy and the relevant resource inputs. In Germany this comes to at least 10 billion kilowatt-hours a year for electricity alone. It is also possible to make considerable reductions in the consumption of primary energy sources such as coal, oil and gas.

For more information, see:

- www.zvei.org/index.php?id=5879

Manufacturers of household appliances have systematically reduced the energy consumption of their appliances. For example, improvements in washing cycles have reduced their water consumption by nearly two thirds in the last 20 years.

For more information, see:
- en-q.de/weissbuch.html

The labelling of resource-conserving products is also mentioned explicitly in Approach 9 of the Resource Efficiency Programme.

In 1998 the ZVEI established the *"Stiftung Gemeinsames Rücknahmesystem Batterien"*, a foundation guaranteeing uniform nationwide collection of spent batteries. In 2010 GRS-Batterien collected 14,500 tonnes of spent batteries.

For more information, see:
- www.grs-batterien.de/

For more than five years now, manufacturers have been accepting returned end-of-life electrical and electronic equipment. In Germany nearly 700,000 tonnes of old equipment were sent for recycling

For more information, see:
- www.stiftung-ear.de/

In both ecological and economic terms the take-back systems for batteries and for end-of-life electrical and electronic equipment are among the most efficient in Europe.

Central Association for Surface Technology (Zentralverband Oberflächentechnik e. V. – ZVO)

Work on resource efficiency calls for an examination of the entire value chain. It is not sufficient to look at individual steps in production. There is a need to use central interfaces such as surface technology.

Together with national and European partners (Europe Innova – Projekt REMake), the ZVO is working to help small and medium enterprises to make efficient use of their resources by using assistance vouchers. To this end a pool of advisers was set up who are familiar with and can assess the industry's specific needs.

At the same time contacts with other industries along the value chain, for example metal working, cleaning and conditioning, and also with end consumers, are used to define criteria for the quality of the component. In particular, the demands of final consumers like the car industry determine the potential for resource-efficient activities by surface coating companies.

- www.zvo.org

4. Decision of the German Bundestag

Upon a motion put forward by the parliamentary groups of the governing coalition parties CDU/CSU and FDP the German Bundestag adopted the "German Resource Efficiency Programme" at its 165th meeting on 8 March 2012 as decided by the Federal government on 29 February 2012.

German Bundestag
17th legislative period

printed paper 17/8575
07/02/2012

Motion

put forward by Bundestag Members Dr. Thomas Gebhart, Marie-Luise Dött, Peter Altmaier, Michael Brand, Cajus Caesar, Dr. Maria Flachsbarth, Josef Göppel, Christian Hirte, Andreas Jung (Konstanz), Jens Koeppen, Ingbert Liebing, Stefan Müller (Erlangen), Dr. Georg Nüßlein, Dr. Michael Paul, Ulrich Petzold, Dr. Christian Ruck, Volker Kauder, Gerda Hasselfeldt and the CDU/CSU parliamentary group and Members Horst Meierhofer, Michael Kauch, Angelika Brunkhorst, Dr. Lutz Knopek, Judith Skudelny, Rainer Brüderle and the FDP parliamentary group

German Resource Efficiency Programme – a building block for sustainable management

The Bundestag is requested to adopt the following resolution:

I. The German Bundestag notes

that a secure and adequate supply of raw materials is vital for the economic success of German businesses. Germany depends largely on imports, in particular imports of metal primary raw materials which are important for industry. In the case of the rare earths used in many future technologies there is the added problem that mining is concentrated in just a few countries. Shortages on raw materials markets, for instance due to exploration bottlenecks or because raw materials policy in the exporting countries is driven by special interests, can result in limited production and higher costs. The Federal government has therefore adopted a Raw Materials Strategy to support raw materials procurement in German industry. In addition to developing raw materials partnerships and assisting companies to diversify their sources of supply, the government also aims to advance the dismantling of trade barriers in the context of EU policy. Enhancing resource efficiency is a key component of an adequate raw materials supply.

In the course of the 20th century exploitation of mineral resources worldwide increased by a factor of 34. In the European Union we now need 16 tonnes of materials per person each year. Six tonnes of this becomes waste and half of this waste is landfilled. Increasingly, resources are being mined in third countries with inadequate environmental standards. This can have far-reaching adverse effects on the environment, damaging ecosystems and leading to social and economic tensions. A similar situation applies to illegal waste exports to third countries using obsolete and technically inadequate methods of recycling which put human health and the environment at risk. The expanding world population is intensifying demand for raw materials, heightening the danger of violent conflicts over supply. In its resource policy, Germany is called upon to use its potential for international influence and set an example by accepting global responsibility for the consequences of resource use and taking on the challenge of uniting healthy economic development with ecological and social needs.

At European level, in its raw materials initiative the European Commission laid down three pillars for a consistent raw materials policy which can reinforce industry's access to important raw materials. These pillars are: securing access to the global market under undistorted conditions, fostering a sustainable raw materials supply from European sources and raising resource efficiency and promoting closed cycle management.

The flagship initiative "A resource-efficient Europe" was adopted under the Europe 2020 Strategy and further defined in a Roadmap to a resource-efficient Europe. It calls on the member states to develop institutional framework conditions which recognise the interdependencies between the economy, well-being and natural capital. Obstacles to greater resource efficiency should be eliminated. The Roadmap also stipulates that suitable resource efficiency indicators should be developed.

The Federal government's proposed German Resource Efficiency Programme (ProgRess) can play a key role in encouraging sustainable and efficient use of resources at national level. The aim is to minimise the adverse effects on environmental media arising from the extraction and processing of raw materials, and to further optimise resource use in Germany. This must take account of the entire life cycle of a product, from raw material extraction and processing to subsequent uses and recycling. Only this will allow an overall analysis of the ecological and economic benefit of a product from the point of view of resource efficiency. In addition, more thought should be given to establishing material cycles. This can be achieved if waste is re-used in biological or technical cycles or – where such an option is not feasible – undergoes appropriate energy recovery.

For German industry sustainable and efficient resource management is already a key factor for success, both for individual businesses and the national economy as a whole. Experience gained so far in efficiency advice to SMEs shows that companies that have received advice can save on average 200,000 euros per year on material costs alone. Many sectors in Germany have already made considerable efforts to improve their manufacturing and combined production processes for the simple reason that for many companies resource use is a major cost factor. Even so, in some areas considerable efficiency potential is yet to be tapped.

Another key element for exploiting existing potential is technological innovation. A great many German companies are now global leaders in efficiency technologies. This means that raising resource efficiency offers a twofold economic opportunity: firstly, efficient resource use can make businesses more competitive, and secondly efficiency technologies are likely to become one of the world's growth sectors.

The German Bundestag welcomes the Federal government's national Resource Efficiency Programme (ProgRess) and its particular focus on incentives, voluntary instruments, information, consultation, training and research and development. In the run-up to the United Nations Conference on Sustainable Development (Rio+20) which takes place in June 2012, the aim of ProgRess is to reinforce Germany's position as a role model in this policy area, provide an overview of current activities and outline the options for action and measures for raising resource efficiency.

II. The German Bundestag calls on the Federal government, in the framework of the 2012 federal budget and financial plan

1. to maintain its commitment to greater resource efficiency and to approach this as both a challenge and an opportunity to achieve a sustainable development which takes economic, ecological and social aspects into account;

2. to ensure that the selected instruments are designed to be competition-oriented at both national and international level, to give preference to incentives and voluntary solutions over governmental regulation and to avoid burdening industry with administrative costs which make resource use more expensive;

3. to systematically implement its Raw Materials Strategy, which aims to eliminate barriers to trade and support companies in procuring their raw materials. Examples of this are: supporting businesses in diversifying their raw material sources, building bilateral raw materials partnerships with key supplier countries, enhancing the efficiency of raw material extraction and processing, promoting recycling, supporting the work of the German Raw Materials Agency in the Federal Institute for Geosciences and Natural Resources (BGR) and expanding research and development;

4. to uphold the high recovery quotas for mineral waste in the future, develop material cycles for economically important metals and strengthen product responsibility as an aspect of closed cycle management. The new Closed Cycle Management Act and the planned recycling bin or equally high-quality collection of recyclables will significantly improve recycling and increase the overall volume of recovered waste;

5. to work to ensure that standardisation processes increasingly take other relevant aspects of resource use into account besides energy consumption. This will raise incentives to develop resource-efficient products and services and bring them to market maturity;

6. to make it possible for manufacturers and distributors in suitable sectors to recover and reuse the materials contained in their products. This can be achieved either by the company's own recovery systems or in the material flow through labelling and tracing systems (for example RFID chips in the products);

7. to work with the Länder and SME-relevant business associations in further developing the current company-based efficiency advice in order to raise awareness of efficient resource management among SMEs and to tap even more of the potential of SMEs to enhance their productivity and competitiveness;

8. to focus research programmes more on resource and energy-efficient production and processing. This includes research into new technologies such as nanotechnology, or developing substitutes for raw materials which are expensive to mine, or which can only be mined at very high cost to the environment.

9. to develop a comprehensive national support strategy for research and innovation. Firstly, this would strengthen the technology-open Research, Development and Innovation (R&D&I) programmes for SMEs, which also support the development of resource-efficient technologies. Secondly, it would offer a new research support programme to bodies such as the Helmholtz Institute Freiberg for Resource Technology, the German Raw Materials Agency (Deutsche Rohstoffagentur), the Federal Environment Agency, Germany's technical universities and other relevant institutions and business organisations;

10. to promote close networks between industry, the scientific community and political players to allow application-based research into new technologies, processes and materials and to speed up their practical implementation. This also means continuing to promote existing successful networks such as that between the German Materials Efficiency Agency (demea) the VDI Centre for Resource Efficiency (VDI Zentrum für Ressourceneffizienz GmbH VDI-ZRE), and the German Raw Materials Agency in the Federal Institute for Geosciences and Natural Resources. The network Resource Efficiency can also play a role in this respect;

11. to work with trade and industry to raise public awareness of resource-efficient product use and to sensitise consumers to resource efficiency, taking the specific conditions of each sector into account;

12. to support the introduction of voluntary certification systems for resource efficiency which are suitable for indicating the origin of a product's raw materials and constituents and the boundary conditions under which they were obtained;

13. to recommend that government procurement offices ensure that specifications in public procurement are more closely geared to the use of resource-efficient products and services;

14. to investigate whether there are suitable approaches for anchoring resource efficiency aspects more firmly in the fields of legislation of the various sectors;

15. to update the Resource Efficiency Programme in line with the European Commission's flagship initiative for a resource-efficient Europe and the Roadmap, and to evaluate and further define the objectives and actions of the Resource Efficiency Programme;

16. to develop suitable indicators for this review which give a practical and consistent representation of resource efficiency and at the same time adequately reflect the framework conditions in Germany as an industrial and production location and the special situation of the value chains that are built on its basic industries;

17. to report to the German Bundestag every four years on the development of resource efficiency in Germany.

Berlin, 7 February 2012

Volker Kauder, Gerda Hasselfeldt and parliamentary group
Rainer Brüderle and parliamentary group

Comments and reports regarding ProgRess are available on the website of the “Resource Efficiency Network” (“Netzwerk Ressourceneffizienz”).

- www.netzwerk-ressourceneffizienz.de/detail/entwd/index.html?no_cache=1&beitrag_id=345&bid=6
- www.netzwerk-ressourceneffizienz.de/to_go/detail/entwd/index.html?no_cache=1&beitrag_id=346&bid=497

PUBLICATION ORDER:

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18132 Rostock
Germany
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Fax: +49 1805 / 77 80 94
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