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and Energy

Technologies and services for climate mitigation and adaptation from Germany

Support for the UNFCCC Technology Mechanism
provided by the German National Designated Entity

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Borderstep Institute

Dr. Severin Beucker
Dr. Jens Clausen
Prof. Dr. Klaus Fichter

Environmental Policy Research Centre,

Freie Universität Berlin

Dr. Klaus Jacob
Holger Bär

In cooperation with the Netzwerk Innovation und Gründung im Klimawandel (NIK) at the Carl von Ossietzky University of Oldenburg

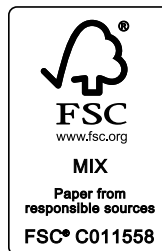
Translation

Sandra H. Lustig, Hamburg
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1 Goals of the study

As the National Designated Entity (NDE) of Germany, the Federal Ministry for Economic Affairs and Energy supports the Climate Technology Centre and Network (CTCN) by providing and analyzing information on goods and services relating to climate-relevant technologies as well as demand for them and transfer mechanisms. The National Designated Entity serves as a point of contact for inquiries from abroad about German technology for climate mitigation and adaptation and as a broker for establishing cooperation with partners in Germany. One priority will be inquiries from emerging markets and developing countries, which are to enjoy special support in the context of the Technology Mechanism of the United Nations Framework Convention on Climate Change (UNFCCC).

For this purpose, an overview is required of relevant goods and services from Germany in the field of climate mitigation and climate adaptation technologies that takes into account especially the needs in emerging markets and threshold countries and that enables access to technology transfer tools, actors, and institutions.

This publication provides that overview. It includes the following information:

- Technologies and services for climate mitigation and providers of such technologies and services in Germany;
- Technologies and services for climate adaptation and providers of such technologies and services in Germany;
- Cooperation activities involving German partners in the areas mentioned;
- Activities for monitoring climate change (weather, etc.) with German involvement.

The following approach was selected to gather and present supply and demand for technologies and services for climate mitigation and adaptation appropriately:

- In a first step, a typology was developed of the supply side in the areas of emission reduction and climate mitigation as well as climate adaptation.

- This structure was used as a basis for researching and documenting the economic significance, the important actors, and the addresses of German goods and service providers in the prioritized sectors and areas of demand. In addition, an overview was prepared of climate research, weather monitoring activities, and cases of international cooperation with German involvement.
- The Technology Needs Assessments (TNAs) and Synthesis Reports (UNFCCC 2009 and 2013) were evaluated in order to gather information about the demand side in the emerging markets and developing countries. In the future, the needs documented in the TNAs will be reflected in concrete demand, depending on the development of new international financial instruments.

Finally, recommendations for action to bring together supply and demand were elaborated; they are presented in this publication only in condensed form. Please refer to the full version of the study for a more in-depth description (Beucker et al. 2014).

In the present publication, the following central results are presented on the basis of the approach selected:

- (1) the structure of the goods and services for climate mitigation and adaptation provided by Germany and international demand for them;
- (2) the evaluation of existing German goods and services and experiences with technology transfer and capacity building; and
- (3) recommendations resulting from these results for the future design of the Technology Mechanism.

The central insights concerning supply and demand for climate technologies and services are summarized in the following sections.

The National Designated Entity of Germany

The UNFCCC's Technology Mechanism is composed of a policy unit – the Technology Executive Committee (TEC), and an implementing unit – the Climate Technology Centre and Network (CTCN). At national level, the CTCN is supported by national contact points (National Designated Entities – NDEs). The tasks of the German NDE are overseen by the Federal Ministry for Economic Affairs and Energy. The German NDE serves as the first point of contact for all enquiries about technology cooperation with German companies, research institutions and the public sector. Where appropriate, information about envisaged research projects and technologies from Germany is passed on to the CTCN, and enquiries from the CTCN and from developing countries and emerging economies are compiled and sent on accordingly.

Contact

Federal Ministry for Economic Affairs and Energy
Division IVC2 – Climate Change and International
Environmental Policy
Scharnhorststraße 34-37
10115 Berlin, Germany
Tel. +49 (30) 18615 7468
E-Mail: NDE-Germany@bmwi.bund.de
www.nde-germany.de

2 The structure of supply and demand for goods and services for climate mitigation and adaptation

2.1 Typology for climate mitigation

The structure of the supply side in the areas of emission reduction and climate mitigation can be ascertained easily using existing approaches for gathering data about the environmental industry in Germany. A classification in sectors and areas of demand/market segments was selected against the background of already existing approaches to structuring (see, e.g., Weiß & Fichter 2013) and also with a view to its translatability into concrete demands and satisfying them. The analysis of the demand side, however, proved to be more complex. Since the goal was especially to capture new, potential demands in various countries as well as in the different fields of application, it would not have sufficed to rely on existing catalogs of available goods and services. Instead, demand-related solutions for emerging markets and developing countries were also taken into account, as presented, e.g., in the Technology Needs Assessments (TNAs) and their Synthesis Reports (UNFCCC 2009

und 2013). In the field of climate mitigation, 14 areas of demand were identified in this way where technologies and services supplied by German suppliers match the demands in emerging markets and developing countries well.

Table 1 shows the combined results of the analyses of both supply and areas of demand as well as the weighting of the priorities for technology transfer. The supply side, i.e., the sectors and areas of demand in which German suppliers can make a contribution to technology transfer to emerging markets and developing countries by means of technologies, products, and services, was weighted in a multi-step process. It took account of both the initial position of German suppliers in the field and expected market development in Germany as well as various regions of the world¹. Therefore, the typologies developed for climate mitigation as well as for adaptation fulfill an important brokering function in that they allocate goods and services supplied and demanded to distinct solutions.

Table 1: Structuring approach to gathering data about goods and services on offer for climate mitigation and emission reductions

Sector	Area of demand/ Market segment	Examples of technologies and services
Low-emission energy supply (on and off grid)	Renewable power generation	Wind power systems, off-grid photovoltaic systems, solar collectors, biogas systems
	Combined decentralized power generation	Combined heat and power units, Stirling engines, contracting models
	Intelligent grids	Planning of microgrids, low-voltage site networks
	Energy storage	Hot water tanks, batteries
	Low-emission fossil-based energy supply	CCS, highly efficient power plants, clean coal
Energy-efficient cities and infrastructure	Energy-efficient buildings (private and public buildings)	Environmentally friendly insulation materials, adaptive heating and cooling technologies, building automation
	Cross-cutting energy-efficient technologies for infrastructure	LED street lighting, efficient pumps and desalinization plants for water
	Energy-efficient domestic appliances and technical systems in buildings (heating etc.)	Energy-efficient cooling devices, solar cookers, energy-efficient lighting
	Efficient information and communication technology	Energy-efficient server and network technology, efficient cooling technology and emergency power supply, utilization of waste heat
Low-emission mobility and transportation	Alternative fuels and propulsion technology	Electric drives, fuel cell drives, efficient combustion engines, alternative and low-emission fuels
	Efficient freight transport	Combined road and rail transport, intermodal logistics, efficient ship and harbor logistics, low-emission urban logistic concepts
	Efficient and low-emission mobility	Environmentally friendly public transportation, rapid transit bus systems, traffic demand management, non-motorized transportation

¹ The methodology is described in detail in the full version of the final report of this study (Beucker et al. 2014).

Sector	Area of demand/ Market segment	Examples of technologies and services
Energy- and resource-intensive industries	Efficient production methods and processes	Energy-efficient production and automation technology, speed-controlled electric motors, efficient compressed air generation, low-emission process heat generation and combustion technology
	Planning of efficient and integrated production concepts	Planning of integrated, energy-efficient production sites and chains, planning and implementation of coupled production and eco-industry parks
	Material- and energy-efficient product design	Efficient product design with regard to raw materials and energy, eco-design concepts
	Substitution of fossil resources by renewable resources	Substitution of fossil resources by cellulose, starch, and lactic acid, use of oils and fats from renewables
Sustainable waste management and circular economy	Waste avoidance	Planning and implementation of systems with returnable items, consulting for planning and implementation of waste avoidance concepts
	Waste collection and treatment	Landfill gas capture, waste sorting plants, waste separation concepts, low-emission waste incineration, composting and biogas systems
	Environmentally friendly recycling concepts	Planning of regional recycling concepts, implementation of specific recycling approaches, e.g., for electronic scrap or waste oil
Climate-friendly agriculture and forestry	Climate-friendly agriculture	Low-emission fertilizing, energy-efficient and emissions-reducing cultivation technologies
	Climate-friendly forestry	(Re-)forestation, energy-efficient and emissions-reducing management technologies
Cross-sectoral cross-cutting technologies for reducing emissions	Reduction of air pollutants and other greenhouse gases	Flue gas particulate collector technology, NOx catalytic converters, capturing mining methane
	Substitution of basic commodities and chemicals harmful to the climate	Replacement of refrigerants harmful to the climate, substitution of laughing gas
Miscellaneous services	Financing concepts for climate mitigation solutions	Development of technology- and country-specific financing concepts for products and services for reducing emissions
	Policy development and consulting	Support and consulting for introducing and implementing the German Renewable Energy Sources Act (EEG), emission reduction standards, etc.
	Training and education for climate mitigation	Training measures accompanying products and services for reducing emissions

Source: authors.

(Areas of demand/market segments/solutions that were prioritized both on the supply side (Germany) and on the demand side (emerging markets and developing countries) are shaded.)

2.2 Typology for climate adaptation

Climate change is bringing about different demands for adaptation in the individual regions and countries, but also in the various sectors within countries. With a view to technologies and services for climate adaptation, it makes sense to develop a suitable structure by focusing on those sectors of the economy and of demand with a high likelihood of being affected most strongly by the changes. The TNAs (UNFCCC 2009 and 2013) provide a starting point for structuring markets to adapt to climate change. Using the TNAs

as a basis, a total of 12 areas of demand were identified in which products or services relevant for climate adaptation can be supplied. Demands identified and prioritized in the TNAs can be allocated to each of these sectors. The number of areas of demand is relatively high in the agriculture and forestry sector due to its high number of climate-dependent functions; in all other sectors, it was significantly lower (see table 2).

The procedure was analogous to the steps described in the section on climate mitigation above.

Table 2: Structuring approach to gathering data about goods and services on offer for climate adaptation

Sector	Area of demand/ Market segment	Examples of technologies and services
Climate-compatible agriculture	Plant breeding	Drought- and salt-resistant plants
	Agricultural irrigation	Efficient irrigation systems, electronic control and monitoring
	Conservation tillage	Tillage concepts and consulting
	Animal husbandry	Climate-tolerant livestock, feed production on the basis of a raw material supply changing because of climate change
	Agricultural extension	Implementation of new methods for cultivation or land management
Climate-compatible forestry	Forestry extension	Consulting on climate-tolerant forestry, such as agroforestry systems
Meteorological measurement technology and climate simulation	Meteorological measurement technology	Instruments for measuring wind, atmospheric pressure, and precipitation
	Weather radar	Weather radar systems and software
	Climate simulation	Calculation of climate scenarios
Resilient energy infrastructures	Energy supply	Low water tolerant thermal power plants
	Energy transport	Electricity storage technologies, gale-tolerant high-voltage power lines
Water management	Water production	Desalination plants powered by renewables, water harvesting technologies
	Water efficiency	Water recycling concepts and systems, electronic monitoring of piping to avoid leakage
	Wastewater treatment	Graywater recycling
	Integrated water resource management	Catchment area planning, flood retention basins, water storage
Building engineering	Architecture and project planning	Spatial planning taking flood-prone areas into account
	Building construction	Extremely storm-resistant buildings
Failure-resistant transportation infrastructure	Transportation infrastructure planning	Railroad, road, and airport planning
	Transportation infrastructure construction	Railroad, road, and airport construction
	Port facility planning	Port facilities tolerant of extreme weather conditions
	Port facility construction	Port facilities tolerant of extreme weather conditions
Coastal management and flood control	Planning of facilities for coastal management and flood control	Planning of dikes, flood protection structures, sewer and drainage technologies
	Construction of facilities for coastal management and flood control	Construction of dikes, flood protection structures, sewer and drainage technologies
Failure-resistant information and communication networks	Data centers	Data centers with reduced need for cooling
	Communication networks	Gale-tolerant mobile communications installations, decentralized energy buffer storage devices
Finance	Reinsurance	Reinsurance for climate change risks
Disaster prevention	Disaster management	Consulting for public disaster management
Health	Diseases transmitted by living organisms, e.g., mosquitoes	Land management limiting multiplication of disease-bearing insects
	Heat stress	Precautions for rapid treatment of heat stress

Source: authors.

(Demand areas/market segments/solutions that were prioritized both on the supply side (Germany) and on the demand side (emerging markets and developing countries) are shaded.)

3 German goods and services

3.1 Information provided in priority sectors and areas of demand

To provide input to the technology mechanisms, it is necessary to broker supply and demand and also to approach sector- or industry-specific organizations and intermediaries whose knowledge of the industry is as comprehensive as possible and who may also possess experience with technology transfer. To enable this, information sources were researched that offer simplified access to German providers of technologies, products, and services for climate mitigation and adaptation.

The tables below present brief profiles of the information sources in these sectors, information on goods and services (examples) in the individual areas of demand, and – where possible – different contact options.

In principle, the German business community is well-positioned in many sectors and areas of demand with its range of products and services for climate mitigation and adaptation. This allows to compile lists with large numbers of existing suppliers with diversified products and services in numerous relevant sectors and areas of demand.

In addition to the industries in which Germany has a strong economic position – e.g., climate-friendly power generation and energy efficiency with the corresponding export initiatives – other sectors, such as water and waste management, stand out because of their particularly comprehensive export and transfer initiatives. The German Water Partnership, the German Recycling Technologies and Waste Management Partnership (RETech), the Center for Research, Education and Demonstration in Waste Management (CReED), and the Export Initiative Energy Efficiency all successfully combine the goal of economic cooperation with emerging markets and developing countries with approaches for education, qualification, financing, and consulting.

Germany possesses strong ranges of goods and services in other sectors as well, e.g. resilient energy infrastructures, cross-sector cross-cutting technologies, and in the areas of demand energy storage systems and intelligent grid expansion. However, no concrete indications of demand from emerging markets and developing countries could be identified for these areas. There may be several reasons for this: For one thing, this could be interpreted as an indication that emerging markets and developing countries are first focusing on meeting central needs in agriculture, energy

supply, and mobility, which is why they do not mention more complex products, technologies, and high-tech solutions dependent on infrastructure and long-term financing. For another, it could be an indication of the major challenges (financing, qualification, etc.) involved with the transfer of such goods and services. Although the long-term effects of such solutions offer substantial synergies and other potential benefits for the countries, which is clearly visible in the example of intelligent grid expansion and climate-compatible infrastructure, those effects must also be embedded in the relevant concepts for planning, financing, education and training. That is the reason why it may be necessary to initiate further and concerted initiatives, especially for the transfer of complex planning and high-tech solutions.

It should be noted at this point that the methods applied in the underlying study of this publication do not permit quantitative estimates of market volumes or assessments of the market dynamics or the ranges of products and services in other countries. However, the tables in the previous chapter do help to briefly characterize the areas of demand with the products and services offered in each. They also contain additional information sources and name institutions that can provide support for seeking out potential suppliers of German products and services.

3.2 Brief profiles of individual sectors and areas of demand

The following brief profiles compile information on the sectors and areas of demand for climate mitigation and adaptation shaded in green in Tables 1 and 2.

They provide an overview of products and services, explain how priorities were set in the TNAs, and list information about suppliers. In addition, the websites of the organizations mentioned were evaluated, and selected representatives of trade associations and companies were interviewed by telephone. In this way, it was possible to determine which points of access to information about products, services, and consulting in the individual sectors and areas of demand exist. Fundamentally speaking, three cases have been differentiated:

1. Lists of members of trade associations exist, and they can be searched for companies providing concrete products, for example, the comprehensive VDMA databases.

2. Export initiatives exist in some sectors, e.g. renewables or water management, in some cases in addition to databases. In individual cases, they even enable differentiated searches for products and countries to which the supplier is prepared to deliver.
3. No trade associations or similar structures exist which compile and update lists of suppliers. In the few (often small) priority sectors of this type, the usually small numbers of suppliers were identified to the extent possible.

The brief profiles of the areas of demand are presented in the form of tables. The data sources were evaluated on the basis of the information accessible. In the category “Comments,” information is given on the focus and the amount of data, and any discernable limitations are noted as well (e.g., that the database includes members of the trade association only). The category “accessibility” includes information about whether the database is accessible to the public and in English, or whether any other restrictions are in place.²

Brief profiles were not compiled for the sector “miscellaneous services for climate mitigation” and its areas of demand “financing concepts,” “policy development and consulting,” as well as “training and education for climate mitigation” because of their cross-cutting nature, the large number of actors involved, and the resulting opportunities for cooperation. Because of the fundamental importance for international cooperation, the section on recommendations in the full report discusses the opportunities and challenges in this sector (see Beucker et al. 2014).

3.3 Brief profiles of the priority sectors and areas of demand regarding climate mitigation

3.3.1 Low-emission energy supply (on and off grid)

The sector “low-emission energy supply (on and off grid)” encompasses the areas of demand “renewables,” “combined decentralized power generation,” “intelligent grids,” “energy storage” as well as “low-emission fossil-based energy supply.” Brief profiles for the areas of demand “intelligent grids” and “energy storage” were not prepared because the TNAs did not include demand corresponding to them at all or demand corresponding well.

3.3.1.1 Renewable power generation

In the area of demand “renewable power generation,” there are several information services or platforms relevant for brokering products and services. This is due to the strength of German providers in this area. The platforms mentioned below, namely the Renewable Energy Export Initiative, Renewables Made in Germany, and Renewables B2B, are the three central platforms of the Federal Ministry for Economic Affairs and Energy in this field. According to information provided by the Renewable Energy Export Initiative in March 2014, they are currently under revision and will be combined into a single platform.

Besides the information sources mentioned, there is also information on target markets for renewables provided by Germany Trade and Invest (GTAI) as well as further supplier directories provided by trade associations (e.g., German Renewable Energy Federation [BEE], German Wind Energy Association [BWE], German Solar Industry Association [BSW], VGB PowerTech, etc.). Because of the large number of individual trade associations, a list of all the directories provided by all the associations was not compiled. Instead, efforts were concentrated on initiatives spanning associations and focusing on exports.

² Additional information on the sectors and areas of demand as well as somewhat more comprehensive profiles are to be found in the final report of the study (Beucker et al. 2014).

Table 3: Brief profile of the area of demand “renewable power generation”

Brief profile of the area of demand “renewable power generation”			
Products	Wind power systems, off-grid photovoltaic systems, solar collectors, biogas systems, hydroelectric facilities, heat pumps		
Services	Planning and dimensioning of systems, integration in local energy supply, maintenance and operation of facilities constructed, training on installation and maintenance of systems in recipient nations		
Priority in the TNAs	High		
Information sources and provision			
Description	Renewable Energy Export Initiative (Exportinitiative Erneuerbare Energien) Information for German suppliers, provided by the Federal Ministry for Economic Affairs and Energy, on foreign markets in the field of renewables	Renewables – Made in Germany Portal for German businesses to present their goods and services abroad; information for foreign buyers about renewables	Renewables B2B Portal and marketplace of the German Chambers of Commerce for companies, products, and knowledge about renewables; communication of information on renewables between the Federal Ministry for Economic Affairs and Energy and German Chambers of Commerce worldwide.
Address	Exportinitiative Erneuerbare Energien im Bundesministerium für Wirtschaft und Energie Scharnhorststrasse 34-37 10115 Berlin, Germany Tel.: +49 (0)30 18615 -7386 Fax: +49 (0)30 18615 - 5400 E-mail: eee@bmwi.bund.de Website: www.export-erneuerbare.de	German Energy Agency (Deutsche Energie-Agentur GmbH, dena) Chausseestr. 128a 10115 Berlin, Germany Tel.: +49 (0)30 72 61 65-600 Fax: + 49 (0)30 72 61 65-699 E-mail: renewables@dena.de Website: www.renewables-made-in-germany.com	German-Greek Chamber of Commerce, representing German Chambers of Commerce (Deutsch-Griechische Industrie- und Handelskammer in Vertretung der deutschen AHKs) Dorileou 10-12 11521 Athens, Greece Tel.: +30 (0)210 64 19 000 Fax: +30 (0)210 64 45 175 Email: ahkathen@mail.ahk-germany.de Website: www.renewablesb2b.com
Comments	Includes relevant information on foreign markets and market access provided by various institutions (ministries, government agencies, Chambers of Commerce, etc.).	Includes information on implementation projects, institutions, suppliers, and networking. The section “yellow pages” includes entries for approx. 100 companies from the various sectors of renewables.	Includes information on international developments in the field of renewables as well as information on companies, products, and services for approx. 3,500 actors (online trade fair).
Accessibility	Freely accessible, English-language site available	Freely accessible, English-language site available	Freely accessible, English-language site available

3.3.1.2 Combined decentralized power generation

The area of demand “combined decentralized power generation” (table 4) is represented by two trade associations, the Federal Association Combined Power Generation (Bundesverband Kraft-Wärme-Kopplung), most of whose members are manufacturers of technical components for combined power generation, and the Heat Supply Association (Verband für Wärmelieferung) in which service providers and companies providing energy contracting are organized.

3.3.1.3 Low-emission fossil-based energy supply

The area of demand “low-emission, fossil-based energy supply” (table 5) is dominated by a few large trade associations because of the structure of the sector and the industry (mostly large companies operating internationally). The central actor is the European technical trade association VGB PowerTech, which has European and international members and cooperation partners and is well integrated in an international network. Besides traditional power plant technology, the trade association is also concerned with the field of renewables; the focus here is more on large power plants (e.g., hydroelectric plants) and the technology and planning they involve.

Table 4: Brief profile of the area of demand “combined power generation”

Brief profile of the area of demand “combined power generation”		
Products	Small-scale cogeneration plants, Stirling engines, fuel cells	
Services	Planning of systems, contracting or operator models	
Priority in the TNAs	High	
Information sources and provision		
Description	<p>Federal Association Combined Power Generation (Bundesverband Kraft-Wärme-Kopplung e.V., B.KWK)</p> <p>Website of the German association for combined power generation including information about the sector as well as a directory of suppliers. The directory lists roughly 130 suppliers of products and service providers and is searchable using keywords. The website also provides links to the websites of the European and global trade associations.</p>	<p>Heat Supply Association (Verband für Wärmelieferung e.V., VfW)</p> <p>Website of the German Heat Supply Association providing information above all about various forms of contracting (energy supply contracting, energy savings contracting, contracting for financing, and technical facility management). The association has approx. 250 members, thus representing most of the sector. The association’s website features a directory of members which is searchable according to various criteria, suppliers, or partner organizations. The association itself also makes contacts to member companies active abroad.</p>
Address	<p>Bundesverband Kraft-Wärme-Kopplung e.V. Markgrafenstrasse 56 10117 Berlin, Germany Tel.: +49 (0)30 270 192 81-0 Fax: +49 (0)30 270 192 81-99 E-mail: info@bkwk.de Website: www.bkwk.de/nc/anbieterforum/</p>	<p>Verband für Wärmelieferung e.V. Lister Meile 27 30161 Hannover, Germany Tel.: +49 (0)511 36590-0 Fax: +49 (0)511 36590-19 E-mail: hannover@vfw.de Websites: www.vfw.de and www.energiecontracting.de</p>
Comments	According to the trade association, most of the actors in the sector are represented in the association and listed in the directory.	According to the trade association, most of the sector is represented.
Accessibility	Freely accessible, German only.	Freely accessible, German only.

3.3.2 Energy-efficient cities and infrastructure

The sector “energy-efficient cities and infrastructure” includes the areas of demand “energy-efficient cross-cutting technologies for infrastructure” as well as “energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)” Nothing corresponding to the area of demand “efficient ICT” was to be found in the TNAs. For this reason, a brief profile of this area of demand was not prepared.

3.3.2.1 Cross-cutting energy-efficient technologies for infrastructure

The area of demand “cross-cutting energy-efficient technologies for infrastructure” (table 6) includes various technologies and sectors that may be employed for energy- and resource-efficient infrastructure. It is difficult to allocate suppliers and their organizations in this field because it

involves a large number of industry sectors. Besides technical solutions and products, planning services must be taken into account in this area of demand.

3.3.2.2 Energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)

The area of demand “energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)” (table 7) includes various products and technologies that are used by end consumers, mostly in homes. Services are practically not provided at all in this area of demand. Even though the initial position of German suppliers in this area of demand is good, it has yet to be clarified whether the products on offer match the specific needs on the demand side (this is true, e.g., of emerging markets and developing countries where stable electricity supply is not available around the clock or where other techniques are used for cooking).

Table 5: Brief profile of the area of demand “low-emission fossil-based energy supply”

Brief profile of the area of demand “low-emission fossil-based energy supply”		
Products	Efficient fuel and firing technology, gas and steam turbines, steam generators, turbines	
Services	Consulting, planning/design, and realization of power plants and their technology	
Priority in the TNAs	High	
Information sources and provision		
Description	<p>European technical association for electricity and heat generation (VGB PowerTech e.V. – Europäischer technischer Fachverband für die Strom- und Wärmeerzeugung)</p> <p>European technical association for electricity and heat generation. Association of companies in the sector of power plant operations and the associated technology. The trade association's activities include exchange and transfer of technical know-how, definition of technical and operational standards as well as identification and organization of joint R&D activities.</p> <p>The trade association has a directory of members on its website (see http://www.vgb.org/en/vgb_memberlist.html); members are grouped as ordinary, associate, and sponsoring members. In addition, experts can be identified in the category “contact” by searching with keywords (see http://www.vgb.org/en/vgb_contact.html).</p>	<p>German Association of Energy and Water Industries (Bundesverband der Energie- und Wasserwirtschaft e.V., BDEW)</p> <p>The BDEW is the central association for companies in the sectors natural gas, electricity, and district heating as well as water and wastewater. The companies represented in the BDEW are both local and municipal companies and supranational ones. They represent roughly 90 percent of electricity sales, approximately 60 percent of local and district heating sales, and 90 percent of natural gas sales in Germany. The trade association and its members operate in the various fields of the energy sector and cooperate internationally with organizations in the energy and water sectors.</p> <p>In the context of the transformation of the energy system, the BDEW plays an important role, as economic, legal, and technical questions of the transformation of the energy supply are coordinated through it. It provides support by conducting market research and offering business consulting and legal consulting services. This experience in implementation may be highly relevant for technology transfer.</p>
Address	<p>VGB PowerTech e.V. Klinkestrasse 27-31 45136 Essen, Germany Tel: +49 (0)2 01 81 28-0 E-Mail: info@vgb.org Website: www.vgb.org</p>	<p>BDEW Bundesverband der Energie- und Wasserwirtschaft e.V. Reinhardtstrasse 32 10117 Berlin, Germany Tel: +49 (0)30 300 199-0 E-mail: info@bdew.de Website: www.bdew.de</p>
Comments	The headquarters of the trade association are located in Germany. The association has 483 member companies, including operators, manufacturers, and other actors in electricity and heat generation. The members are from 34 countries.	The trade association has more than 1,800 members and represents a significant part of Germany's energy sector. To date, one focus has been on representing the interests of the German members.
Accessibility	Freely accessible, information available in German and English.	Freely accessible, most of the information is in German.

Because of the proximity to end consumers and the large number of product suppliers operating globally, there are only a few usable information sources that can meaningfully be allocated to this area of demand.

3.3.3 Low-emission mobility and transportation

The sector includes the areas of demand “alternative fuels and propulsion technology,” “efficient freight transport,” as well as “efficient and low-emission mobility.” Brief profiles of all areas of demand were compiled because of the corresponding demands formulated in the TNAs.

3.3.3.1 Alternative fuels and propulsion technology

The area of demand “alternative fuels and propulsion technology” (table 8) comprises products and services required for low-emission mobility and transport. Besides traditional, but efficient, combustion engines, they also include alternative propulsion technologies such as electric motors, fuel cells, and hybrid drives, as well as alternative fuels, for example biodiesel.

Table 6: Brief profile of the area of demand “cross-cutting energy-efficient technologies for infrastructure”

Brief profile of the area of demand “cross-cutting energy-efficient technologies for infrastructure”			
Products	LED street lighting, speed-controlled/energy-efficient pumps, energy-efficient electric motors, water desalinization plants, energy-efficient drinking water purification and wastewater treatment		
Services	Infrastructure planning for energy, water, and mobility; closed water cycles and recycling of water; planning services offered by engineers, architects, spatial planners, etc.		
Priority in the TNAs	High		
Information sources and provision			
Description	<p>German Engineering Association (Verband Deutscher Maschinen- und Anlagenbau e.V., VDMA)</p> <p>As a trade association of the German mechanical engineering industry, the VDMA is a central source for energy-efficient products, facilities, machines, and technologies with a broad range of applications.</p> <p>Besides general information and the services for seeking products and manufacturers it provides, the trade association also offers information and contacts for the topics energy efficiency and environmental technologies.</p>	<p>German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI)</p> <p>With 3,500 members the German Association of Consulting Engineers VBI is the leading professional organization of independent consulting and planning engineers and engineering firms in Germany.</p> <p>It also represents engineers/planners working on international infrastructure projects. Even though the concept of the website enables various search options (e.g., for planners, cooperation projects) it appears that the amount of data on the website is insufficient.</p>	<p>Engineers without borders (Ingenieure ohne Grenzen)</p> <p>The nonprofit aid organization Engineers without borders provides international technical support and is active in development cooperation.</p> <p>The organization’s engineering projects are in the areas of water, sanitation, and energy supply, bridge engineering, and securing basic infrastructure provision. Engineers without borders supports other aid organizations and the needy by means of knowledge transfer and is involved in implementing aid projects on the ground. Engineers without borders has a large network of company partners and sponsors including businesses as well as other organizations involved in development cooperation and technology transfer.</p>
Address	<p>Verband Deutscher Maschinen- und Anlagenbau e.V.</p> <p>Lyoner Strasse 18 60528 Frankfurt/Main, Germany Tel: +49 (0)69 6603 0 E-mail: kontakt@vdma.org Website: www.vdma.org Product search: http://vdma-products.com</p>	<p>VBI-Bundesgeschäftsstelle</p> <p>Budapester Strasse 31 10787 Berlin, Germany Tel: +49 (0)30 26062-0 Website: www.vbi.de</p>	<p>Ingenieure ohne Grenzen e.V.</p> <p>Greifswalder Strasse 4 10405 Berlin, Germany Tel: +49 (0)30 32 52 98 65 E-mail: info@ingenieure-ohne-grenzen.org Website: www.ingenieure-ohne-grenzen.org/de</p>
Comments	Includes VDMA members.	The list of members is available on www.vbi.de . Queries about suppliers should be directed to the VBI office by telephone.	Engineers without borders is organized in regional groups and groups of experts. The number of members is not known.
Accessibility	English website available, combined search for products and applications possible.		

Table 7: Brief profile of the area of demand “energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)”

Brief profile of the area of demand “energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)”	
Products	Energy-efficient refrigerators, small/decentralized air conditioners, energy-saving heaters and cookers (solar cookers), energy-efficient lighting
Services	No specific services available
Priority in the TNAs	High
Information sources and provision	
Description	<p>The German Energy Agency DENA provides an information portal of the Initiative Energieeffizienz (Initiative Energy Efficiency). General information about the energy efficiency of domestic appliances is available on www.stromeffizienz.de; this information does not favor any particular manufacturer and is oriented toward German end consumers.</p> <p>Export-oriented information on individual technologies (e.g., solar cookers or solar lighting) can be found in assessments and market studies on the export initiative’s website (www.renewablesb2b.com/).</p>

Table 8: Brief profile of the area of demand “alternative fuels and propulsion technologies”

Brief profile of the area of demand “alternative fuels and propulsion technologies”			
Products	Electric drives, fuel cell drives, highly efficient combustion engines, lightweight design, biofuels		
Services	Planning and engineering services for biorefineries, planning and operation of environmentally friendly public transportation fleets		
Priority in the TNAs	Medium		
Information sources and provision			
Description	<p>Association of the Automotive Industry (Verband der Automobilindustrie e.V., VDA)</p> <p>The VDA is the central trade association of the German automobile industry. Its members include automobile manufacturers, their suppliers as well as manufacturers of trailers, bodies, and buses. The VDA represents the industry at the national and international levels and is active in all areas of the motor traffic industry (economic and transportation policy, technical legislation, quality assurance, and taxes). Particular emphasis is on the topics of environment and climate mitigation. The trade association is organized in application areas offering information and solutions on all important aspects concerning climate mitigation (emissions, lightweight design, electric drives, etc.).</p>	<p>Association of the German Biofuels Industry (Verband der Deutschen Biokraftstoffindustrie e.V.)</p> <p>The trade association VDB represents approx. 20 companies in the biofuels industry, including producers of bioethanol, biodiesel, and bio-fuel oil.</p>	<p>Association of the Oilseed-Processing Industry in Germany (Verband der Ölsaatenverarbeitenden Industrie in Deutschland, OVID)</p> <p>The trade association OVID represents the interests of oilseed-processing companies in Germany and has approx. 20 members.</p>
Address	<p>Verband der Automobilindustrie e.V. Behrenstrasse 35 10117 Berlin, Germany Tel. +49 (0)30 897842-0 E-mail: info@vda.de Website: www.vda.de</p>	<p>Verband der Deutschen Biokraftstoffindustrie e.V. Am Weidendamm 1A 10117 Berlin, Germany Tel. +49 (0)30 72 62 59 11 E-mail: info@biokraftstoffverband.de Website: www.biokraftstoffverband.de</p>	<p>Verband der Ölsaatenverarbeitenden Industrie in Deutschland e.V. Am Weidendamm 1A 10117 Berlin, Germany Tel: +49 (0)30 72625900 E-mail: info@ovid-verband.de Website: www.ovid-verband.de</p>
Comments	All the important manufacturers and suppliers of the automotive sector are organized in the VDA. Presentation of the members on the trade association's website: www.vda.de/en/verband/mitglieder/	Presentation of the members on the trade association's website: www.biokraftstoffverband.de/index.php/mitglieder.html	Presentation of the members on the trade association's website: www.ovid-verband.de/der-verband/mitgliedsfirmen
Accessibility	Website freely accessible, searchable for manufacturers in various groups, English-language search available.	Website freely accessible, but no information on international activities, search available in German.	Website freely accessible, but no information on international activities, search available in German.

3.3.3.2 Efficient freight transport

The area of demand “efficient freight transport” (table 9) includes products and services for environmentally friendly and energy-efficient freight transport. Depending on the type, properties, and urgency of the goods to be transported, various transport media (truck, rail, ship, plane, etc.) or combinations of these media can be employed.

3.3.3.3 Efficient and low-emission mobility

The area of demand “efficient and low-emission mobility” (table 10) includes products and services for environmentally friendly passenger services, e. g., public transportation solutions, non-motorized concepts for local transportation, or technologies and systems for smooth traffic flow.

Table 9: Brief profile of the area of demand “efficient freight transport”

Brief profile of the area of demand “efficient freight transport”	
Products	Energy-efficient means of transportation, logistics infrastructure for rail, ports, or airports
Services	Planning and operation of efficient intermodal logistics concepts, planning of highly efficient urban logistics
Priority in the TNAs	Medium
Information sources and provision	
Description	<p>Because of its complexity, the area of demand “efficient freight transport” is not covered by a single industry sector or trade association. Each of the following organizations, provides partial information:</p> <ul style="list-style-type: none"> • German Haulage and Logistics Association, (Deutscher Speditions- und Logistikverband e.V., DSLV): an organization of haulage companies offering transport by rail, truck, plane, air, or ship (see: www.dslv.org). • Association of German Transport Companies (Verband Deutscher Verkehrsunternehmen e.V.,VDV): an organization of service providers for freight transport by rail, among others (see: www.vdv.de/schienengueterverkehr.aspx). • German Aviation Association (Bundesverband der Deutschen Luftverkehrswirtschaft e.V., BDL): an organization of airlines and airport operators (see: www.bdl.aero/de). • German Shipowners’ Association (Verband Deutscher Reeder e.V., VDR): represents the common business and social policy interests of German shipping companies (see: www.reederverband.de).
Comments	The organizations mentioned provide widely differing information in terms of content, quality, and accessibility. Many of them explicitly take positions on the environmental relevance of their sector and of freight logistics. It is difficult to assess to what degree the services provided by these organizations can be utilized for international transfer.

Table 10: Brief profile of the area of demand “efficient and low-emission mobility”

Brief profile of the area of demand “efficient and low-emission mobility”	
Products	Rapid transit bus systems, traffic demand management technology and software
Services	Planning and implementation of traffic management systems, modal shift concepts and realization
Priority in the TNAs	High
Information sources and provision	
Description	<p>There is no specific trade association or organization that covers the entire area of demand “efficient and low-emission mobility.” Some technical aspects of the area of demand, such as propulsion technology for buses or alternative fuels, were described in the areas of demand above. Further technical products and components for traffic management and control are provided by companies in the fields of automation and measuring as well as control and feedback control engineering. The relevant sector organizations are:</p> <ul style="list-style-type: none"> • German Electrical and Electronic Manufacturers’ Association (Zentralverband Elektrotechnik- und Elektronikindustrie e.V., ZVEI), see www.zvei.org and • Association for Electrical, Electronic & Information Technology (Verband der Elektrotechnik Elektronik Informationstechnik e.V., VDE), see www.vde.com), whose activities are focused on science, standardization, and product testing. <p>The goal of these organizations is primarily to represent the sector in Germany; technology transfer to emerging markets and developing countries plays a lesser role.</p>
Comments	In light of the demand in the current TNAs, German planning and engineering services for efficient and low-emission mobility could improve their visibility. This should include the competencies of urban, spatial, and regional planners.

3.3.4 Energy- and resource-intensive industries

In the sector “energy- and resource-intensive industries,” (table 11) the emerging markets and developing countries mention demand only in the field of efficient production methods and processes in their TNAs. The production processes are relatively heterogeneous, and they are informative or representative only to a limited extent. The demands are related to energy-efficient production technology (drives and process heat) as well as selected industries (bricks and

cement). Because they were mentioned only twice, the selected industries will not be discussed in more detail.

3.3.5 Sustainable waste management and circular economy

The sector “sustainable waste management and circular economy” (table 12) is divided into three areas of demand: waste avoidance, waste collection and treatment, and envi-

Table 11: Brief profile of the area of demand “efficient methods and processes”

Brief profile of the area of demand “efficient methods and processes”	
Products	Speed-controlled, efficient electric motors and drives, efficient combustion technology for process heat
Services	–
Priority in the TNAs	High
Information sources and provision	
Description	<p>There is no specific trade association or organization that covers the entire area of demand “efficient production methods and processes.” However, information on products such as efficient electric motors and combustion technology is available from the following trade associations mentioned above:</p> <ul style="list-style-type: none"> • German Engineering Association (Verband Deutscher Maschinen- und Anlagenbau e.V., VDMA) see www.vdma.org • German Electrical and Electronic Manufacturers’ Association (Zentralverband Elektrotechnik- und Elektronikindustrie e.V., ZVEI), see www.zvei.org • VGB PowerTech e.V., see www.vgb.org

Table 12: Brief profile of the sector “sustainable waste management and circular economy”

Brief profile of the sector “sustainable waste management and circular economy”		
Products	Facilities for waste separation, treatment, and disposal, landfill technology, incineration technology	
Services	Planning and implementation of concepts for waste avoidance and recycling as well as systems with returnable items, consulting concerning the introduction and implementation of concepts for collecting and recycling individual waste fractions such as batteries, waste oil, etc.	
Priority in the TNAs	High	
Information sources and provision		
Description	<p>German Recycling Technologies and Waste Management Partnership e.V. (RETech) RETech is the export network of the German recycling and waste management sector. Its precursor was the Initiative Recycling and Efficiency Technology of the Federal Ministry for the Environment. The network considers itself a point of contact for public and private organizations in Germany and abroad interested in German resource and efficiency technology. It provides a neutral platform for companies interested in innovative technologies for recycling and waste management and their export. Members can exchange experiences and information on specialized questions, for example financing or securing against risks (currency risks, insurance, loan guarantees) when doing business abroad. RETech is collaborating with ministries and subordinate authorities, institutes, and trade associations in Germany and abroad to establish a network of actors supporting the export of German recycling and waste management technology as well as knowledge transfer.</p>	<p>Center for Research, Education and Demonstration in Waste Management e.V. (CReED) CReED is a German national center for research and education in the waste and resources sector. CReED offers international experts and actors the opportunity to conduct site visits of technologies in the waste management industry and provides training in their application. In this way, CReED provides know-how transfer, enabling the use of modern waste management methods.</p>
Address	<p>German Recycling Technologies and Waste Management Partnership e.V. Am Eichgarten 15 12167 Berlin, Germany Tel.: +49 (0)2202 2005 94 E-mail: Contact form on website Website: www.retech-germany.net</p>	<p>CReED e.V. Pohlsche Heide 1 32479 Hille, Germany Tel.: +49 (0)57 03 8 02-0 E-mail: info@creed-ev.de Webseite: www.creed-ev.de</p>
Comments	The network represents approx. 40 sector organizations, including central companies as well as research institutions.	The network represents approx. 50 waste management organizations with a focus on education and training. Members include both companies and universities.
Accessibility	Website freely accessible, searchable for manufacturers in various groups, English-language search available.	Website freely accessible, searchable information available in several languages (English, French, Spanish).

ronmentally friendly recycling concepts. Since the demand articulated in the TNAs cannot always be differentiated clearly according to these areas of demand, and since there are two central organizations in Germany that serve this field, the demands were combined in a single sector.

3.4 Brief profiles of the priority sectors and areas of demand regarding climate adaptation

3.4.1 Climate-compatible agriculture and forestry

The sector climate-compatible agriculture includes brief profiles of the areas of demand plant breeding, irrigation, conservation tillage, and agricultural extension.

3.4.1.1 Plant breeding

Although the area of demand “plant breeding” (table 13) represents both numerous needs in developing countries and high competence in German breeding research and breeding companies, the initial position in this area of demand concerning transfer is problematic. The reason for this is that German plant breeding is specialized in plants for agriculture in Germany and Europe, while the demand is for other (non-European) cultivars and other site conditions.

The research sector is represented by the Association for Plant Breeding (Gesellschaft für Pflanzenzüchtung e.V., GPZ), the corporate sector by the German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter e.V., BDP). Both trade associations provide online directories of members. In addition, the German Food Partnership

Table 13: Brief profile of the area of demand “plant breeding, especially drought- and salt-resistant plants”

Brief profile of the area of demand “alternative fuels and propulsion technologies”			
Products	Climate-compatible cultivars are not exported to any substantial extent.		
Services	The BDP and its member companies are actively involved in individual projects, for example, cooperatively developing the structures and capacities for plant breeding as well as breeding plants for regional cultivation in Ethiopia. Since its establishment in 2012, the German Food Partnership has been working closely with the Federal Ministry for Economic Cooperation and Development, businesses, and the plant breeding research community to prepare cooperative projects with emerging markets and developing countries.		
Priority in the TNAs	More than 50 % of the countries mention drought- and salt-resistant plants as a priority among their biotechnology needs.		
Information sources and provision			
Description	German Plant Breeders' Association (Bundesverband Deutscher Pflanzenzüchter e. V., BDP) The German Plant Breeders' Association bundles the interests of its 130 member companies, most of which are agricultural and horticultural breeding and trading companies.	Association for Plant Breeding (Gesellschaft für Pflanzenzüchtung e. V., GPZ) The Association for Plant Breeding is a network organization of 32 scientific and other plant breeding organizations.	German Food Partnership (GFP) The German Food Partnership was established in June, 2012; its task is to support agriculture and nutrition in emerging markets and developing countries.
Address	Bundesverband Deutscher Pflanzenzüchter e. V. Kaufmannstrasse 71-73 53115 Bonn, Germany Tel.: +49 (0)228/985 81-10 Fax: +49 (0)228/985 81-19 Website: www.bdp-online.de	Gesellschaft für Pflanzenzüchtung c/o Julius Kühn-Institut (JKI) Erwin-Baur-Strasse 27 06484 Quedlinburg, Germany Tel.: +49 (0)3946-47899 Fax: +49 (0)3946-47600	Koordinationsbüro GFP Kathrin Fochtmann, Koordinatorin GFP c/o Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Dag-Hammarskjöld-Weg 1-5 65760 Eschborn, Germany Tel.: +49 (0)6196-79 1974 E-mail: gfp@giz.de Website: www.germanfoodpartnership.de/
Comments	List of the 130 BDP members available at www.bdp-online.de/de/Ueber_uns/Mitglieder/	List of 32 German plant breeding organizations available at http://gpz-online.de/links/ . In addition, a list of 20 working groups and their heads is available at / Organisation.	
Accessibility	Website freely accessible, searchable for plant groups in German.	Website freely accessible, no searches, in German.	

(GFP) has been established within GIZ; its task is to support agriculture and nutrition in emerging markets and developing countries.

3.4.1.2 Agricultural irrigation

The area of demand “agricultural irrigation” (table 14) includes a small portion of German agricultural machine production. Because of the historically rather low need for irrigation technology, there is no trade association representing the three manufacturers identified in this study, only one of which is listed in the directory of VDMA members.

The manufacturers of machine components such as pumps are better-placed, and many can be found in the directory of VDMA members. It provides for combined searches for products (e.g., pumps and pumping systems) and areas of application (e.g., irrigation).

3.4.1.3 Conservation tillage

The area of demand “conservation tillage” (table 15) includes one part of German agricultural machinery production. The Gesellschaft für konservierende Bodenbearbeitung e.V. (Society for Conservation Tillage, GKB) represents companies and research institutes working in this area. Manufacturers of tillage equipment are also represented by the VDMA.

3.4.1.4 Agricultural extension

No trade associations or advocacy groups were identified in the area of demand “agricultural extension” (table 16). In 2012, the GIZ (German Corporation for International Cooperation) and the Federal Ministry for Economic Cooperation and Development mentioned several political actors, research institutes and (a few) consultants.

The Thünen Institute developed, as an individual activity, a procedure for surveying soil condition which would be available for transfer.

Table 14: Brief profile of the area of demand “agricultural irrigation”

Brief profile of the area of demand “agricultural irrigation”			
Products	Spray irrigation systems, irrigation booms, pump units, wellpoint equipment, submersible wastewater pumps		
Services	–		
Priority in the TNAs	Approx. 38 % of the TNAs mention improved agricultural practices including irrigation as a priority technology.		
Information sources and provision			
Description	Three manufactures were identified in a supplier survey at Agritechnika 2013.	VDMA search for companies and products on irrigation and spray irrigation systems	VDMA search for companies and products on machine components
Address	<p>Beinlich Agrarpumpen und -maschinen GmbH, Ulmen Website: www.beinlich-beregnung.de</p> <p>Heinrich Deierling Maschinenbau GmbH & Co. KG, Lehrte-Sievershausen Website: www.deierling-beregnung.de</p> <p>HÜDIG GmbH & Co KG, Celle Website: www.huedig.de</p>	<p>Verband Deutscher Maschinen- und Anlagenbau e.V. Lyoner Strasse 18 60528 Frankfurt/Main, Germany Tel.: +49 (0)69 6603 0 Website: www.vdma.org/ Product search available at http://vdma-products.com results in one supplier in Germany (Beinlich)</p>	<p>Verband Deutscher Maschinen- und Anlagenbau e.V. Lyoner Strasse 18 60528 Frankfurt/Main, Germany Tel.: +49 (0)69 6603 0 Website: www.vdma.org/ Product search available at http://vdma-products.com The company search provides results for pumps and measurement technology, but not for water filtering technology (only some trade associations and companies collaborate with the search portal). As a matter of principle, high technical competence is required to use the VDMA product search in order to select precisely the proper product.</p>
Accessibility		English website available, combined search for products and applications possible.	English website available, combined search for products and applications possible.

Table 15: Brief profile of the area of demand “conservation tillage”

Brief profile of the sector “sustainable waste management and circular economy”		
Products	Equipment for plowless tillage, seeding technology, and grassland maintenance; wheels and tires; seeds adapted to conservation seeding	
Services	–	
Priority in the TNAs	Conservation agriculture is mentioned as a priority in 28% of the TNAs.	
Information sources and provision		
Description	Society for Conservation Tillage (Gesellschaft für konservierende Bodenbearbeitung e.V., GKB) 29 companies and numerous individual members offering equipment for conservation tillage and no-till or conducting research and consulting on the topic have joined together in the GKB.	VDMA search for companies and products VDMA search for companies and products on “soil working equipment” in the category “agricultural machinery”
Address	Gesellschaft für konservierende Bodenbearbeitung e.V. Hauptstrasse 6 15366 Neuenhagen, Germany Tel.: +49 (0)3342 / 422 130 Website: www.gkb-ev.de	Verband Deutscher Maschinen- und Anlagenbau e.V. Lyoner Strasse 18 60528 Frankfurt/Main, Germany Tel.: +49 (0)69 6603 0 Website: www.vdma.org/ Product search under http://vdma-products.com yields 16 suppliers in Germany.
Comments	A list of 29 manufacturers and suppliers of relevant technologies is available on www.gkb-ev.de , under “Fördermitglieder” (sponsoring members).	Includes VDMA members only.
Accessibility	Website is available free of charge, available in German.	English website available, combined search for products and applications possible.

3.4.1.5 Forestry extension

With the exception of two working groups, no trade associations or advocacy groups were identified in the area of demand “forestry extension and agroforestry” (table 17). Lists of working group members are not publicly accessible.

3.4.2 Meteorological measurement technology and climate simulation

Meteorological data and climate simulations are of great importance for the development of strategies for adaptation to climate change and for lessening its effects, as their global, national, or regional projections form an important basis for decision-making by businesses, intermediaries, and policy-makers (cf., for example, IPCC 2007a; IPCC 2007b; Nordwest2050-Konsortium 2010).

Monitoring climate change encompasses both weather-related services and activities and activities dealing with scenarios, models, and prognoses for climate change in the medium and long term.

The German manufacturers of meteorological measuring instruments and data evaluation devices play an important role internationally. The sector includes manufacturing of various kinds of instruments, ranging from, e.g., measuring instruments for relative humidity, wind, temperature, precipitation, and atmospheric pressure, to weather stations, data loggers, displays, and software. Some of the German manufacturers are among the so-called “hidden champions,” i.e., companies with large global market shares in very specific niche markets.

Overall, at least four expert institutions and five university institutes in Germany are active in preparing mostly regional climate simulations. Thus, Germany is one of the top three international climate simulation actors.

Numerous institutions exist at the federal and Land level as well to ensure close links between climate research and users. These include Germany’s National Meteorological Service (Deutscher Wetterdienst, DWD), the Federal Environment Agency (Umweltbundesamt, UBA), the Climate Service Center (CSC), and the Regional Climate Offices (Regionale Klimabüros, RKB) of the Helmholtz Association, the Potsdam Institute for Climate Impact Research (Pots-

Table 16: Brief profile of the area of demand “agricultural extension”

Brief profile of the sector “sustainable waste management and circular economy”		
Products	–	
Services	Elaboration of local and regional climate adaptation strategies, studies on biodiversity and climate, regional climate modeling, land policy and land management, combating desertification. Soil condition survey: Surveying the concentrations and stocks of organic carbon in soils is a commitment within the framework of the UNFCCC (UNFCCC Art. 3. 3, 4. 1, 4. 2 and decision 3/CP5). A very systematic method was developed for Germany.	
Priority in the TNAs	Approx. 38 % of the TNAs mention improved agricultural practices as a priority technology.	
Information sources and provision		
Description	<p>German Corporation for International Cooperation GmbH (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ) GIZ coordinates numerous projects in the area of agriculture. It also networks research and consulting institutions.</p>	<p>Soil condition survey Surveying the concentrations and stocks of organic carbon in soils is a commitment within the framework of the UNFCCC (UNFCCC Art. 3. 3, 4. 1, 4. 2 and decision 3/CP5). A systematic method was developed for Germany by the Thünen Institute of Climate-Smart Agriculture (Thünen-Institut für Agrarklimaschutz).</p>
Address	<p>Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH Dag-Hammarskjöld-Weg 1-5 65760 Eschborn, Germany Tel.: +49 (0)6196 79-0 Fax: +49 (0)6196 79-11 15 Website: www.giz.de</p> <p>In 2012, GIZ and the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety documented the suppliers of research and consulting services:</p> <ul style="list-style-type: none"> • KLIFF, climate impact research, Lower Saxony: www.kliff-niedersachsen.de • IASS Potsdam, Institute for Advanced Sustainability Studies e.V.: http://www.iass-potsdam.de • Association for AgriCulture and Ecology in Africa, Asia, Latin America and Eastern Europe (AGRECOL): www.agrecol.de • Biodiversity and Climate Research Centre: www.bik-f.de • Thünen Institute of Climate-Smart Agriculture: www.ti.bund.de/en/startseite/institutes/climate-smart-agriculture.html • Leibniz Centre for Agricultural Landscape Research (ZALF) e. V.: www.zalf.de • Agripol – network for policy advice GbR: www.agripol-network.com • UNIQUE forestry and land use: www.unique-landuse.de • GIZ: agricultural production and resource use: www.giz.de 	<p>Thünen Institut für Agrarklimaschutz Hanne Schmidt-Przebierala Bundesallee 50 38116 Braunschweig, Germany Tel.: +49 (0)531 596 2601 Fax: +49 (0)531 596 2699 E-mail: ak@ti.bund.de Website: www.bze-landwirtschaft.de</p>
Comments		This national activity could be applied in other countries.
Accessibility	Information available in pdf document.	Individual website

dam Institut für Klimafolgenforschung, PIK), and many others. Meteorological measurement technology, climate and weather data, and climate simulations are therefore highly specific, but important goods and services from Germany in the context of climate adaptation.

No trade associations or advocacy groups were identified in the sector “meteorological measurement technology and climate simulation” (table 18). The suppliers listed below were identified by means of telephone interviews of individual suppliers as well as internet research.

Table 17: Forestry extension development cooperation

Area of demand “forestry extension”			
Products	Rapidly growing and heat-tolerant trees and shrubs.		
Services	Consulting on climate-tolerant forestry and agroforestry systems.		
Priority in the TNAs	23 % of the TNAs mention agroforestry as a priority in the context of land use. 55% of the countries expressed needs for adaptation in forestry in the Second Synthesis Report, with the topics forest rehabilitation and melioration topping the agenda. The report mentions the topics agroforestry, reforestation, rapidly growing trees and shrubs as well as early warning systems for forest fires in particular. Forest management using an ecosystems approach is required. Increasing biological diversity – including diversity of tree species – is documented as a priority.		
Information sources and provision			
Description	<p>Research institutes A number of research institutes are working on projects concerning international forestry.</p>	<p>German Corporation for International Cooperation GmbH (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ) GIZ’s Forestry Expert Working Group (Facharbeitskreis Waldwirtschaft) is a working group with 13 German consulting firms focusing on development cooperation in forestry. The working group collaborates with GIZ on current topics in order to exchange knowledge on the most current developments at the German political level and the level of implementation in the partner countries. Sector Networks of GIZ are the forum for the organization and implementation of expert work within GIZ.</p>	<p>German Forest Society (Deutscher Forstverein e.V., DFV) DFV’s Network for international sustainable Forest Management (Netzwerk Internationale Nachhaltige Waldwirtschaft, NIWA) is comprised of representatives of public forestry agencies and ministries, the scientific community, trade associations, students, and practicing foresters engaged and working in international forest and wood management.</p>
Address	<p>Göttingen University Faculty of Forest Sciences and Forest Ecology Büsgenweg 5 37077 Göttingen, Germany Tel.: +49 (0)551 39 33 402 Website: www.uni-goettingen.de</p> <p>University of Freiburg Faculty of Environment and Natural Resources Tennenbacher Strasse 4 79106 Freiburg, Germany Tel.: +49 (0)761 203 3601 Website: www.uni-freiburg.de</p> <p>Thünen Institute for International Forestry and Forest Economics Leuschnerstrasse 91 21031 Hamburg, Germany Telefon: +49 (0)40 73962 301 Website: www.ti.bund.de/en/startseite/institutes/international-forestry-and-forest-economics.html</p>	<p>Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH Abt. Internationale Waldpolitik Dag-Hammarskjöld-Weg 1-5 65760 Eschborn, Germany Tel.: +49 (0)6196 79-0 www.giz.de</p>	<p>Deutscher Forstverein e.V. Büsgenweg 1 37077 Göttingen, Germany Tel.: +49 (0)551 37 96 265 www.forstverein.de/deutscher-forstverein/profil/arbeitsbereiche/content.php?cid=1252595259.20431</p>
Accessibility	Websites freely accessible, partly in English.		

Table 18: Brief profile of the sector “meteorological measurement technology and climate simulation”

Brief profile of the sector “meteorological measurement technology and climate simulation”				
Areas of demand “meteorological measurement technology, weather radar, climate simulation”				
Products	Measuring instruments for relative humidity, wind, temperature, precipitation, atmospheric pressure; electronic systems, weather stations, data loggers, displays, software; measuring instruments for flow rate, water gauge, and water quality of flowing waters and groundwater. Weather radar systems for monitoring and forecasting rain.			
Services	Software and application technology for weather radar systems; Climate simulations			
Priority in the TNAs	Climate monitoring is prioritized in 30% of the TNAs in the context of water supply and in 10 % of the TNAs in the context of agriculture.			
Information sources and provision				
Description	<p>Hydro-Meteorological Equipment Industry (HMEI) HMEI represents 120 manufacturers of hydro-meteorological systems worldwide. Its goal is the improvement of the systems’ standards and quality.</p>	<p>Four suppliers of weather radar system were identified in a survey.</p>	<p>Eight institutions conduct research on climate simulation.</p>	<p>One research institute simulates ocean currents.</p>
Address	<p>Association of HMEI c/o WMO WMO Building 7 bis, avenue de la Paix CH-1211 Geneva 2, Switzerland Tel.: +41 (0)22 730 8334 Website: www.hmei.org A global list of suppliers is available. The 15 German suppliers are to be found at: www.hmei.org/index.php?page_id=321&country=Germany</p>	<p>Selex Systems Integration GmbH Neuss-Rosellen www.gematronik.com</p> <p>METEK GmbH Elmshorn: www.metek.de</p> <p>GAMIC mbH Aachen: www.gamic.com</p> <p>hydro & meteo GmbH&Co.KG Lübeck: www.hydrometeo.de</p>	<p>Climate Service Center (CSC) Chilehaus, Eingang B Fischertwiete 1 20095 Hamburg, Germany Tel.: +49 (0)40 226 338 0 Website: www.climate-service-center.de</p> <p>Potsdam Institute for Climate Impact Research Telegraphenberg A 31 14473 Potsdam, Germany Tel.: +49 (0)331/288-2500 Website: www.pik-potsdam.de</p> <p>Max Planck Institute for Meteorology Bundesstrasse 53 20146 Hamburg, Germany Tel.: +49 (0)40 41173 0 Website: www.mpimet.mpg.de</p> <p>Germany’s National Meteorological Service (Deutscher Wetterdienst) Frankfurter Strasse 135 63067 Offenbach, Germany Tel.: +49 (0)69 80 62 - 0 Website: www.dwd.de</p> <p>University of Würzburg, Institute for Geography and Geology Am Hubland 97074 Würzburg, Germany Tel.: +49 (0)931 31-84688 Website: www.geographie.uni-wuerzburg.de</p> <p>Karlsruhe Institute of Technology (KIT), Institute for Meteorology and Climate Research 76128 Karlsruhe, Germany Tel.: +49 (0)721 608-43356 Website: www.imk-tro.kit.edu</p> <p>University of Cologne, Institute for Geophysics and Meteorology 50969 Köln, Germany Tel.: +49 (0)221 470 2552 Website: www.geomt.uni-koeln.de</p> <p>Technological University Cottbus, Chair Environmental Meteorology 03044 Cottbus, Germany Tel.: +49 (0)355 69-1186/-1114 Website: www.tu-cottbus.de/meteo</p>	<p>GEOMAR – Helmholtz Centre for Ocean Research Kiel Düsternbrooker Weg 20 24105 Kiel, Germany Tel.: +49 (0)431 600-4003 Website: www.geomar.de</p>

3.4.3 Water management

The German Water Partnership e.V. is a network oriented toward the export of all kinds of water management products and services; it explicitly includes developing countries and emerging markets (table 19). The German Asso-

ciation for Rainwater Harvesting and Water Utilization (Fachvereinigung Betriebs- und Regenwassernutzung e.V.) represents suppliers in one portion of the water management sector. Further consultants in the area are represented by the German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI).

Table 19: Brief profile of the sector “water management”

Brief profile of the sector “water management”				
Areas of demand: Water production, water efficiency, wastewater treatment, integrated water resource management, graywater systems				
Products	Desalinization plants powered by renewables, water harvesting technologies, water recycling systems, electronic monitoring of piping to avoid leakage, wastewater treatment plants, flood retention basins, water storage, graywater systems			
Services	Water recycling concepts, catchment area planning, integrated water resource management			
Priority in the TNAs	New methods of water production in particular (rainwater harvesting, water catchments) are mentioned as a need in more than 50% of the TNAs. Climate monitoring for forecasting rain is also important (30%). The goods and services offered by German suppliers, however, are more focused on water processing and wastewater treatment.			
Information sources and provision				
Description	<p>German Water Partnership e.V. The German Water Partnership is a network in which private and public companies in the field of water, trade associations as well as business, scientific, and research institutions have joined together. The initiative is supported by five federal ministries: the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety; the Federal Ministry for Economic Affairs and Energy; the Federal Ministry for Economic Cooperation and Development; the Federal Ministry of Education and Research; and the Federal Foreign Office.</p>	<p>German Association for Rainwater Harvesting and Water Utilisation (Fachvereinigung Betriebs- und Regenwassernutzung e.V.) The German Association for Rainwater Harvesting and Water Utilisation represents several hundred suppliers offering consulting and planning, manufacture, construction and installation, maintenance, and operation of rainwater harvesting and water utilization. The association is not explicitly oriented toward exports.</p>	<p>German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI) With 3,500 members, the German Association of Consulting Engineers VBI is the leading professional organization of independent consulting and planning engineers and engineering firms in Germany. VBI also represents members in the area of hydraulic engineering.</p>	<p>VDMA search for companies and products Search for structural elements such as “pumps” and “gas-kets”.</p>
Address	<p>German Water Partnership e.V. Reinhardtstrasse 32 10117 Berlin, Germany Tel.: +49 (0)30 300199-1220 Website: www.germanwater-partnership.de List of members available at: http://members.germanwater-partnership.de/?id=195&L=2</p>	<p>Fachvereinigung Betriebs- und Regenwassernutzung e.V. Havelstraße 7 A 64295 Darmstadt, Germany Tel.: +49 (0)6151 339257 Website: www.fbr.de List of members available at: www.fbr.de/mitgliederund-produkte.html</p>	<p>VBI-Bundesgeschäftsstelle Budapester Strasse 31 10787 Berlin, Germany Tel.: +49 (0)30 26062-0 Website: www.vbi.de</p>	<p>Verband Deutscher Maschinen- und Anlagenbau e.V. Lyoner Strasse 18 60528 Frankfurt/Main, Germany Tel.: +49 (0)69 6603 0 Website: www.vdma.org/ Product search available at http://vdma-products.com</p>
Comments	Includes 350 suppliers interested in exports	Approx. 500 members in science, production, distribution, planning, and administration; member search possible	The list of members is available on www.vbi.de . Queries about suppliers should be directed to the VBI office by telephone.	Includes VDMA members only.
Accessibility	English-language user interface available; use free of charge.	Available only in German; use free of charge.		English website available, combined search for products and applications possible.

3.4.4 Engineering and architectural planning services

In the area of demand “engineering and architectural planning services” (table 20) such services are offered for the sectors “building engineering,” “transportation infrastructure,” and “coastal management and flood control.” The Federal Statistical Office (Statistisches Bundesamt 2013) indicates just under 102,800 companies or institutions for the reporting year 2011 whose business focus is an architect-

ural or engineering firm; approx. three-quarters of them (76.0 %) with an annual turnover of less than 250,000 €. The focus of two-thirds of the companies (66.8 %) was in engineering, for 33.2 % it was in architecture. The larger firms are represented mostly by the German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI). The roughly 1,000 architectural firms active abroad have joined together in the Network Architecture Export (Netzwerk Architektorexport)

Table 20: Brief profile of “engineering and architectural planning services”

Brief profile of “engineering and architectural planning services”		
Areas of demand: planning services in the sectors “building engineering,” “transportation infrastructure,” and “coastal management and flood control”		
Products	All types of residential and other buildings, infrastructural facilities (roads, railroad lines, ports, and airports), facilities for coastal management and flood control (dikes, locks, sewers, retaining structures, as well as “soft” measures such as water overflow areas).	
Services	Planning services by consulting engineers in the fields of building engineering, transportation engineering, coastal management and flood control, and harbor construction. The engineering services also include construction supervision.	
Priority in the TNAs	32 % of the national documents mention the areas “infrastructure and settlement including coastal zones” as priorities in the TNAs. Most of the technologies mentioned concern coastal management with both “hard” and “soft” methods. Wetland restoration, beach reclamation, and early warning systems for high tides were mentioned most often. However, construction services in structural or civil engineering, including transportation infrastructure, were not mentioned in the Second or Third Synthesis Reports.	
Information sources and provision		
Description	German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI) With 3,500 members, the German Association of Consulting Engineers VBI is the leading professional organization of independent consulting and planning engineers and engineering firms in Germany. VBI also represents members in the area of hydraulic engineering.	Network Architecture Export (Netzwerk Architektorexport NAX) The Federal Chamber of Architects’ NAX includes approx. 1,000 architectural firms, but only a small fraction of them is active in developing countries and emerging markets. The website features a map of the world offering access to country-specific information and “contact architects” for individual countries. NAX also organizes the forwarding of requests for proposals to interested firms.
Address	VBI-Bundesgeschäftsstelle Budapester Strasse 31 10787 Berlin, Germany Tel.: +49 (0)30 26062-0 Website: www.vbi.de	Netzwerk Architektorexport Askanischer Platz 4 10963 Berlin, Germany Tel.: +49 (0)30 263944 62 Website: www.nax.bak.de
Comments	The list of members is available on www.vbi.de. Queries about suppliers should be directed to the VBI office by telephone.	There is no directory of members online.

3.4.5 Reinsurance

In the area of demand “reinsurance” (table 21), German reinsurance companies have a global market share of approx. 40 % of premiums written. Three German reinsurance companies active worldwide were identified. All the others limit their sales areas to Germany or Europe.

3.4.6 Disaster management

The sector “disaster management” (table 22) follows free-market principles only to a limited extent. The majority of international projects is coordinated by a small working group of the THW, which is an agency of the Federal Ministry of the Interior and is bound by instructions; it often works in coordination with GIZ. According to the VBI, individual projects have also been carried out by consultants.

Table 21: Area of demand “reinsurance”

Area of demand: “reinsurance”				
Products	–			
Services	Reinsurance reduces the risks to which individual insurance companies are exposed. Reinsurance serves two purposes: firstly, to ensure that the direct insurance company remains solvent even in the event of major claims (protection of insured parties), and secondly, to reduce the loss burden of the direct insurance company (protection of the insurance company).			
Priority in the TNAs	Neither banks nor insurance services are mentioned in the Second and Third Synthesis Reports.			
Information sources and provision				
Description	Three companies provide reinsurance on a worldwide basis.			
Address	<table border="0"> <tr> <td>Munich Re Königinstrasse 107 80802 München, Germany Tel.: +49 (0)89 3891-0 Website: www.munichre.com</td> <td>Hannover Rück SE Karl-Wiechert-Allee 50 30625 Hannover, Germany Tel. +49 (0)511 5604-0 Website: www.hannover-rueck.de</td> <td>Allianz Re Königinstrasse 28 80802 München, Germany Tel.: +49 (0)89 3800-0 Website:www.allianzre.com</td> </tr> </table>	Munich Re Königinstrasse 107 80802 München, Germany Tel.: +49 (0)89 3891-0 Website: www.munichre.com	Hannover Rück SE Karl-Wiechert-Allee 50 30625 Hannover, Germany Tel. +49 (0)511 5604-0 Website: www.hannover-rueck.de	Allianz Re Königinstrasse 28 80802 München, Germany Tel.: +49 (0)89 3800-0 Website:www.allianzre.com
Munich Re Königinstrasse 107 80802 München, Germany Tel.: +49 (0)89 3891-0 Website: www.munichre.com	Hannover Rück SE Karl-Wiechert-Allee 50 30625 Hannover, Germany Tel. +49 (0)511 5604-0 Website: www.hannover-rueck.de	Allianz Re Königinstrasse 28 80802 München, Germany Tel.: +49 (0)89 3800-0 Website:www.allianzre.com		
Accessibility	Websites publicly accessible.			

Table 22: Brief profile of “consulting in disaster management”

Area of demand: “consulting in disaster management”			
Products	–		
Services	Consulting regarding establishment of local and national disaster relief forces, procurement of equipment, and training of disaster relief forces.		
Priority in the TNAs	The only demand mentioned in the Third Synthesis Report is “community-based early warning systems for natural disaster prevention.” In the Second Synthesis Report, roughly 30% of countries expressed a demand for limiting the effects of natural disasters.		
Information sources and provision			
Description	<table border="0"> <tr> <td>Federal Agency for Technical Relief (Technisches Hilfswerk, THW) Organizationally speaking, the THW belongs to the portfolio of the Federal Ministry of the Interior. However, just 1 % of the THW’s staff has a salaried position with the THW, and 99 % work as volunteers. More than 80,000 helpers, men and women alike, work in their free time, in 668 local groups across Germany, to provide competent and active help to people in need.</td> <td>German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI) With 3,500 members, the German Association of Consulting Engineers VBI is the leading professional organization of independent consulting and planning engineers and engineering firms in Germany. VBI also represents members in the area of hydraulic engineering.</td> </tr> </table>	Federal Agency for Technical Relief (Technisches Hilfswerk, THW) Organizationally speaking, the THW belongs to the portfolio of the Federal Ministry of the Interior. However, just 1 % of the THW’s staff has a salaried position with the THW, and 99 % work as volunteers. More than 80,000 helpers, men and women alike, work in their free time, in 668 local groups across Germany, to provide competent and active help to people in need.	German Association of Consulting Engineers (Verband Beratender Ingenieure, VBI) With 3,500 members, the German Association of Consulting Engineers VBI is the leading professional organization of independent consulting and planning engineers and engineering firms in Germany. VBI also represents members in the area of hydraulic engineering.
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Address	<table border="0"> <tr> <td>Bundesanstalt Technisches Hilfswerk Provinzialstrasse 93 53127 Bonn, Germany Tel.: +49 (0)228 940 0 Website: www.thw.de</td> <td>VBI-Bundesgeschäftsstelle Budapester Strasse 31 10787 Berlin, Germany Tel.: +49 (0)30 26062-0 Website: www.vbi.de</td> </tr> </table>	Bundesanstalt Technisches Hilfswerk Provinzialstrasse 93 53127 Bonn, Germany Tel.: +49 (0)228 940 0 Website: www.thw.de	VBI-Bundesgeschäftsstelle Budapester Strasse 31 10787 Berlin, Germany Tel.: +49 (0)30 26062-0 Website: www.vbi.de
Bundesanstalt Technisches Hilfswerk Provinzialstrasse 93 53127 Bonn, Germany Tel.: +49 (0)228 940 0 Website: www.thw.de	VBI-Bundesgeschäftsstelle Budapester Strasse 31 10787 Berlin, Germany Tel.: +49 (0)30 26062-0 Website: www.vbi.de		
Comments	The list of members is available on www.vbi.de. Queries about suppliers should be directed to the VBI office by telephone.		

3.4.7 Health

Demand exists in the health sector, esp. concerning insect-borne diseases and in the context of the health-related effects of heat stress. It was not possible to identify an

active role of the German health industry. Bayer S.A.S. is the only key actor, producing insect-repellent finishing for anti-insect netting (table 23).

Table 23: Health

Areas of demand: Diseases transmitted by living organisms, e.g., mosquitoes; heat stress	
Products	Insect-repellent finishing for anti-insect netting
Services	–
Priority in the TNAs	Although the 3rd Synthesis Report on the TNAs states that 10% of the countries express demand in the health sector, no detailed information is provided about the nature of this demand. This was clearer in the Second Synthesis Report, published in 2009. That report states that 48.5% of the countries reported demand in the health sector. The technologies mentioned most often concerned better hygiene and better water supply, in other words, they do not refer directly to the health sector. In the more narrowly defined health sector, improved diagnostic techniques are mentioned by 21% of the countries, improved ways to fight mosquitoes and other disease-bearing insects by 19%, and improved ways to treat the effects of heat stress, e.g., cardiovascular disorders by 15%.
Information sources and provision	
Description	One manufacturer could be identified
Address	Bayer S.A.S. – Environmental Science 16 rue Jean-Marie Leclair, CS 90106 692 66 Lyon Cedex 09, France Tel. +33 (0)472 85 48 35 Website: www.vectorcontrol.bayer.com

4 International cooperation in the climate context

4.1 International cooperation with German involvement

International cooperation of German actors can make a significant contribution to transferring German climate mitigation and adaptation technologies to emerging markets and developing countries and thus to reducing global greenhouse gas emissions.

There is need for action in particular for the transfer of climate-relevant technologies to these countries. Although purely market-based trade in technologies also exists, spillover effects, the dependence of climate technologies on regulation, high transaction costs – esp. for SMEs concerning market access – and financing needs for adaptation of technologies point to the necessity of support for technology transfer. Starting points for strengthening technology transfer include (see figure 1):

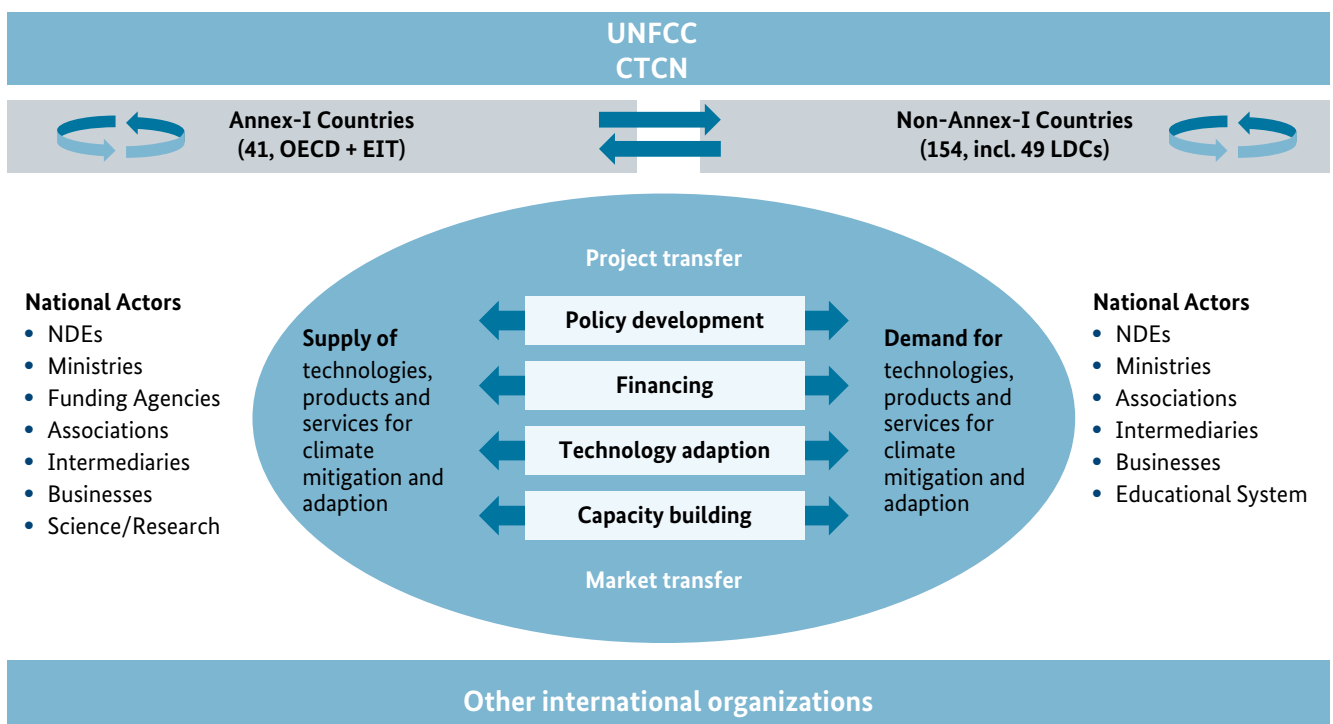
- Policy development – the development of the necessary political incentives and regulations;
- Financing – creating access to capital for financing technology transfer;

- Adaptation of technology – adapting technologies to the conditions of the target market;
- Capacity-building – creating the technical and administrative capacities required to make use of the technology.

These four starting points were taken up repeatedly during the course of the study, e.g., to structure the German landscape of actors, or also concerning the question as to which country characteristics were to be studied in the correlation analysis.

The analysis of the German landscape of actors was focused on the federal level. Additional actors are to be found in the *Länder*; they were not included in this brief summary of the report. The actors mentioned in the following were selected because of their significance for technology transfer. Actors involved in certain sectors (for example, the energy industry, agriculture, or water management) were identified, but also actors involved across sectors. The following actors' activities span various sectors; they are presented according to the focal areas of their activities (see table 24).

Figure 1: Overview of the conditions for international technology transfer



Source: authors

Table 24: German actors for technology transfer

Actors	Website
Policy development:	
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB)	www.bmub.bund.de
Federal Environment Agency (Umweltbundesamt, UBA)	www.umweltbundesamt.de
Federal Foreign Office (Auswärtiges Amt, AA), German embassies	www.auswaertiges-amt.de
Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, BMZ)	www.bmz.de
German Corporation for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ)	www.giz.de
Financing:	
Kreditanstalt für Wiederaufbau (KfW Group)	www.kfw.de
International Climate Initiative (Internationale Klimaschutzinitiative, IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety	www.international-climate-initiative.com
Technology adaptation:	
Fraunhofer-Institutes	www.fraunhofer.de
Fraunhofer Center for Central and Eastern Europe (Fraunhofer-Zentrum für Mittel- und Osteuropa, MOEZ)	www.moez.fraunhofer.de
Capacity-building:	
Federal Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie, BMWi)	www.bmwi.de
Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF)	www.bmbf.de
German Academic Exchange Service (Deutscher Akademischer Austauschdienst, DAAD)	www.daad.de
German Corporation for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ)	www.giz.de
Kreditanstalt für Wiederaufbau (KfW Group)	www.kfw.de

4.2 Special aspects of cooperation concerning climate technologies

TNAs were analyzed to ascertain the demands for climate technologies in developing countries and emerging markets. Of all the available TNA reports, the reports submitted by 30 countries in the years 2012 and 2013 were selected; they are representative of the various countries (in terms of geographical situation, per capita income, etc.). In spite of the fact that there are many distinct differences between the countries, their TNAs are similar. Most TNAs prioritize the same sectors in the field of climate adaptation and mitigation. For one thing, there are a few dominating sectors; for another, there are some sectors that are rarely prioritized in the TNAs or not at all. The dominant sectors in the area of climate adaptation are agriculture and water management, with 37% and 29% of the articulated demands, respectively. In the area of climate mitigation, 40% of all articulated demands are in the sector “low-emission energy supply.”

In order to analyze which correlations exist between the demands for climate technologies and particular country characteristics, the demands mentioned in the TNAs for certain technologies were coded, and the 30 countries were classified according to the most varied characteristics. On this basis, the extent to which groups of countries (e.g., countries with low, medium, or relatively high per capita income, or agriculture’s share of GDP) differ from each other was examined in terms of their demands for climate mitigation and adaptation.

Because of the relatively low variance between the TNAs, only a few distinct correlations between country characteristics and concrete demands were identified. The country characteristic with the most distinct correlation to the distribution of demands between various areas of demand and sectors is the country’s innovation capacity. The evaluation shows that differing capacities for innovation result in different priorities in the distribution of demands between

various sectors and areas of demand. They point to the fact that less innovative countries and more strongly innovative countries allocate climate mitigation and adaptation potentials to different areas of demand and different sectors. For example, the sector “climate-compatible agriculture and forestry” and the area of demand “energy-efficient domestic appliances and technical systems in buildings (heating systems etc.)” have high significance as climate mitigation technologies for less innovative countries. When expressing their demands, more strongly innovative countries emphasize technologies in the sectors “low-emission mobility and transportation” as well as “sustainable waste management and circular economy.” This shifting of demands points to the fact that as an economy develops, the sources of its greenhouse gas emissions shift, and therefore, the demands for certain climate mitigation technologies shift as well.

The infrastructure indicators – e.g., access to electric grids and data networks and the quality of transportation infrastructures – vary very clearly between countries. These empirical results on innovation capacity and the role of infrastructures underline the significance of the target countries’ transfer capacities. The term “transfer capacities” describes the ability of countries to take on climate technologies successfully and to use them in their own context, and this includes both the technological capabilities (measured by a country’s innovation capacities) and the existence of different infrastructures essential for using technologies. Both dimensions of transfer capacities must be taken into account in concrete technology transfer measures, as they decisively affect such a transfer’s chances of success.

A correlation analysis also shows that the countries affected most strongly by climate change as well as those affected to an average degree prioritize a larger range of technologies in various sectors and areas of demand. The countries affected least by climate change concentrate their demand for adaptation technologies more strongly in the sectors agriculture and water management.

It was also studied in the correlation analysis whether relationships between demand structures and groups of similar countries exist. Distinct differences are to be observed between the groups of countries, concerning both climate adaptation and climate mitigation. For example, it became clear that the sector “climate-compatible agriculture” was mentioned much less frequently in Central and South America (17%) than in the universe of all countries (37%). Technologies for climate-compatible water management were rarely identified in Northeast, Southern, and Central Asia (13%), but very often in sub-Saharan countries (42% vs. 29% as the average of all 30 countries).

These data can be seen as an indication that regional export strategies and measures to support technology transfer should take such regional priorities into account and should be adapted accordingly.

5 Concluding recommendations

The following points are intended to be food for thought about how climate technology goods and services on the one hand and the demands for them in emerging economies and developing countries on the other can be better coordinated and to what extent technology transfer can be improved.

Identifying regional priorities and using them as starting points for concrete measures to support technology transfer

Concrete measures to support technology transfer should take up the fact that regional priorities concerning demands for climate technologies have been observed in order to bring together supply and demand for climate technologies. Such regional priorities can be used as starting points for workshops to link up suppliers (companies, industry representatives) with demanders (actors from the relevant countries). Country classifications and additional country data can be used to identify participants on the part of the countries.

For example, workshops in Central and South America on climate mitigation technologies could be focused on the sectors “low-emission mobility and transportation” and “sustainable waste management and circular economy.” In the two regions Central and South America, there would be a universe of 20 potentially participating countries. This selection could be narrowed down on the basis of certain country characteristics (degree of urbanization, degree of motorization, fine particulate air pollution). On the supply side, potential participants from Germany could represent the fields of mobility and transportation, suppliers of vehicles and propulsion technologies, suppliers of logistics services, and suppliers in the area of public transportation; the German RETech Partnership as well as companies in that sector could represent the field of waste management and circular economy.

Improving the quality of information on demands for climate mitigation and adaptation

The information on demands for various climate mitigation and adaptation technologies was generated on the basis of the TNAs. This should be considered a first step in describing a future demand side that is developing. However, it involves some limitations that diminish the quality

of the information. A number of approaches appear suitable for improving the quality of information on the demands in the emerging markets and developing countries (non-Annex I countries). They can be divided in two groups: (1) approaches for improving the TNAs themselves and (2) approaches for complementing the TNAs with additional country data.

- The process employed to date for preparing TNAs results in the description of only the most important sectors, so they tend to be overemphasized. Because of the fact that the TNAs usually describe two sectors, this may highlight similarities of the various countries. One approach for improving the usability of the TNAs would be to describe more than two priority sectors. However, this would imply additional resources for preparing the TNAs which would have to be provided either by the countries or by the CTCN. One alternative could take up the observation that different countries within individual regions display similar demands. This means that regional TNAs could be prepared instead of national ones. In this way, resources could be pooled so that a larger range of sectors could be described than has been the case to date.
- The presentation of demands on the basis of the TNAs could be complemented by data on the individual countries that describe demands and conditions for demand more precisely. The correlation analyses conducted in the study elucidate various correlations between country characteristics and the demands for technologies in various areas of demand of a particular sector. Certain country characteristics and indicators are very important for some sectors or technologies, but unimportant for others. An open database could be prepared with a large number of datasets about the non-Annex I countries; this database can be used to describe the demand for climate technologies in certain areas of demand and sectors more precisely.

Technology transfer should take the differences in transfer capacities into account

The countries studied differ significantly in their transfer capacities, i.e., in their capability to take up and use climate technologies successfully. These capacities include both innovation capacities for handling technologies and the existence of infrastructures necessary for using these tech-

nologies. The following approaches for action are imaginable in order to improve coordination of supply and demand:

- Monitoring and analysis of transfer capacities in the countries, e.g., the existence of infrastructures, regulatory frameworks, innovation capacities, levels of education.
- Improvement of the countries' transfer capacities, e.g., by targeted measures of development cooperation, establishment of training programs, support of policy transfer.
- Adaptation of the technologies to the target markets: innovation policy and export promotion can aim to support the adaptation of technologies to the context conditions of the target countries, e.g., by developing off-grid electricity supply powered by renewables.

All three approaches for action can be pursued in parallel, and each has its own specific advantages and disadvantages. Monitoring and analysis of transfer capacities is necessary in any case and also enables private-sector actors to develop activities in the markets. The improvement of transfer capacities in the countries has a potentially broad effect, but the effects will tend to be long-term. The adaptation of (high-tech) technologies to the needs of the target country may also contradict the interest of marketing the most advanced technologies possible.

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