

Country Report Germany

IEA Bioenergy Task 42

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Country Introduction

Germany has a total federal area of 35.7 million hectares (ha). Agricultural raw materials and wood can potentially be sourced from 11.9 million ha (33 %) and arable land, 4.9 million ha (14 %) of grassland, 0,2 million ha (30 %) of forest.

Around 15 % on non-food crops and three-quarters of domestic timber are used as industrial raw materials. The rest is used for bioenergy production. In addition to domestic resources, considerable quantities of agricultural biomass, timber and semi-finished wood products are imported from other European countries and from overseas for processing in Germany.

Renewable resources for the production of materials and chemicals are utilized predominantly in chemical plants, in the pharmaceutical sector and in the wood processing industry. Biomass for bioenergy is used for heat and power generation, as well as for biofuels. Overall, the production of renewable resources for industry secures about 130,000 jobs in Germany. Jobs in the successive first stages of processing and biomass logistics have been estimated to be over 260,000 employees. 96,000 jobs are created by bioenergy. Beyond this, 98,000 people work in forestry and around 851,000 in the wood and paper industry (Schütte and Peters, 2010)

Energy production and consumption based on biomass

Data from 2009, BMU Erneuerbare Energien in Zahlen (Juni-Aug. 2010)

http://www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/broschuere_ee_zahlen.pdf

- Current energy production and consumption (mtoe):

Primary energy production:	13,281 PJ = 317 mtoe
End energy consumption:	8,470 PJ = 202 mtoe (preliminary estimation)
Production in Germany	3,913 PJ = 93.4 mtoe
Imports:	
Nuclear: (100 %)	1624 PJ (2008)
Natural gas: (82.9 %)	2546 PJ (2008)
Mineral Oil: (97.8 %)	4974 PJ (2008)
Brown coal: (-1.4 %)	- 22 PJ (2008) (net export)
Anthracite coal: (72.1 %)	1298 PJ (2008)

- Current production of renewable energy and energy from biomass:

Total renewable energy:	879 PJ =	10.4 % of end energy consumption (EEC) and 6.6 % of primary energy production (PEP)
Energy only from biomass	640 PJ =	7.6 % of EEC 4.8 % of PEP

Imported biomass for bioenergy

Overall about 30-40 % of all agricultural raw materials used in the non food sector are grown domestically. The remainder is covered by imports (Schütte and Peters, 2010)

In 2006 (estimated data) these amounted to:

- Feedstock for material use only: 1,800,000 t (of 2,700,000 t in total)
- Plant oil: 670,000 t (of 1 million t in total) = 28 PJ
- Raw wood: In 2008 Germany had a net export surplus in raw wood. According to calculations the German market (about 126.7 million m³) can be supplied solely by domestic production. The imports of tropical roundwood for sawn timber production in Germany amount to approx. 35,000 m³ of sawn timber, which is marginal.

Imported biofuels for bioenergy

- Biodiesel: 600,000 t (of 2,7 million tons in total) = 21 PJ
- Ethanol (net import 2009, W.O.Licht2010) : 770,000 t = 19 PJ

Table D1. Current bioenergy production in Germany:

Use	Year	Unit	Amount	% of total bioenergy	Feedstock(s)	Number of plants (Source FNR)
Power	2009	PJ	109	17.0	Biomass (mainly wood), landfill./sewage gas, biogas	Biomasse 162 Biogas: 4671 (2010: 5800)
Heat	2009	PJ	410	64.1	Biomass (mainly wood, biogas)	9 Mio (household) thereof 125.000 (pellets) > 1000 (communities)
CHP*	2009	PJ				
Bioethanol	2009	PJ	25	3.9	Grain, sugar beet	12
Biodiesel	2009	PJ	92	14.4	Rapeseed, soy, palm, fats	42
Biogas	2009	PJ	-	-	Energy plants, residues, manure	Fuelgas:48
Other (plant oil)	2009	PJ	4	0.6	Rapeseed, sunflower, soy, palm	48*
Sum	2009	PJ	640	100		

* incl. Food

Biogas is not yet used for fuel. The amount used for power and heat production is included in line 1 and 2. This will change in the near future. The infrastructure is changing. Biogas starts to be upgraded to methane in special plants (2009: 48) and will be sent to the grid, not only for transportation but also for the decentralised production of electricity, heat and even chemicals.

Table D2. Breakdown of biomass energy use on feedstock:

Source	Year	Unit (Mm ³ or PJ)	Amount	% of biomass energy reported above
Round wood	2008	Mm ³		
Forest wood chips	2008	Mm ³ (PJ)	2.8 (28)	4.4
Wood industry residues	2008	Mm ³ (PJ)	5 (50)	7.8
Wood pellets/briquettes	2008	Mm ³ (PJ)	25.2 (255)	40
Black liquor and sludge	2008	Mm ³ (PJ)	19.8 (201)	31
Wastes (organic fraction)				
Straw/agricultural residues				
Sugar beet/sugar cane				
Cereals (grain, corn)				
Other				

* 1 Mm³ = 2.8 MWh = 0.086 Mtoe

Lit: Mantey, U. 2009 MANTAU U. (2008): Holzrohstoffbilanz Deutschland: Szenarien des Holzaufkommens und der Holzverwendung bis 2012. Hamburg

In Germany, the growth of renewable energies is remarkable. Production of electricity increased from 2,479 GWh (0.21 Mtoe) in 1997 to 22,785 GWh (2.0 Mtoe) in 2007, which is nearly tenfold.

Heat production in 2009 was 114 TWh (9.8 Mtoe)) compared to 48,546 (4.2 Mtoe) in 1997. The biofuels share of 5.9 % from 2008 decreased slightly to 5.5 % in 2009. But the biofuels quota forced by the renewable energy sources act probably will stop this trend in 2010.

Biomass used for non-energy purpose

Table D3. Use of biomass for non-energy purpose:

Use*	Year	Unit	Amount
Wood for particle boards	2007	Ktons (10^6 m^3)	17,000 (17,4)
Wood for pulp and paper	2007	Ktons (10^6 m^3)	5,300 (9,8)
Saw wood		10^6 m^3	37,2
Wastes from pulp and paper			?
Chemicals from biomass	2008	ktons	725
Cereal production			included in starch
Sugar production	2008	ktons	136
Starch production	2008	ktons	886
Oilseed production	2008	ktons	1,450
Algae production	2008		of no importance
Other (proteins, waxes, rubber, cork)	2008	ktons	653

Use of renewable raw materials for non energetic purposes

Approximately 3.7 million tonnes are used annually a raw material in industry. The German chemicals industry processes around 17 million tonnes of fossil and 2.4 million tonnes of renewable raw materials annually. The share increased from 8 % in 1991 to 12 % in 2007. About 1.3 million tonnes are consumed by the paper industry, natural fibre and natural rubber processing industry and other sectors. Raw materials from forestry amounted to 36.9 million tonnes in 2007. In industrial chemistry, 213,000 tonnes of starch and sugar are currently processed. Additional 700,000 tonnes of starch is used in the manufacture of paper and corrugated cardboard.

Examples of large scale sugar fermentation in Germany are production of vitamin C (primary stages), organic acids (e.g. citric), amino acids, bioethanol, and isomaltulose (precursor of Isomalt®).

Fats and oils are going mainly into the production of polymers, polymer additives and solvents. Approximately 80,000 tonnes of soy oil and 40,000 tonnes of special rapeseed oil are used as plasticisers in petrochemical based plastics such as PVC.

Policy issues related to biomass, bioenergy or biorefineries

- Policy targets for energy – renewable energy, bioenergy, biofuels

Where, how and how much biomass contributes to energy and material supplies depends to a great extent on the legal context. A regulating legal framework exists especially for bioenergy, although not generally for biobased materials and chemicals.

Regulations for bioenergy (most important regulations)

- Anti pollution measures.
Federal Immission Control Act (BImSchG) and directives including Technical Instructions for Air Quality Control (TA Luft).
- Renewable Energy Sources Act (EEG).
Most important legal instrument to promote Electricity production from renewable Resources including Biomass
- Biomass Ordinance (feedstocks, technologies, environmental requirements).
Became effective in 2000 with major amendments in 2004 and 2008
- Market Incentive Programme for Renewable Energy (MAP)
Since 2000, financial supporting purchase of biomass plants by government (via Credit Institute for Reconstruction (KfW))
- Agricultural investment Support Programme (AFT)
Improving the structure of agriculture and Coastal Protection (GAK), supporting biogas and biomass plant construction, Framework plan
- Energy Saving Regulation (EnEV)
since 2002, Taking into account the primary energy efficiency of different energy sources, the process effectiveness as well as environmental impact of technologies
- Renewable Energy Heating Act (EEWärmeG)
makes the use of heat from renewable resources mandatory. Until 2020 about 14 % of heat production have to be from renewable energies
- Biofuel legislation (Biofuel Quota Act, updated in 2010)
Tax regulations since 2006 and biofuels quota act since 2007: (see tables D4 and D5)

Table D4: Tax regulations since 2006

Year	Biodiesel [Cent/L]	Plant oil [Cent/L]
August 2006	9,00	0,00
2007	9,00	2,15
2008	14,88	9,85
2009	14,25	18,15
2010	18,60	18,46
2011	18,60	18,46
2012	18,60	18,46
since 2013	45,03	45,03

Table D5: Biofuels quota act since 2007

Year	Diesel-quota	Benzine-quota	Total
2007	4,4%	1,2%	-
2008	4,4%	2,0%	-
2009	4,4%	2,8%	5,25%
2010 - 2014	4,4%	2,8%	6,25%
2015 - 2016	Decarbonisation 3,0%		
2017 - 2019	Decarbonisation 4,5%		
2020	Decarbonisation 7,0%		

- Biomass Sustainability Ordinance (BioNachV)
to provide a legal framework for the assessment and certification of biomass.

Regulation for biobased materials (most important regulations)

- Recycling and Waste Management Act
Manufacturers have to design their products to reduce waste and to be environmentally compatible (e.g. no undesired byproducts, degradability of polymers, natural cycles)
- Bioplastics: EN 13432 – standardised compostability
standardized methods to determine the biodegradability. Bioplastics and Bioproducts have to fulfill international standards, Responsible in Germany: DIN CERTCO
- Packaging Ordinance (VVO)
Since May 2005: regulates the use and handling of packaging material, the recycling proportion have to be as high as possible
- Biological Waste Ordinance (BioAbfV)
Since 1998: recognizes biodegradable polymers as biological waste to used as compost
- Fertiliser Ordinance
Biodegradable materials containing fossil raw material most not end up on arable land as compost. Compost requires compliance with the ordinance
- Waste Oil Ordinance (AltöIV)
since 2002, regulates the disposal of waste oil including biodegradable lubricants
- Waste Wood Ordinance (AltholzV)
since 2002, regulates the material and energy recovery of waste wood, to ensure the environmental compatibility
- Planning and building laws and fire protection regulations (e.g. multi-storey buildings built from wood)
regulates the planning, construction and fire protection of multi-storey buildings made of wood
- Energy Saving Regulation (EnEV)
since 2002, regulation of certain energy saving features. E.g since 1997 some buildings provide not only their own energy but also feed excess to the public grid

Projects

In the Area of renewable resources, the FNR is supporting R&D projects. The main instruments for managing and supporting projects are

1. Research programme "Renewable Resources"

Under the "Renewable Resources" programme, projects can be supported which either

- Build up production chains of renewable resources (from production to end uses),
- Open up further possible applications in the non-food sector,
- Provide information and counsel, especially for producers, processors and users of renewable resources or
- Engage in marketing and public relations work.

Projects can only be funded if they align with the three aims of the programme, i.e. if they

- Contribute to a sustainable allocation of raw materials and energy.
- Help the environment by saving resources, producing environmentally friendly goods and decreasing CO₂ emissions.
- Improve the competitiveness of the German agricultural and forestry sector as well as upstream and downstream business areas.

The fields which can be supported include starch, sugar, biogenous oils and fats, fibres, lignocellulose/wood, wood as a construction/industrial material, proteins, plant extractives (for the pharmaceutical, cosmetic or food industry etc) and energy uses of solid, liquid and gaseous fuels, as well as public relations work improving public acceptance of renewable resources and increasing the demand for products made from them.

Budget 2010: 51,5 Mio. EUR

Scheduled: 31.12.2015

Responsible: BMELV / FNR

Examples

Lignocellulose biorefinery based on hard wood

- Component separation (into cellulose, hemicelluloses, lignin) by an organosolv process; hydrolysis of carbohydrates to get fermentable sugars for various chemicals; materials and chemical use of lignin
- Phase 1: lab-scale research (2007-2009); Phase 2: pilot plant (2010-2013) at Chemical Site Leuna (Saxony-Anhalt) under construction, funded by BMBF, BMELV, BMU, a.o.: 50 Mio. Euro
Consortium from academia and industry

Lignocellulose biorefinery based on straw (sunliquid®)

- Component separation (into cellulose/ hemicelluloses, lignin) by an modified steam explosion process; hydrolysis of carbohydrates to get fermentable sugars for bioethanol; lignin use for energy
- Operating pilot plant and planned demo plant in Munich (Bavaria)
- Additional RTD project “Biofuels 2021”

Süd-Chemie AG

Lignocellulose/Starch biorefinery based on cereals

- Existing Sugar Mill Zeitz (Saxony-Anhalt) and CropEnergies Bioethanol Plant Zeitz (Saxony-Anhalt)
- Conversion of the existing bioethanol production plant into a fully integrated biorefinery based on lignocellulose (RTD project “Biorefinery2021”)

Consortium from academia and industry

Syngas biorefinery based on wood (Carbo-V®)

- Three-stage gasification with downstream Fischer-Tropsch-Synthesis (modified Shell-FT-Process)
- Demonstration plant with 50 MWth in Freiberg (Saxony) having a capacity of about 15.000 t/a

Choren Industries GmbH

Syngas biorefinery based on straw (bioliq®)

- Decentralised fast pyrolysis to get pyrolysis oil, coke and gas
- Centralised gasification of a slurry (pyrolysis oil & coke) using a highpressure entrained flow gasifier with subsequent gas conditioning
- Downstream synthesis of biomass-to-liquid fuels
- Pilot plant (500 kg/h) in Karlsruhe (Baden-Wuerttemberg)

FZ Karlsruhe

Small projects covering detailed aspects

Prof. Dr. Burkhard König, University Regensburg: Catalytic conversion of renewables resources in the micro reactor (KonaRoM): New ways to produce fine chemicals from carbohydrates

PYTEC Thermochemische Anlagen GmbH, Hamburg: Oil source wood – The technology of flash pyrolyses

Subitec GmbH, Stuttgart: Integrated process for the production of omega-3-fatty acids EOA with micro algae

Prof. Ramke, Hochschule Ostwestfalen/Lippe: Enery from municipal waste.

HydroCarb GmbH & Co. KG, Kirtorf-Arnshain: Plant coal economically produced – hydrothermal carbonisation

Prof. Dr. Klaus Vorlop, vTI-Institute of Agricultural Technology, Braunschweig: Chemical catalytic conversion and biotechnological conversion of renewable resources including feedstock provision, product upgrading and LCA, several projects (EU, BMBF, BMELV)

Biorefinery related funding programs

Fachagentur Nachhaltende Rohstoffe (FNR, Agency of Renewable Resources)

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2. Directive on bioenergy demonstration projects

Description: While energy production from biomass is increasingly viewed as important due to decreasing stocks of fossil fuels and concerns about climate change, the market situation of these renewable fuels leaves a lot to be desired. To improve this situation, a directive issued by the Federal Ministry of Food, Agriculture and Consumer Protection in December 2005 makes it possible for FNR to support bioenergy demonstration projects.

The scheme concentrates on plants and technologies whose practicability has already been proven at pilot stage. Furthermore, they must be state of the art and likely to continue running on a commercial scale after the demonstration project. Support is given either as an investment grant or an allowance for operating costs, never as a combination of both.

Expiring date: 31.12.2010

Furhter organizations which promote projects in the area of Renewable Resources:

- International Energy Agency (IEA)

- German Research Foundation (DFG)
- Deutsche Bundesstiftung Umwelt (DBU)
- Deutsche Gesellschaft für Holzforschung (DGfH)

Running commercial biorefineries

Table D6. Examples of the most representative existing biorefineries – preferable not conventional biofuel production facilities or traditional use of biomass (e.g. pulp and paper):

Company	Feedstock	Products	Description	Size
Südzucker	Sugarbeet, grain	Palatinit, Ethanol	www.palatinit.de	80.000 t/a
Emsland Stärke				
Zellstoff Stendal				
Choren			See demo plants	
Biopetrol	Plant oil (rapeseed)	Biodiesel, Glycerin	Schwarzheide, Rostock	Each 150.000 and 200.000 t/a biodiesel
Linde-KCA, Dresden	Wheat, cap. 120 000 t/a	Modified starch 60000 t/a, gluten 10000 t/a, feed 30000 t	Starch-based 1. Generation biorefinery, Zeitz (Germany) Investment: > 50 Mio EUR	Capacity 120.000 t/a
Biowert Industrie GmbH, Brensbach	grass	30 % Insulation material, 70% composites, fertilizer, biogas	Since 2007 Composites made from recycling polymer material reinforced by gras fiber www.biowert.de	Capacity 5000 t/a

Demo and pilot plants

Table D7. Examples of the most representative demo and pilot plants:

Company	Feedstock	Products	Description	Status (demo/pilot)
Aufwind Schmack Betriebs-GmbH & Co; RES projects GmbH, München	Biomass	Biogas (920 Nm ³ /h)	Conditioning and injection of biogas into the gas distribution system	Demo plant
Biogas-Brennstoffzellen GmbH, Leonberg	Biowaste	Biogas, electricity (250 kWel)	Fermentation, conditioning and use of biogas in fuel cell “hot module”	Demo plant
Bioprodukte Prof. Steinberg GmbH, Klötze	Micoalgae	Fatty acids, lipids, carotenoids (130 t/a)	Photobioreaktor to produce microalgal species	Demo plant
Brandenburg	Alfalfa and wild mix grass (30kt/yr)	high valuable proteins, Amino acids, lactic acid, fodder	Green biorefinery: production of green juice for high valuable proteins and lactic acid	Demo plant
CHOREN Industries GmbH, Freiberg	Wood	FT/BtL-biofuels (15.000 t/a)	Carbo-V process, feedstock pre-treatment, gasification, FT-synthesis, BtL (sundiesel)	Demo plant
Emsland-Stärke GmbH, Wietzenorf	Whole crop biorefinery (potato starch & biogas)	potato starch & biogas	Integrated unit for bioproducts and bioenergy	Demo plant
Kreiskrankenhaus Wolgast, Wolgast	Rapeseed oil	240 kW electricity, 310 KW heat, 258 kW for cooling	gas motor with alternative fuel generator plant, co-generation heat/power and cooling energy	Demo plant
Landwirtschaftszentrum Eichhof, Landesbetrieb Landwirtschaft Hessen, Bad Hersfeld	Biomass	Biogas, electric power (35 kWel)	Use of biogas in a microgasturbine	Demo plant
Postdam	Lignocellulose	Bioethanol	Bioethanol from lignocellulosic feedstock	Demo plant
PYTEC GmbH Thermochemische	Biomass	Biofuels (6 t/day)	Ablative flash pyrolysis	Demo plant

Anlagen, Lüneburg				
Schornbuscher Biogas GmbH & Co KG, Euskirchen	Energy Plants	Biogas, electricity (500 kWel)	Slurry free fermentation of energy plants	Demo plant
Stadtwerke Düsseldorf AG, Holzvergaseranlage Arnsberg-Wildshausen	Biomass	270 kW electricity, 410 KW heat	Gasification, gas motor generator plant, biomass feedstock pre-treatment	Demo plant
Vattenfall Europe AG, Biomasse-HKW Sellessen	Wood	2,5 MW electricity, 3,5 MW heat biomass-fuels, woody-feedstocks	Steam generator plant, biomass firing, feedstock pre-treatment	Demo plant
Agrargenossenschaft Bergland Clausnitz e.G.	Biomass	Biogas (5.000 t/a, 175 kWel)	Solid state fermentation, slurry free, tub reactor, bioleaching	Pilot plant
CUTEK-Institut GmbH, Clausthal-Zellerfeld	Biomass	Biofuels (1 l/h)	Artfuel process, gasification, FT-Synthesis, BtL	Pilot plant
Forschungszentrum Karlsruhe, Karlsruhe	Biomass	Biofuels (500 kg/day)	Bioliq-process Dentralized (flash-) pyrolysis of biomass, centralized gasification, Methanolsynthesis, BtL fuel synthesis	Pilot plant
Fraunhofer Pilot Plant Center (PAZ) for polymer synthesis and polymer processing at Schkopau ValuePark	Various feedstocks	Biopolymers, Biomaterials	Polymer synthesis & processing	Pilot plant
Fraunhofer Institute for Chemical Technology, Pfinztal	Various feedstocks	Biopolymers, Biomaterials	Chemical biomass conversion. Several units and arrays for polymer engineering & processing, Microwave arrays, units for membrane technology, units for processing in supercritical fluids	Pilot plant
Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT, Oberhausen, Branch Teterow	Renewable Resources	Adsorbents made from renewable resources	Rotary kiln pilot plant for the development and sample production of specific high-performance adsorbents made from renewable resources.	Pilot plant
Fraunhofer Institute	Renewable Resources	Biopolymers	Biodegradable plastics, polymers from renewable resources,	Pilot plant

for Environmental, Safety and Energy Technology UMSICHT, Oberhausen, Branch Willich			nanocomposites, pilot and small-scale series production	
Fraunhofer-Institute for Environmental, Safety and Energy Technology (UMSICHT), Oberhausen	Wood chips	500 kW: 150 kW electricity, 250 KW heat	Gasification, circulating fluidised bed gasifier for wood chips, gas motor generator plant, biomass feedstock pre-treatment	Pilot plant
Leibniz-Institut für Agrartechnik Potsdam-Bornim (ATB), Bornim	Rye (starch)	Lactic acid (10 t/a)	Green biorefinery for a continuous production of lactic acid Feedstock pre-treatment, fermenter, nanofiltration, elektrodialyse, product separation & refining	Pilot plant
Leibniz-Institut für Agrartechnik Potsdam-Bornim (ATB), Bornim	Rye (starch)	Lactic acid (10 t/a)	Green biorefinery for a continuous production of lactic acid Feedstock pre-treatment, fermenter, nanofiltration, elektrodialyse, product separation & refining	Pilot plant
Leibniz-Institut für Agrartechnik Potsdam-Bornim (ATB), Bornim	Hemp fibre	Fibre-pulping process (300 kg/h)	Feedstock pre-treatment,	Pilot plant
Sauerkraut- und Gemüse- verarbeitungs- GmbH, Ritschenhausen	Algae	Fatty acids, lipids, carotenoids (6 t/a)	Photobioreaktor to produce microalgal species	Pilot plant
Subitec GmbH, Stuttgart	Microalgae from polluted water and CO ₂	Fatty acids, lipids, carotenoids, (1,5 t/a) Feed, food, pharmacy and cosmetics	Marine biorefinery: high value products from microalgae	Pilot plant
Technische Universität Hamburg-Harburg, Hamburg	Flax fibre	Fibre-pulpe	Feedstock pre-treatment, fibre-pulping process	Pilot plant
Uhde Inventa-Fischer GmbH,	Lactic acid	Biopolymers, PLA, (50 kg/d)	Miniplant, polymerisation of lactic acid to PLA, downstream operations	Pilot plant

Berlin				
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Major RTD activities

Table D8. Major RTD activities:

Name of project	Type of project	National coordinator	Description	Duration	Size (€s, US\$)
Lignocellulose-Biorefinery	National	DECHEMA	1. Phase: Preparation of cellulose, glucose, hemicellulose, xylose and lignin as well as testing of carbohydrates for fermentation processes 2. Phase: construction and integration of pilot plant at Leuna; product upgrading,	2007-2009 2010-2013	2. phase total € 9,5 Mio. funded € 8,5 Mio. (BMELV)
BMBF 2021			www.fz-juelich.de/ptj/bioenergie2021		
International: IG-Biotech	International	Fraunhofer IME	Biotechnological conversion of raw glycerol to high value products for polymer chemistry	2007-2010	
Lignocellulose biorefinery based on straw (sunliquid®)	national	<i>Süd-Chemie AG</i>	Component separation (into cellulose/hemicelluloses, lignin) by an modified steam explosion process; hydrolysis of carbohydrates to get fermentable sugars for bioethanol; lignin use for energy Operating pilot plant and planned demo plant in Munich (Bavaria) Additional RTD project “Biofuels 2021”		
Lignocellulose/Starch biorefinery based on cereals	national	<i>Consortium from academia and industry</i>	Existing Sugar Mill Zeitz (Saxony-Anhalt) and CropEnergies Bioethanol Plant Zeitz (Saxony-Anhalt) Conversion of the existing bioethanol production plant into a fully integrated biorefinery based on lignocellulose (RTD project “Biorefinery2021”)		
Syngas biorefinery based on straw (bioliq®)		<i>FZ Karlsruhe</i>	Decentralised fast pyrolysis to get pyrolysis oil, coke and gas Centralised gasification of a slurry (pyrolysis oil & coke) using a highpressure entrained flow gasifier with subsequent gas conditioning Downstream synthesis of biomass-to-liquid fuels		

			Pilot plant (500 kg/h) in Karlsruhe (Baden-Wuerttemberg) see above		
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Stakeholders

Table D9. Major stakeholders in Germany:

Name	Short Description
Industry	
Mineral Oil Industry (Shell, BP)	Promotion of biofuels from plant oil, sugar, algae www.shell.de www.deutschebp.de
Automotive Industry (VW, Ford, Daimler)	New Biofuels (BTL) Materials based on renewable Resources
Chemical Industries (Südzucker, Evonik, BASF, Henkel, Cognis, Bayer, Südchemie, Wacker, Dow a. o.)	Projects with universities and research Institutes
Engineering Industry (Uhde, Linde, BMA)	Conception, Construction and operation of pilot- and demoplants, economical evaluation
Primary sector (see others below)	Biomass provider (wood, energy crops, oil plants, grain, starch, sugar, grass, algae)
Research Institutes	
Johann Heinrich von Thünen Institute (vTI) – Institute of Agricultural Technology and Biosystems engineering	Whole chain from feedstock to chemicals/materials including feedstock production and provision, logistics, product separation and upgrading, LCA www.vti.bund.de
Leibniz institute (LIFIS)	Innovative Energy and material conversion and utilization, Environmental protection, Intelligent Logistics www.leibniz-institut.de
Fraunhofer Insitutes (IME, ICT, UMSICHT, WKI)	Basic and applied research on conversion and downstream processeses involved in biorefineries, Materials from biomass based chemicals www.fraunhofer.de/institute-einrichtungen
Deutsches Biomasse Forschungs Zentrum GmbH, Leipzig (DBFZ)	Energetic utilization of Biomass www.dbfz.de
Das Helmholtz-Zentrum für Umweltforschung (UFZ)	investigates the complex interactions between nature and human beings under the influence of global change. The aim of UFZ research is to work out solutions for the management of complex environmental systems and for the handling of environmental problems. www.ufz.de
Universities	
Governmental Organisations	
BMELV	Federal Ministry of Food, Agriculture and Consumer Protection, climate protection, renewable resources and feeding the global population. One of the main goals is to protect the natural environment through sustainable agricultural production. At the same time, perspectives are to be created for rural areas (see also FNR) www.bmelv.de
DBU	Promoting projects in the area of environmental technologies, environmental protection and communication www.dbu.de
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Fundamental

	environmental policy issues, Climate protection, environment and energy Protection, maintenance and sustainable utilisation of biodiversity www.bmu.de
BMBF	Federal Ministry of Education and Research, funding projects related to biorefineries, also international cooperations www.bmbf.de
FNR	Founded in 1993 by BMELV, supporting research and development in the area of renewable resources, information of the public about current research www.fnr.de
PTJ	Founded 1974 by BMF, partner for researchers, industry representatives and policy-makers in the area of project management. www.fz-juelich.de/ptj/
CARMEN	Bavarian coordinating office for renewable raw materials and was set up as a service institution for partners from both the industrial and the political sector www.carmen-ev.de
Energy Agency NRW	Strategic platform of North Rhine-Westphalia with wide-ranging competence in the energy domain: from the all-through funding of research, technical development, demonstration and market launch to energy consultancy www.ea-nrw.de
Non-governmental Organisations (NGOs)	
Dechema	Society for Chemical Engineering and Biotechnology, a non-profit making scientific and technical society, promoting and support research and development in Chemical Technology and Biotechnology. www.dechema.de
UFOP	Gathering all companies, associations and institutions participating in the production, processing and marketing of indigenous oil and protein-bearing plants www.ufop.de
LAB	Consulting firm in Brandenburg for agriculture, horticulture and fishery, daughter of agricultural associations
DBV (Deutscher. Bauernverband)	German Farmers association, the representative of German farmers, 18 federal with about 500 district associations www.bauernverband.de
Dt. Forstverein,	www.forstverein.de
AGDW (AG Deutscher Waldbesitzer)	Working committee of German Forest owners www.waldbesitzerverbaende.de
DHWR (Deutscher Holzwirtschaftsrat e.V.)	Umbrella association of German timber industry www.dhwr.de
DFWR (Deutscher Forstwirtschaftsrat)	Council of German forestry industry www.dfwr.de
Others	
Several Regional Biorefinery Networks	
Biovision 2030 group	BioVision 2030 Group (Dow, FHG-ICT, biorefinery.de, biopos u.a.)

Other issues/updates

References Cited:

Schütte, A., and D. Peters, 2010, Biobased products and bioenergy in Germany, in H Langeveld, J Sanders, and M Meeusen eds., *The Biobased Economy*: London, Earthscan, p. 302-322.