TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

2nd German-Polish Symposium

Arbeitskreis Kohlenstoff der Deutschen Keramischen Gesellschaft e. V.
Polish Carbon Society



Prof. Dr.-Ing. Bernd Meyer
Rector

16 October 2013

An Overview of the Resource University
Facts and Figures

6 Faculties

10 Central facilities

40 Institutes

57 Courses of study

1.402 First semester students

5.727 Students

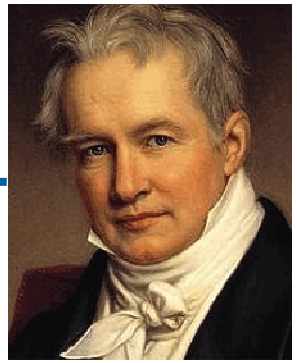
53,6 Mill. Euros in external funds in 2012

86 Professors

1.920 University employees

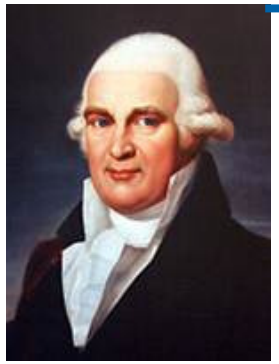
History
Milestones and Personalities

1711-1765
Michail Wassiljewitsch Lomonossow
Russian polymath, 1739 – 1740 student in the laboratories of mining councilor Johann Friedrich Henkel



1769-1859
Alexander von Humboldt
Natural scientist and humanist, studied geology with Abraham Gottlob Werner

1765 → 1739 → 1769 → 1791 → 1873



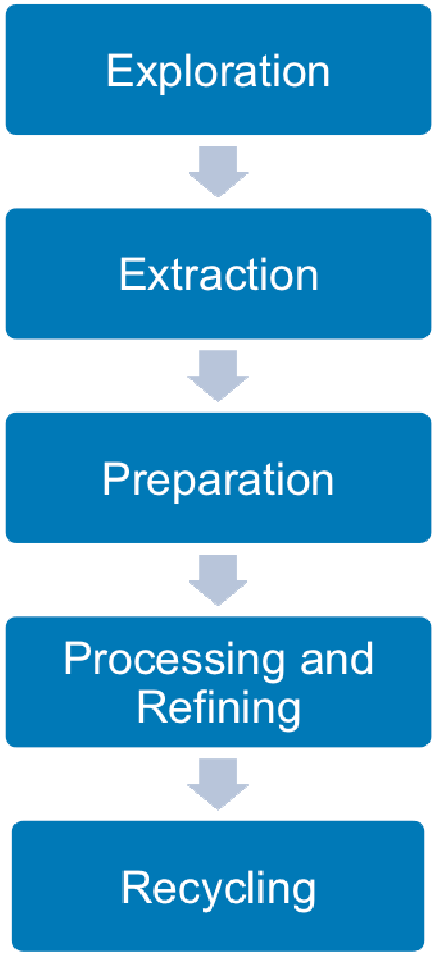
1749-1817
Abraham Gottlob Werner
Most important teacher at the Bergakademie; considered as the originator of the science of the structure and composition of the earth‘s crust

1838-1904
Clemens Winkler
From 1873 on professor of chemistry at the Bergakademie, 1886 discovery of germanium

An Overview of the Resource University
Raw materials supply chain

University in the service of sustainable materials and energy along the raw materials supply chain

- from the exploration of new and domestic deposits
- to the development of alternative energy technology, recycling
- to the research of new materials
- with the national mission of securing raw materials – with a worldwide network



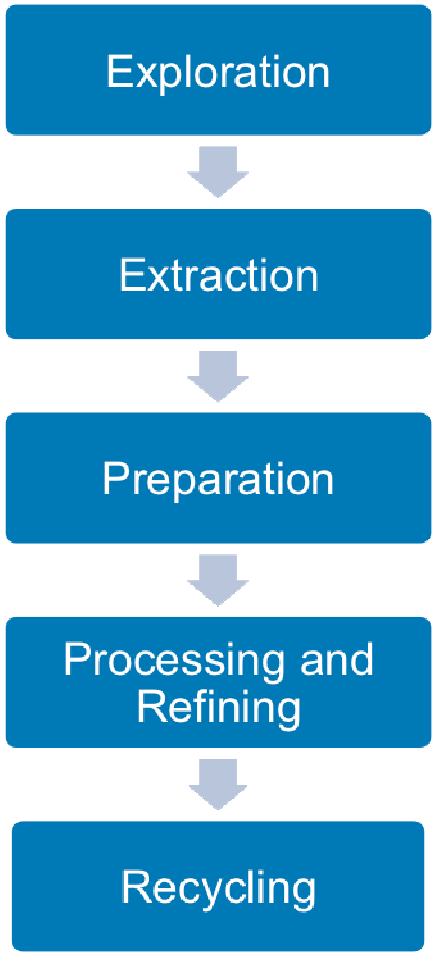
Research for the Future
Profile segments GEOMATENUM

GEOSCIENCES
Exploration and extraction of raw materials

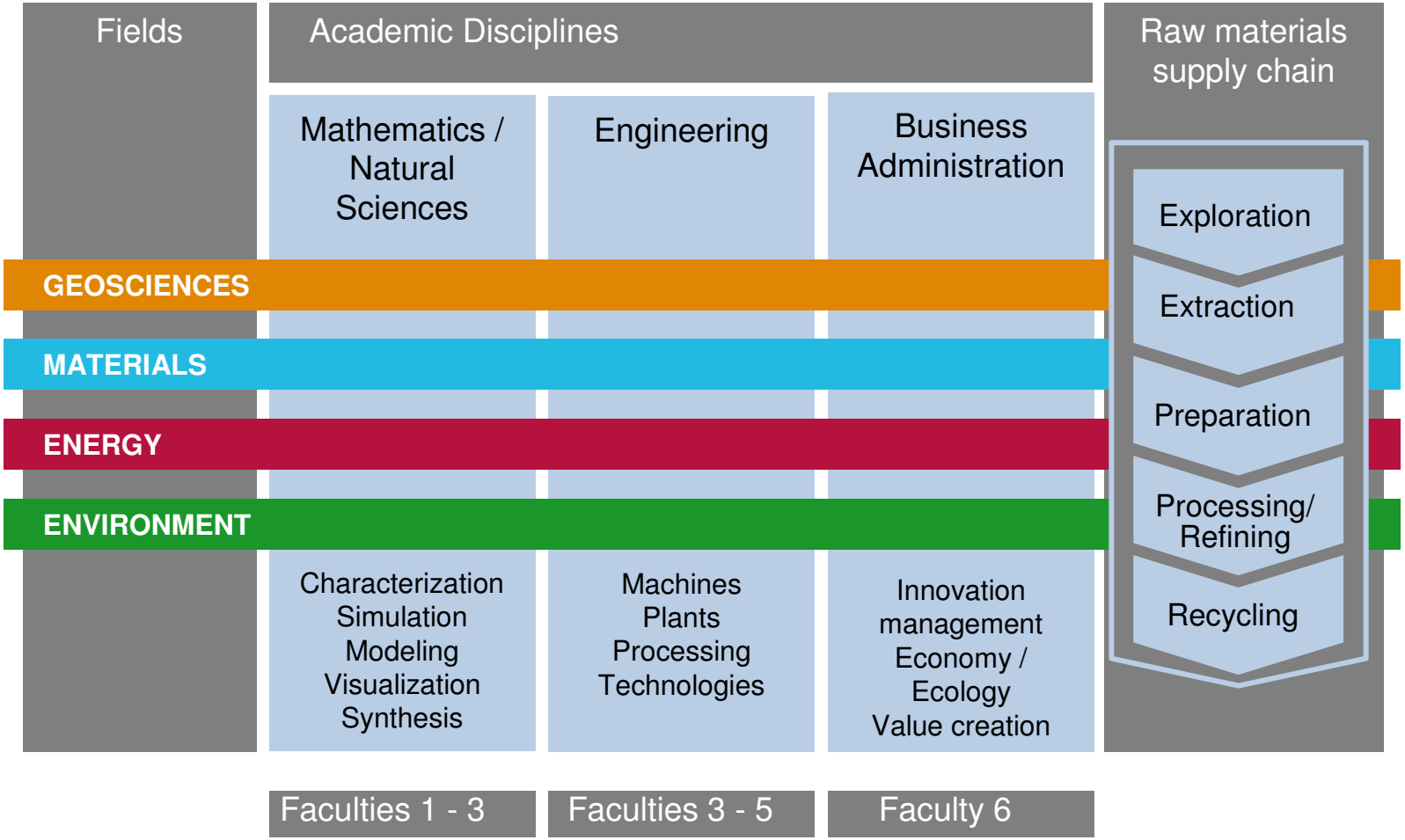
MATERIALS
Materials for the solid-state industry, development of new materials

ENERGY
Energy sources and technology

ENVIRONMENT
Sustainability, resources



TU Bergakademie Freiberg
Academic Profile



Faculty 1: Mathematics and Informatics, Faculty 2: Chemistry and Physics, Faculty 3: Geosciences, Geotechnology, and Mining, Faculty 4: Mechanical Engineering, Processing and Energy Technology, Faculty 5: Materials and Material Technology, Faculty 6: Business Administration

Teaching profile

Study programmes along the raw materials supply chain

Raw materials supply chain

Exploration	Extraction	Processing	Refining/ Finishing	Recycling
• Geoscience • Mine Surveying and Applied Geodesy • Geoinformatics and Geophysics • Groundwater Management	• Geo-Engineering and Mining* • Geosience • Mechanical Engineering (Excavation and special heavy construction machinery*)	• Mechanical Engineering (Processing machines*, Environmental Technology) • Process Engineering (Chemical Engineering, Energy Engineering*, Environmental and materials engineering)	• Materials Science and Technology • Foundry Technology* • Ceramics, Glass and Construction Technology* • Vehicle Construction: Materials and Components	• Materials Science and Technology • Electronic and Sensor Materials* • Thermotechnical Plants*

economic value creation

- **Resource economy/ Resource ecology:** Economic Engineering, International Management of Resources and Environment, Energy- and Resources Mangement, Geoecology, Environmental Engineering, Sustainable Mining and Remediation Management
- **Mathematics and Informatics:** Business Mathematics, Applied Mathematics, Network Computing, Geoinformatics and Geophysics, Engineering & Computing, Applied Informatics
- **Natural sciences:** Chemistry, Applied Natural Sciences
- **Wirtschaftswissenschaften:** Business and Law, Technology Management, Industrial Archeology / Industrial Culture, Technology Law, International Business in Developing and Emerging Markets, Business Administration

* Unique study programmes in the field of resource technologies

TU Bergakademie Freiberg
Six Faculties

Fac. 1 **Faculty of Mathematics und Informatics**
5 Institutes, 16 Professors

Fac. 2 **Faculty of Chemistry and Physics**
9 Institutes, 13 Professors

Fac. 3 **Faculty of Geosciences, Geotechnology and Mining**
7 Institutes, 26 Professors

Fac. 4 **Faculty of Mechanical Engineering and Processing and Energy Technology** 11 Institutes, 20 Professors

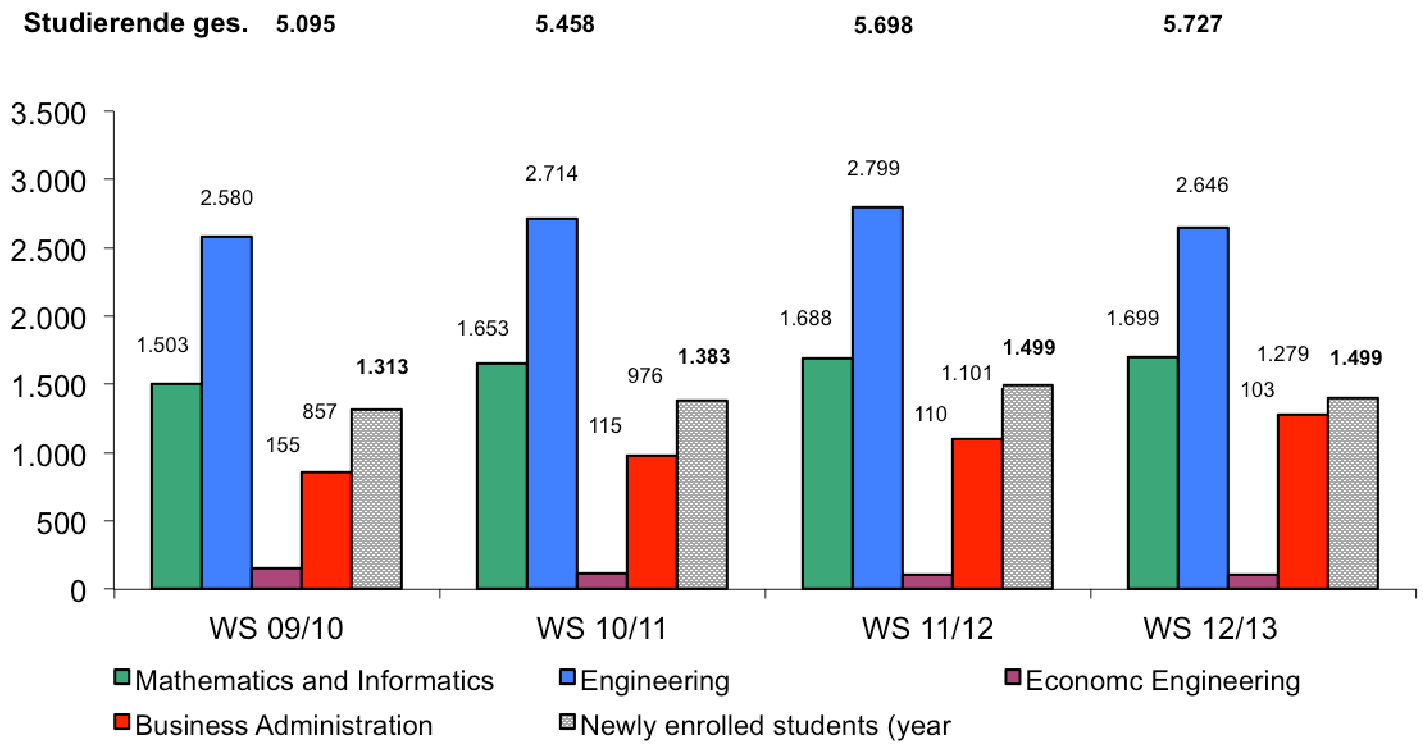
Fac. 5 **Faculty of Materials and Material Technology**
7 Institutes, 9 Professors

Fac. 6 **Faculty of Business Administration**
1 Institute, 15 Professors

Students

Increasing number of students between WS 95/96 (2.013 students) until WS 12/13 (7.129 students)

Students according to disciplines / newly enrolled students / international students



International students	China	Commonwealth of Independent States	Vietnam
	99	81	29

Research profile
Selected projects

DFG

MAT	EN	UM	SFB 799 “TRIP-Matrix Composite”
MAT	EN	UM	SFB 920 “Multifunctional Filter for the Metal Melt Filtration“
MAT	EN	UM	SPP 1418 “Refractories - Innovation for Reduction of Emissions” (FIRE)
MAT	EN	UM	SPP 1204 “Algorithms for Fast, Adaptive Process Chain Design and Analysis in Metal Forming“

BMBF

	MAT	EN	UM	Virtual High Temperature Conversion Processes (Virtuhcon)
GEO	MAT	EN	UM	German Energy Raw Materials Centre (DER)

State Excellence Initiative

GEO	MAT	EN	UM	Functional structure design of new high performance materials via atomic design and defect engineering (ADDE)

Industry/Foundations/Other sources

GEO		EN	UM	Syngas-to-Fuel (STF)
GEO	MAT		UM	Freiberg High Pressure Research Centre
GEO			UM	Mine Water Research Centre

Research profile
Selected Research Centres

University

GEO		EN		DBI Bergakademie – Energie bündeln im Deutschen Brennstoff Institut/ German Combustible Material Institute
GEO		EN	UM	Geothermal Research Center (GRC)
GEO	MAT		UM	Lithium Initiative
	MAT		UM	European Center for High-strength and Ductile Magnesium Alloys
GEO	MAT	EN	UM	Process Control, Optimization and Uncertainty Quantification Competence Center
GEO			UM	Interdisciplinary Ecological Centre (IÖZ)
GEO			UM	Mine Water Research Center
GEO			UM	GEOARC – Asia Geosciences Research Center

External

GEO			UM	Geocompetence Center Freiberg e.V.
GEO	MAT	EN	UM	International University of Resources

Large Scale Plant Technology

A characteristic of resources research

- Exploration
- Extraction
- Preparation
- Processing/ Refining
- Recycling

ISASMELT-Pilot plant

Shock wave laboratory

Melting furnace for NF metals

Hot rolling mill

Reprocessing unit

Casting rolling line

Vacuum orecision casting furnace

Drilling technology

Research and Teaching mine „Reiche Zeche“

STF-Petrol plant

HP-POX-plant

Konti rolling line (wire)

Strategic Cooperations
excluding Universities

Industry, e. g.

- Siemens AG select university partner
- Thyssen Krupp select university partner
- RWE select university partner

Large scale research, e. g.

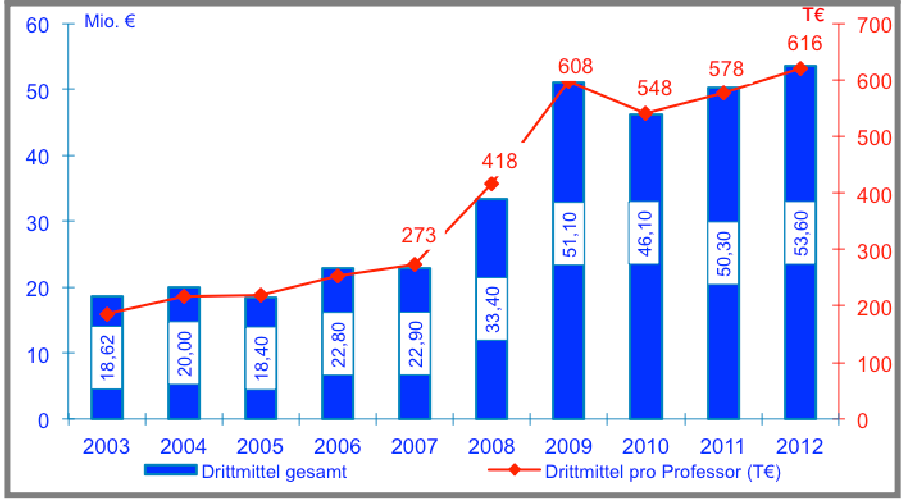
- Helmholtz Centres (particularly HIF)
- Fraunhofer Institutes
- Leibniz Institutes
- Federal Institute for Geosciences and Natural Resources (BGR)

International cooperations, e. g.

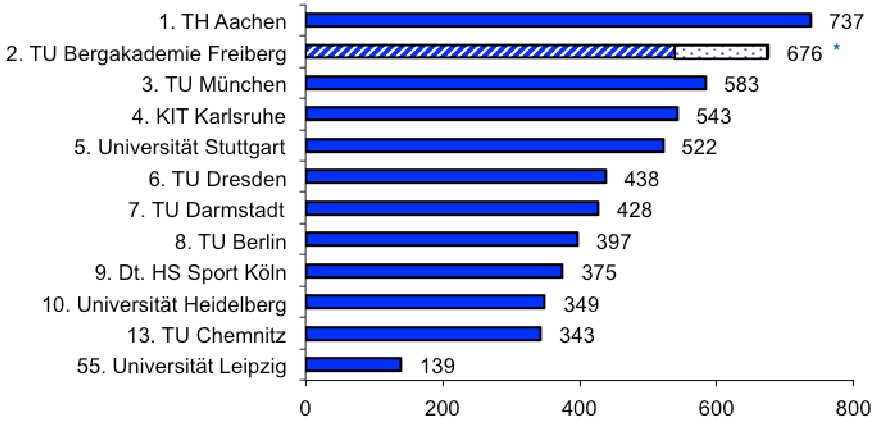
- German Russian Raw Materials Forum

Research Funds
Highest specific third-party funding

Third-party funding



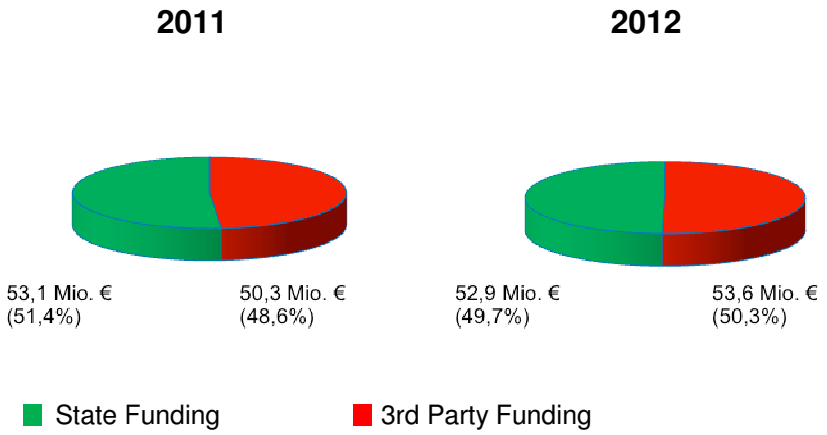
Third-party funding per professor in 2010 (€ k)



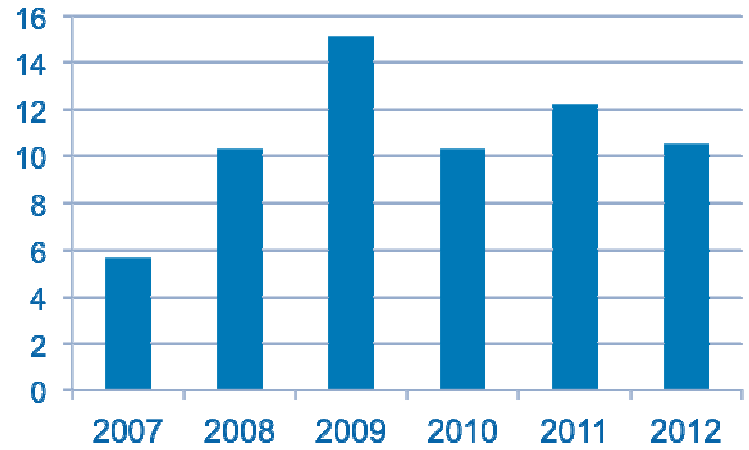
Quelle: Statist. Bundesamt, Fachserie 11, Reihe 4.3. vom 12.10.2012

* Effekte aus Übertragungen 2009

Budget



Funded by DFG (€ Million)



Helmholtz Institute Freiberg for Resource Technology

17.12.2010	28.03.2011	09.05.2011/ 06.06.2011	29.08.2011	Today
BMBF decision in favour of the Ressource Technology Institute	Signing of the cooperation contract HZDR-TUBAF	Assessment by the HGF commission and approval of the HGF senate	Grand foundation; attended by former federal minister Schavan and state premier Tillich	45 employees, Infrastructure development

Moving into the building at Chemnitzer Str. 40
Planned for the end of 2013/ beginning of 2014

Management	Director: Prof. Gutzmer (management team: 6 employees)					
Departments	**Department of Exploration** (W3 professor) NN 2 employees	**Extracting technology** (W3 professor) NN	**Processing** Prof. Peuker[1] W3 call 2 employees	**Metallurgy and Recycling** Prof. Stelter[1] W3 call 10 employees	**Modeling and Evaluation** Prof. van den Boogaart 3 employees	**Analytics** Prof. Gutzmer 6 employees
Groups	***Remote sensing***	***Robotics/ automation***	***Bio Technology*** Dr. Pollmann 10 MA	***Pyro- / Hydro-Metallurgy*** Prof. Stelter[1]	***Ressourcen-wirtschaft*** 1 MA	***Ion beam analytics*** Dr. Renno 4 MA

1: provisional

World Forum of Universities of Resources on Sustainability

11 June 2012: Founding event in Freiberg - by 80 resource universities from over 50 countries

Goals

- Responsibility for a new awareness of raw materials: Principle of sustainable development
- Education: Sustainability-oriented minimum standards in teaching and training
- International exchange for unlimited access to knowledge and experience through global networks and suitable platforms

Next Conference: 10-12 November 2013 Trondheim, Norway

Institute of Energy Process Engineering and Chemical Engineering (IEC)

Director of the Institute: Prof. Dr. Ing. B. Meyer

Chair of Energy Process Engineering and Thermal Waste Treatment

Prof. Dr.-Ing. B. Meyer

Chair of Reaction Engineering

Prof. Dr. rer. nat. S. Kureti

Chair of Numerical Thermo Fluid Dynamics

Prof. Dr.-Ing. C. Hasse

136 employees (July 2013)

engineers, chemists, mathematicians, mineralogists, economists, lab and technical staff

→Largest institute at the TU Bergakademie Freiberg
→Highest third-party funds for fossil fuel research in Germany

Research groups at the IEC

Institute of Energy Process Engineering and Chemical Engineering

Chair of Energy Process Engineering and Thermal Waste Treatment
Prof. Dr.-Ing. Bernd Meyer

- Thermo-chemical Conversion of Coal and Biomass
- High-Pressure Gasification / POX / Gasoline Synthesis
- Gasifier Development
- Flow Sheet Simulation
- Mineral Matter Reactions
- German Energy Raw Materials Centre (DER)

Chair of Reaction Engineering
Prof. Dr. rer. nat. Sven Kureti

- Environment-related Catalysis
- Energy-related Catalysis and CO_2 Reduction
- Refining of Petrochemical Products

Chair of Numerical Thermo-Fluid Dynamics
Prof. Dr.-Ing. C. Hasse

- Modeling of Gasification Processes
- Engine Combustion
- Turbulence Modeling

Research Groups

- VIRTUHCON group: Multi-phase Systems
- VIRTUHCON group: Interphase Phenomena

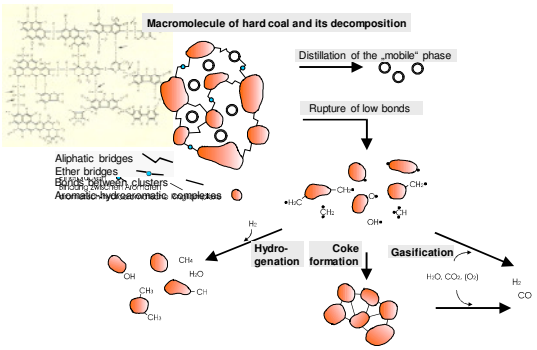
IEC research on fuel utilization

Modeling-based research at IEC:

CFD — Gaseous and liquid fuels: POX
Coal: Fixed bed, entrained flow and fluidized bed

Flow Sheet — Comprehensive stationary and dynamic modelling, concept development and technological, energetic, ecological and economic evaluation

Fuel → Gasification → **Raw Gas** → Gas Treatment → **Syngas** → Synthesis or Power Generation → **Product**



Dependent on:
- Fuel characteristics and conversion behaviour
- Process conditions
- Process technology

Experimental research at IEC:

Lab Scale — Low and high-temperature conversion of coal and biomass

Large Scale — POX + ATR of gaseous and liquid fuels
Slagging fixed bed + fluidized bed coal gasif. → Syngas-to-Fuels plant

IEC large-scale test plants

High Pressure Partial Oxidation (HP POX®)

Test plant for high pressure partial oxidation (HP POX) of liquid and gaseous hydrocarbons

Syngas-to-Fuel (STF)

Development of a new technology for production of high-octane gasoline from synthesis gas

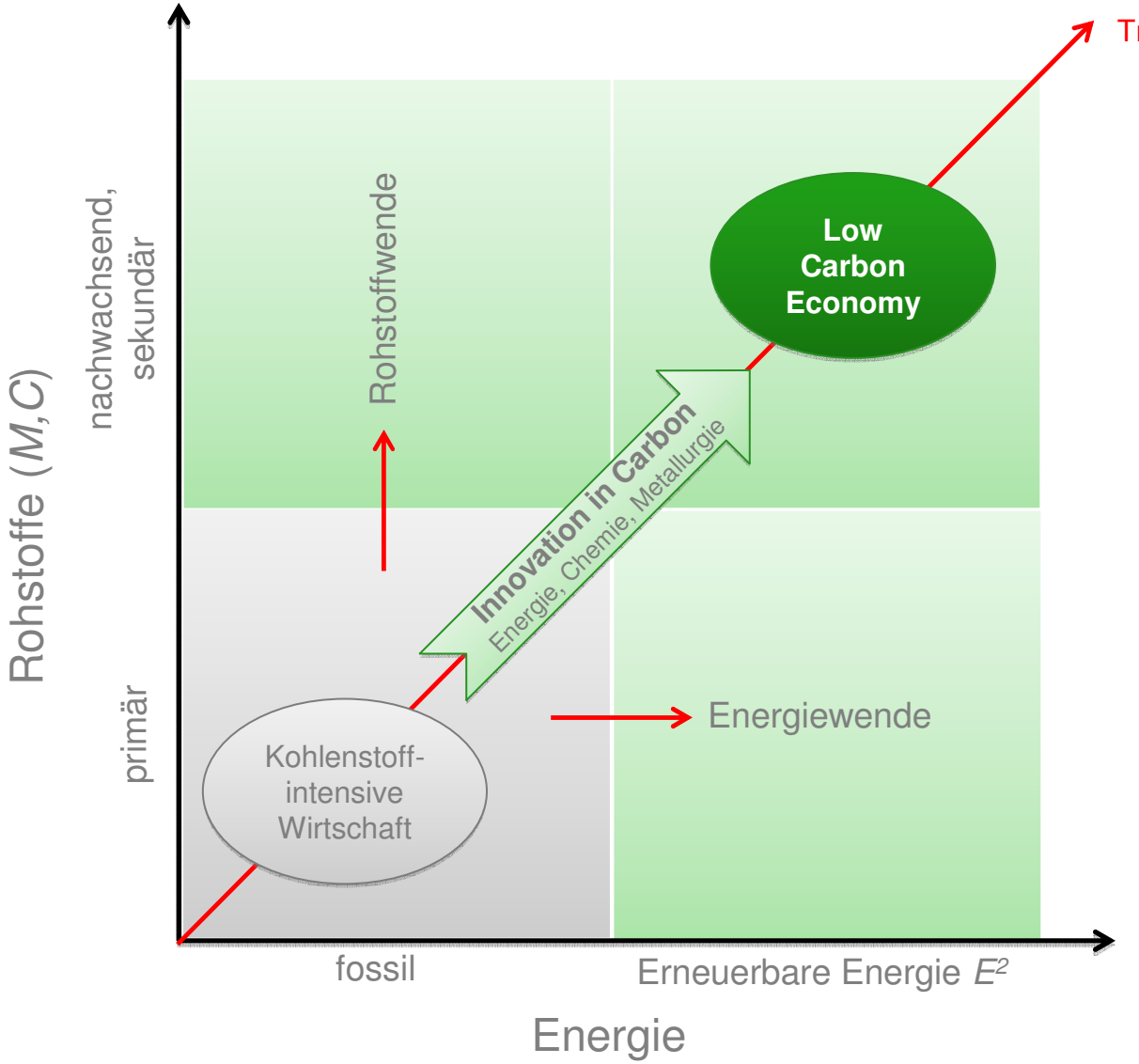
BGL Slagging Gasifier

Investigation of liquid slag behavior under high pressure

Characterization of slag from different ash compositions

Testing of coals to demonstrate application of “unknown” feedstock

Lösungsansatz: $E^2 \rightleftarrows MC$



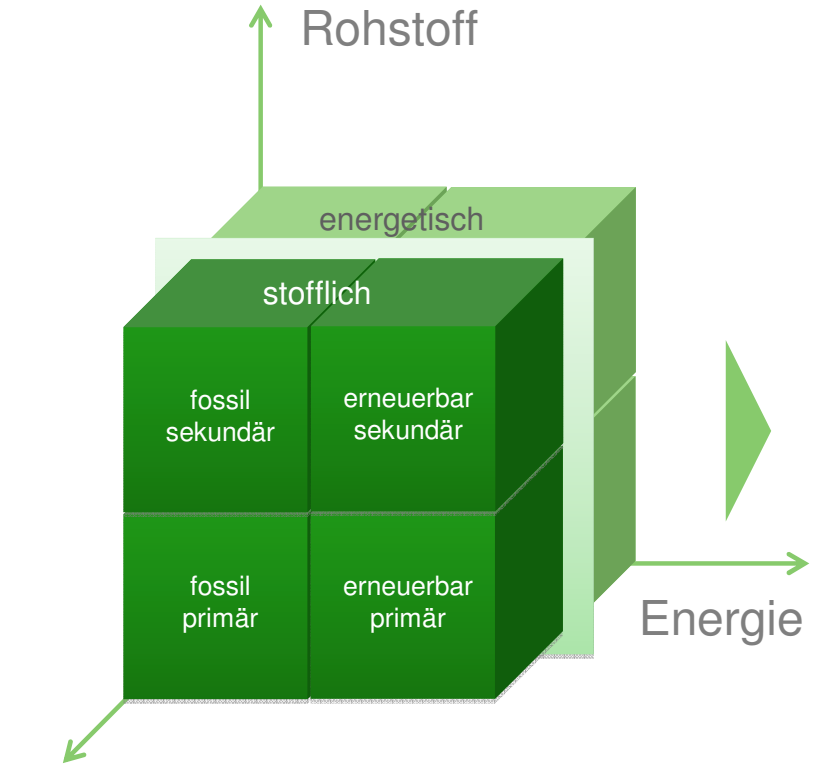
Transformationsgleichung

$$E^2 \leftrightharpoons MC$$

Masse-Energie-Äquivalenz in einer neuen Dimension

Lösungsansatz: $E^2 \rightleftarrows MC$

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.



Basisinnovation

Elektro-Thermochemie

z. B. MW-Plasma-Reaktionen, SOEC, rev. Chloralkali-Elektrolyse, STF, Ionische Flüssigkeiten, Reaktivextraktion...

Neue Industriebranche

Energie-Stoff-Transformation

- Power2Chemicals
- Power2Metals
- Carbon4Metals

Markt und Lösungsansatz – IIC @ Work

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

Zukünftiger Markt IIC (Mrd. € p. a.)*

Sektor	Welt	EU
Energie	15,0	2,5
Metallurgie	21,5	3,6
Chemie	11,2	1,9
Gebäude	10,4	1,7
Forst	4,3	0,7
Abfall	3,0	0,5
Summe	**65,3**	**11,0**

Leitprojekt	E	M	C
Ressourceneffizienz & Flexibilisierung			
Stoffliche Nutzung gasförmiger C-Träger			
CO_2-emissionsarme Stofftransformation			
Rückverstrombare M-C-Speicher			

- Für 2°-Klimaziel sind bis 2030 ca. 860 Mrd. € p. a. Zusatzinvestitionen erforderlich (McKinsey)!
- Davon adressiert IIC 12 %.

* Herleitung aus McKinsey-Studie (2010) „Notwendige Investitionen zum Erreichen des 2°-Zieles“

Mineral collection at Schloss Freudenstein in Freiberg

Thank you for your attention!

www.tu-freiberg.de