Presentation of the

Institute of Waste Management
at the
BOKU - University of Natural Resources and Life Sciences, Vienna, Austria

University of Natural Resources and Life Sciences
Department of Water, Atmosphere and Environment
Institute of Waste Management

University of Natural Resources and Life Sciences, Vienna

University of Natural Resources and Life Sciences, Vienna

- Today 15 departments:

  Material sciences, chemistry, water management, civil engineering, natural hazards, (nano-)biotechnology, agricultural sciences, food sciences, applied genetics and cell biology, soil sciences, economic sciences, environmental technology, etc.
- 1,769 scientists and lecturers (total staff 2,450) (2012)
- 12,384 students (2013)
- 9 Bachelor und 25 master programs (10 international master programs in English) (2014)

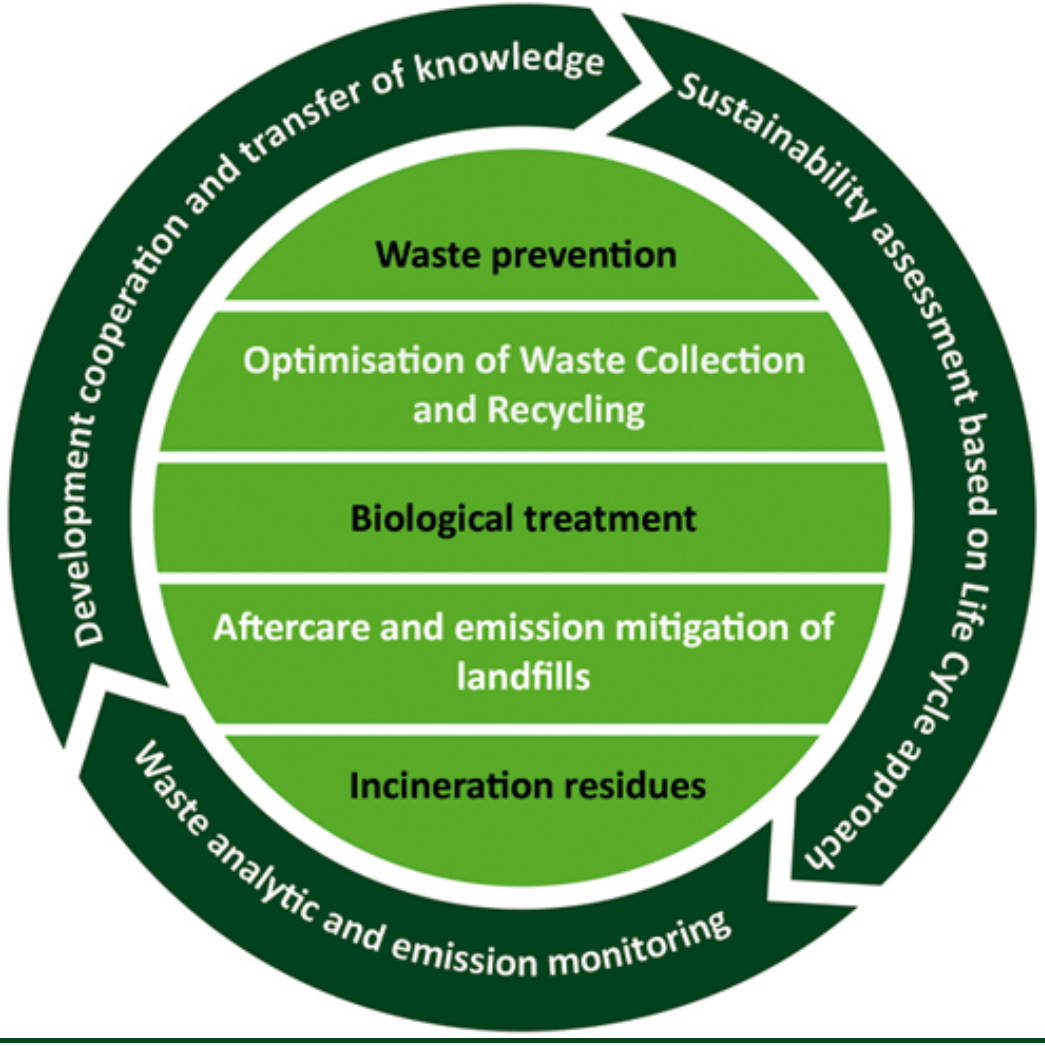
University of Natural Resources and Life Sciences, Vienna

Department for Water, Atmosphere and Environment

7 Institutes:

- Sanitary Engineering and Water Pollution Control (SIG)
- Hydrobiology and Aquatic Ecosystem Management (IHG)
- **Waste Management (ABF-BOKU),** including planning, disposal technology and disposal logistics
- Meteorology (BOKU-Met)
- Hydraulics and Rural Water Management (IHLW)
- Water Management, Hydrology and Hydraulic Engineering (IHWH)
- Safety and Risk Management (ISR)

Institute of Waste Management (ABF-BOKU) - Focus of Research



ABF-BOKU - Focus of Research

1. Waste prevention

- Considered highest priority within waste management hierarchy
- Our approach comprises the whole life cycle of consumer goods and material flows
- Selected material flows:
  - **food**
  - **WEEE**
  - **bulky waste**
- Analysis with respect to individual psychological (e.g. consumption behaviour) as well as contextual (e.g. social, legal, economic) influencing factors.

http://www.leics.gov.uk/index/environment/waste/waste_minimisation.htm

ABF-BOKU – Focus of Research

Lead Projects

- **FUSIONS** (Food Use for Social Innovation by Optimizing waste prevention Strategies): http://www.eu-fusions.org
- **TransWaste** (Formalisation of informal sector activities in collection and transboundary activities shipment of wastes in and to Central and Eastern Europe):

Main Publications

- Salhofer S.P., Obersteiner G., Schneider F., Lebersorger S. (2008): Potentials for the Prevention of Municipal Solid Waste. In: Waste Management Vol. 28, No. 2, pp. 245-259, ISSN 0956-053X.
- Lebersorger S., Schneider F. (2011): Discussion on the methodology for determining food waste in household waste composition studies. In: Waste Management 31 (9-10), pp. 1924-1933.

Waste generation and prevention - Food waste from households

6 to 12 % in residual waste from households!

FUSIONS project (Food Use for Social Innovation by Optimizing waste prevention Strategies), 2012-2016

The 21 project partners from 13 countries (EU FP7).

FUSIONS will contribute to:

- the harmonisation of food waste monitoring;
- improved understanding how social innovation can reduce food waste;
- the development of guidelines for a common Food Waste policy for EU-27.

FUSIONS will support:

- the delivery of the Roadmap towards a Resource Efficient Europe;
- the European Commission"s target of a 50% reduction of food waste;
- a 20% reduction in the food chain"s resource inputs by 2020.

TransWaste

Cause:

- WEEE, bulky wastes, clothes collected by non authorised (informal) people
- Transport into countries with less developed waste management and lower GDP

Effect:

- Financial
  - Negative for waste collection and fiscal authorities
  - Positive to waste pickers
- Social:
  - Negative conditions for waste pickers (deteriorate due to EU directives)
- Ecological:
  - Negative: Littering, no guarantee for adequate waste processing
  - Positive: Re-Use

TransWaste - main project goals

- Implementation of transnational cooperation of authorities concerning informal sector activities;
- Legitimising waste pickers in a changing system for selected regions;
- Formalisation of informal sector in cooperation with target groups taking into consideration their needs for selected regions.

Training of former informal collectors

TransWaste – preferred items

TransWaste – flea markets in Hungary

More information: http://www.transwaste.eu

ABF-BOKU – Focus of Research

2. Optimisation of Waste Collection and Recycling

- **Generation and composition of waste** are analysed regarding socio-economic and demographic factors of influence.
- Prognosis models are developed and applied as planning criteria for the development of measures like preferable treatment technologies, capacities, economics, etc.)
- **Optimisation of Disposal Systems:**
  - holistic approach (taking into account mutual effects between waste generation, collection and treatment)
- Complex products **(Waste Electrical and Electronic Equipment)**:
  - In this field we work on appropriate collection structures, recycling technologies and holistic management structures.
  - Recovery of critical resources.
  - Aim of our research is to utilise resources from complex products (WEEE) up to buildings in the future (**“urban mining”**).

ABF-BOKU – Focus of Research

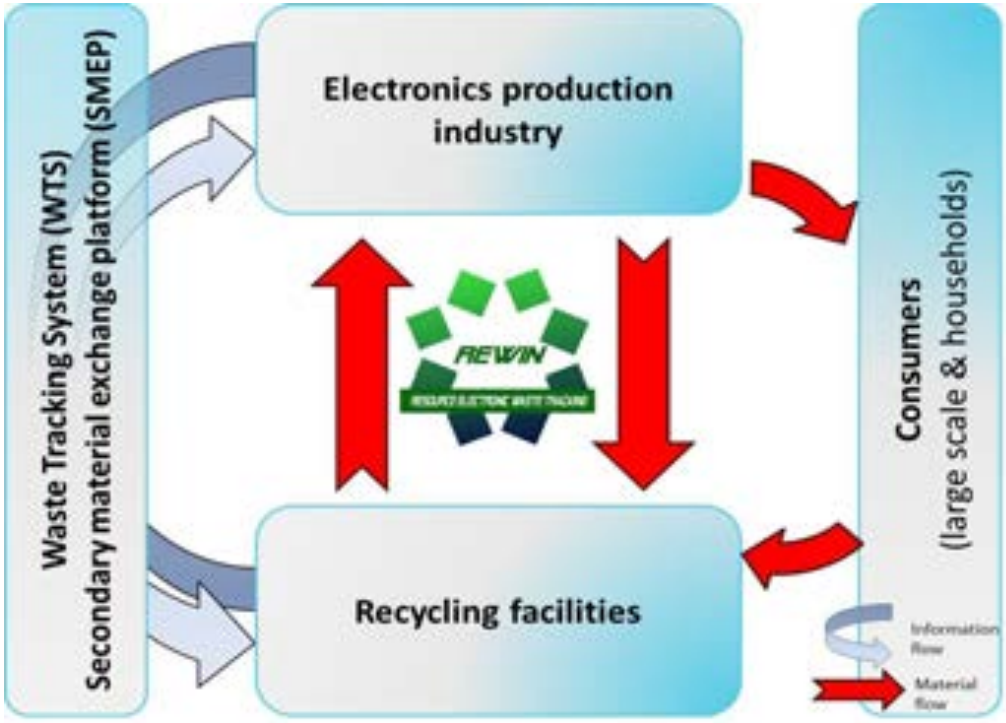
Lead Project

- **REWIN**
  aims at closing the cycle of material cycles by linking supply and demand of secondary raw materials in electronic production and recycling in the People„s Republic of China: http://www.rewin-china.net
- Development of a waste detection system as well as a stock market for secondary material

Main Publications

- Salhofer S., Tesar M.: Assessment of removal of components containing hazardous substances from small WEEE in Austria. Journal of Hazardous Materials 186 (2011) pp 1481 – 1488.
- Lebersorger S., Beigl P.: Municipal solid waste generation in municipalities: Quantifying impacts of household structure, commercial waste and domestic fuel. In: Waste Management 31 (9-10), pp. 1907-1915.

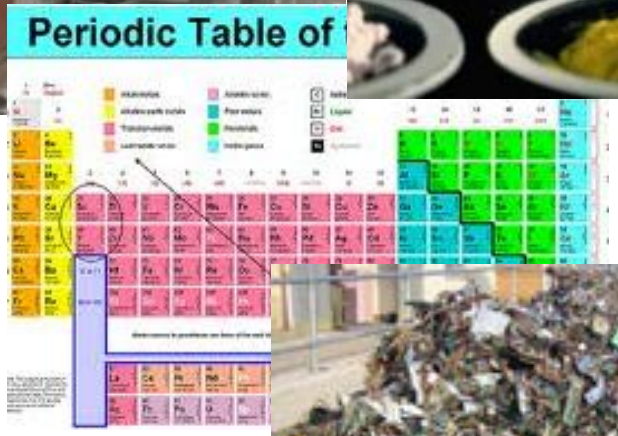
REWIN


Waste Tracking System (WTS)
Secondary material exchange platform (SMEP)
Electronics production industry
Recycling facilities
Consumers
(large scale & households)
REWIN
Information flow
Material flow

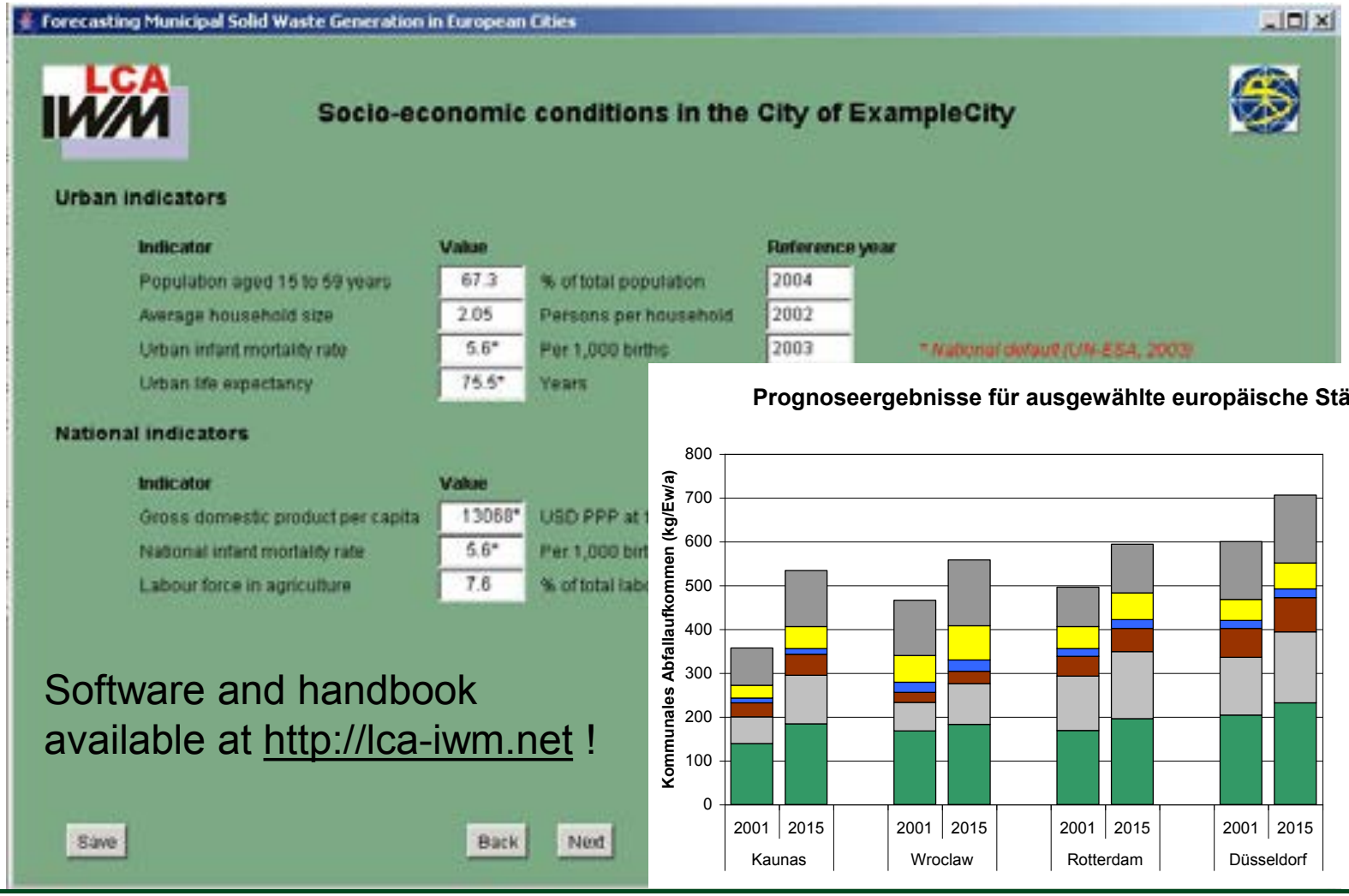

China
Hubei

REWIN

Waste Electrical and Electronic Equipment - Resource recovery - Rare Earths



Forecast of Waste Quantities - Modelling



Prognoseergebnisse für ausgewählte europäische Städte

ABF-BOKU – Focus of Research

3. Biological Treatment

- Production of a high-quality product composting of separately collected organic waste);
- Our advanced methods for examination and analysis allow a full quality assurance of the final products;
- investigations of the interaction between organic and mineral components, nitrogen dynamics and the long term development of organic components;
- Especially the estimation of long-term fixed carbon **(carbon sequestration including quantification)** is subject of current research.

ABF-BOKU – Focus of Research

Lead projects

- **Carbon sequestration in the soil by compost**
- **Development of methods to enable rapid and reliable determination of the stability of mechanically-biologically treated waste**

Main Publications

- Binner E., Smidt E., Tintner J., Böhm K., Lechner P. (2011): How to enhance humification during composting of separately collected biowaste: impact of feedstock and processing. Waste Management & Research 29(11) pp. 1153–1163
- Binner E., Böhm K., Lechner P. (2012): Large scale study on measurement of respiration activity (AT_4) by Sapromat and OxiTop. In Waste Management xx, in press

ABF-BOKU – Focus of Research

4. Aftercare and emission mitigation of landfills

- The **long-term disposal of waste and materials in an environmentally responsible way** still constitutes an essential element in sustainable waste management.
- Development of **(site-)appropriate technologies** for emission mitigation (e.g. **in-situ aeration, methane oxidation covers**) as well as aftercare and after-use concepts.
- **Development of proper aftercare criteria** and remediation target values.

ABF-BOKU – Focus of Research

Lead Project

- **NUTZRAUM: Nutzungsspezifische Altlastensanierung, Technologie, Umweltressourcen und Raum - PP1: In-situ Aerobisierung Mannersdorf**

  (utilization-specific remediation of contaminated sites, technology, environmental resources and land use – PP1: in situ aerobisation)

Main Publications

- Hrad M., Huber-Humer M., Wimmer, B., and T. G. Reichenauer (2012). Design of top covers supporting aerobic in situ stabilization of old landfills – An experimental simulation in lysimeters; Waste Management, in press, available online 30 June 2012
- Huber-Humer, M., J. Tintner, K. Böhm, P. Lechner (2011). Scrutinizing compost properties and their impact on methane oxidation efficiency, Waste Management 31(5): 871-883.

Landfill Aftercare & Remediation – Monitoring strategies and methods

Exploration

Biocover

Remediation – In-situ Aeration

Aftercare

ABF-BOKU – Focus of Research

5. Incineration Residues

- Residues from waste incineration, from combustion, from pyrometallurgical ashes from biomass firing c **secondary resources** in the future.
- Treatment of **incinerator slag** for use as a secondary construction material**, aging processes** in slags and ashes and technical treatment with gasses containing CO_2 **(active carbonation).**
- The dynamics of reactions of alkaline residues with CO_2 and H_2S is investigated because of its significance for upgrading of biogas **(BABIU process).**
- laboratory devices and a **geochemical model** are available as tools for evaluation of the long-term behavior of **inorganic residues**

ABF-BOKU – Focus of Research

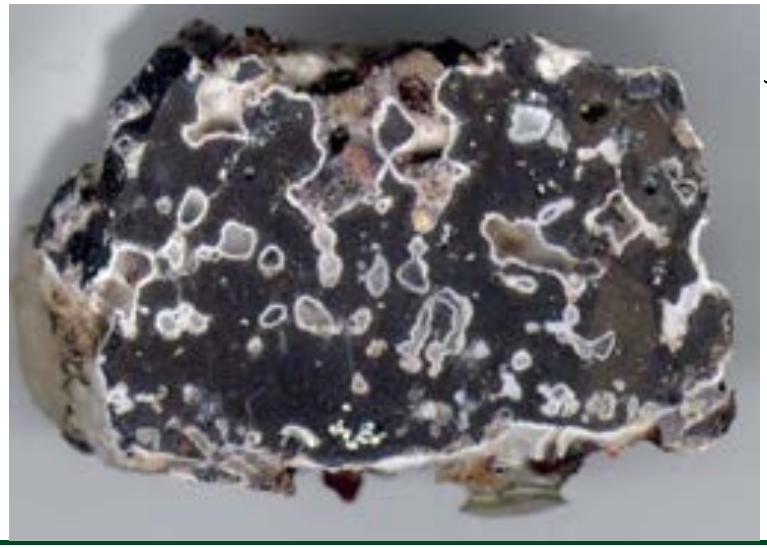
Lead Project

UPGAS Upgrading of landfill gas for lowering CO2 emissions

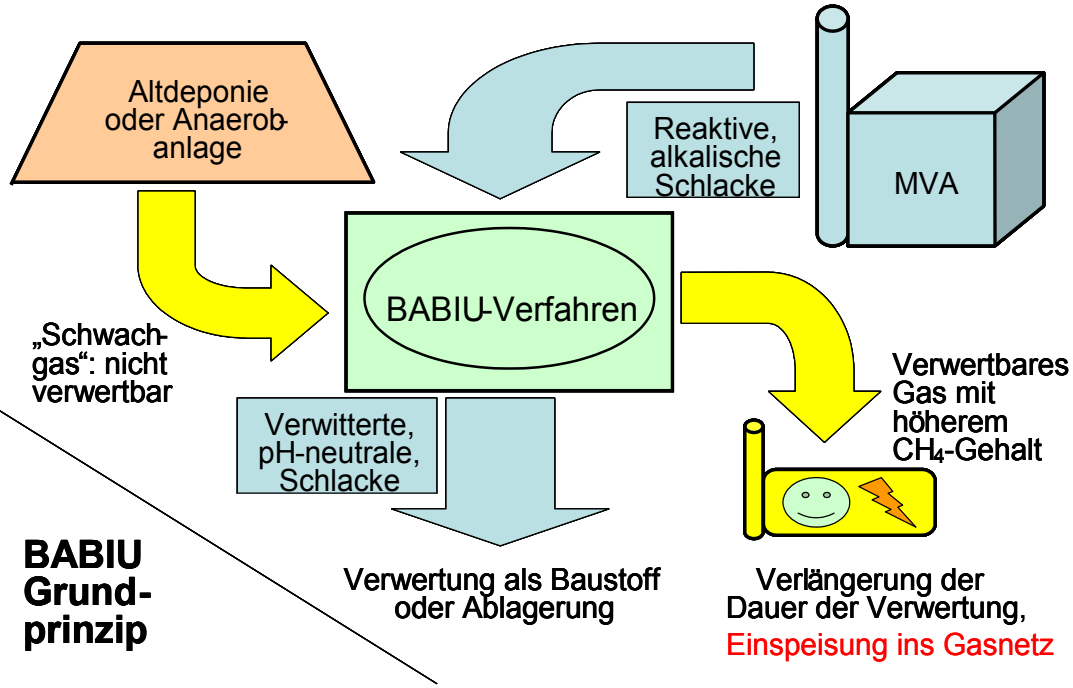
Main Publication

- Mostbauer, P; Lenz, S; Lechner, P (2008): MSWI bottom ash for upgrading of biogas and landfill gas. Environmental Technol. 2008; 29(7):757-764.

Landfill of inorganic waste – Incineration residues



BABIU - „Bottom ash and biogas upgrading“



Patent (Mostbauer/Lechner): Austria, Nr. 504345

ABF-BOKU – Focus of Research

6. Waste analytic and emission monitoring

- Practice-oriented emission monitoring from diffuse sources (landfills, composting plants, mechanical biological treatment plant)
- For the first time in Austria, **optical remote sensing technologies and continuous laser measuring procedures** are used
- Modern analytical methods like **Fourier Transform Infrared Spectroscopy** (FTIR) and **thermal analysis** coupled with **mass spectroscopy** are applied for a comprehensive assessment of solid waste
- Estimation of compost quality by the use of biological test methods (e.g. respiration activity, gas generation potential)

ABF-BOKU – Focus of Research

Lead Project

- **KLIMONEFF –** Monitoring of greenhouse gases to optimize the energy balance efficiency of biogas plants
  - A project running since June 2011 (supported by Klima- und Energiefonds, FFG).
  - Application of modern open-path measuring technologies and analysis of fermentation residues at various biogas plants.
  - Development of a monitoring-tool to quantify greenhouse gas emissions

Main Publications

- Smidt E., Meissl K., Tintner J. (2007): Investigation of 15-year-old Municipal Solid Waste Deposit Profiles by Means of FTIR Spectroscopy and Thermal Analysis. In: Journal of Environmental Monitoring, Vol. 9, Issue 12, pp. 1387-1393.
- Huber-Humer M., Hrad M., Piringer M. (2012): Greenhouse gas monitoring for optimization of process efficiency of biogas plants. In: ORBIT 2012: Global assessment for organic resources and waste management, 8th International Conference, June 12th - 14th, 2012 in Rennes, Frances.

Monitoring tools for gas emissions (CO_2, CH_4, N_2O)

Open-path Technologies, Tracer Techniques, …

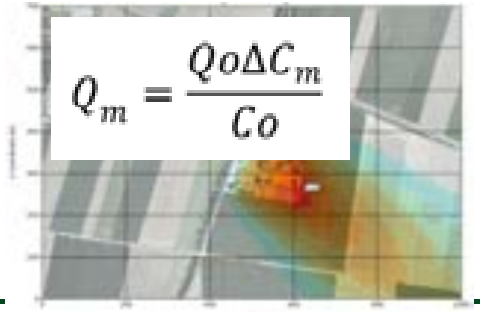
- Monitoring of Landfill Cover (e.g. methane oxidation layer, water balance layer)
- Emissions from Landfills
- Emissions during Methane Oxidation or In-situ-aeration on Landfills
- Emissions from biogas plants, composting plants, MBP processes

Determination of Emission rate I

1. **Concentration measurement (ppm*m)**

2. 3D-wind measurement

3. Dispersion model => Emission rate



1. **Concentration measurement (ppm*m)**

2. Release of tracer gas (ppm*m), (kg/h)

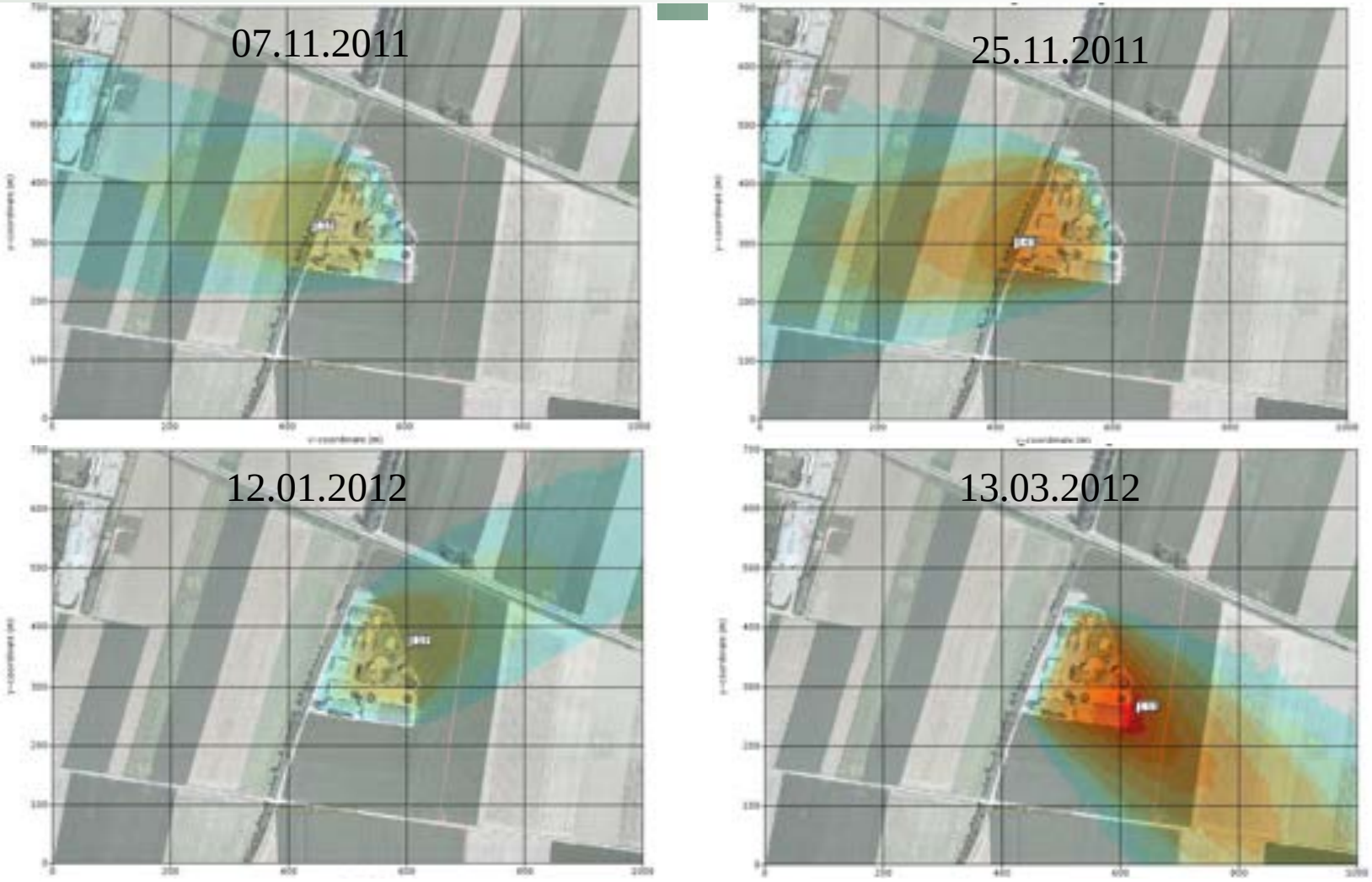
3. Calculation of ratio => Emission rate (kg/h)

$$Q_m = \frac{Q_t \Delta C_m}{\Delta C_t}$$

Example case project KLIMONEFF – Biogas Plant

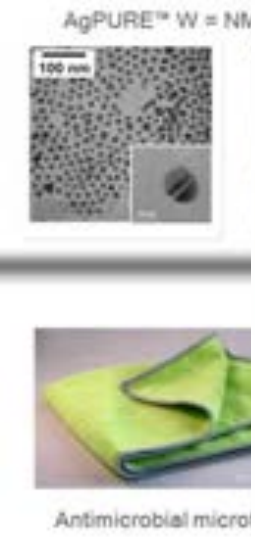
Project KLIMONEFF

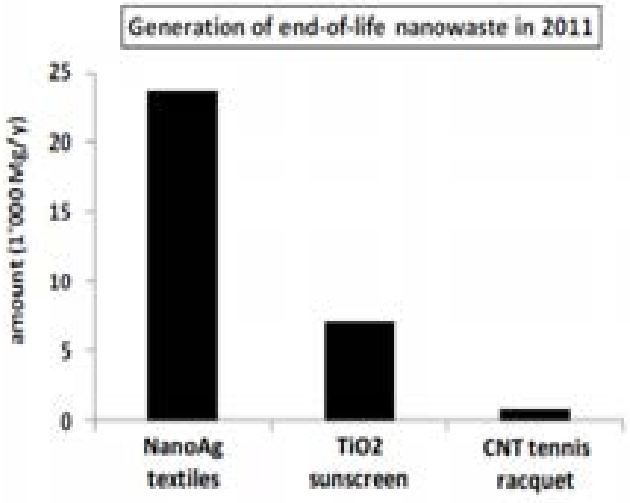
KLIMONEFF first results –
modelled imissions per measurement day

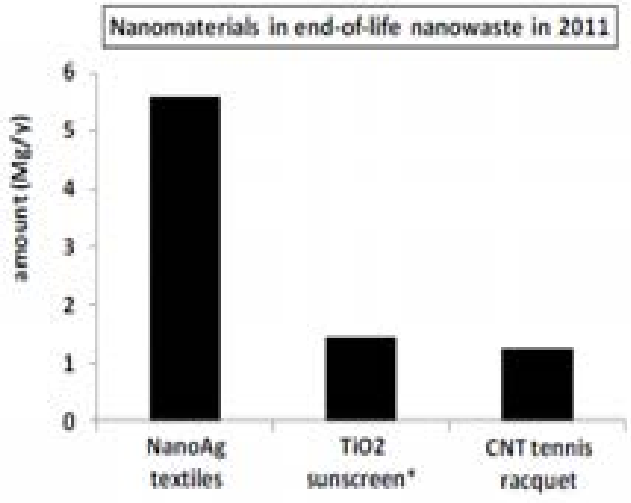


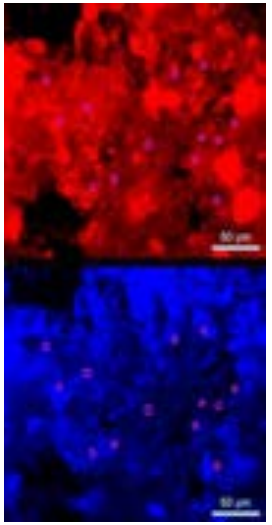
New challenges – Nanoparticles in waste

Environmental relevance of nanoparticles and nanomaterial in products that become waste respectively their reactions during waste treatment.









The behaviour of nanoparticles and nanomaterial in waste opens up a new area of research at ABF-BOKU. Therefore, the development of appropriate monitoring methods and technical test approaches is necessary.

ABF-BOKU – Focus of Research

7. Sustainability assessment based on Life Cycle approach

- Through the consideration of the entire life cycle it can be illustrated in which lifecycle phase of a – from raw material production to has the highest environmental impacts, costs and social effects.
- Application: **Life Cycle Assessment** (**LCA**) Practice-oriented projects, application for **social (e.g. Social LCA)** and **economic assessment (e.g. Life Cycle Costing),** specific issues, which go beyond conventional LCA are in the main focus.
- In the context of Life Cycle Assessment also Carbon Footprint, Material Flow Analysis (MFA) and Process Analysis can be created.

ABF-BOKU – Focus of Research

Lead Project

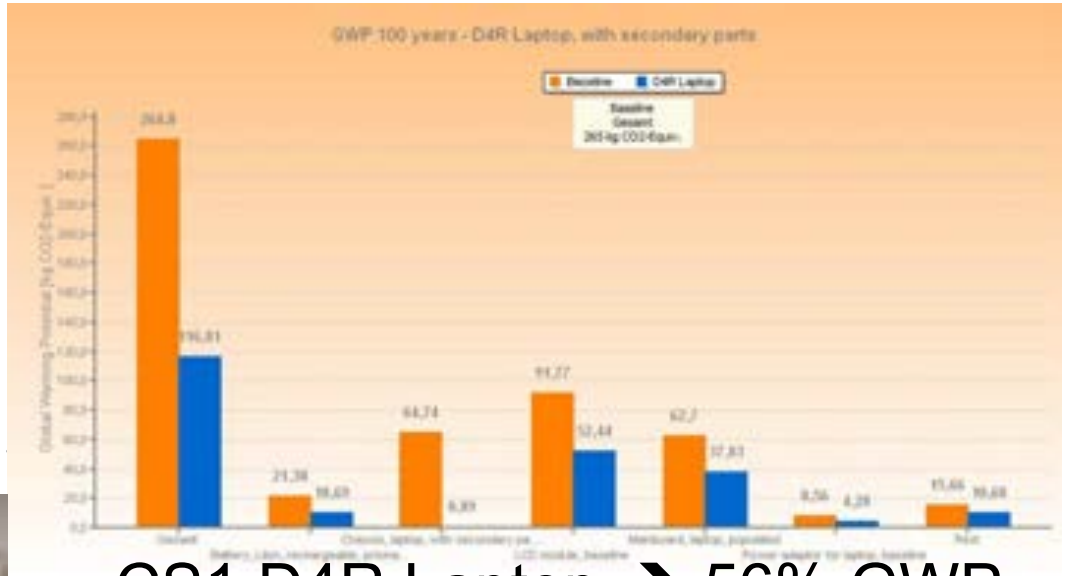
- **ZeroWin** (Towards Zero Waste in Industrial Networks)
- http://www.zerowin.eu

Main Publications

- Pertl, A; Mostbauer, P; Obersteiner, G (2010): Climate balance of biogas upgrading systems. Waste Management 2010; 30(1):92-99
- Obersteiner G., Binner E., Mostbauer P, Salhofer S.P. (2007): Landfill Modelling in LCA - a contribution based on empiric data. Waste Management , 27, S58-S74; ISSN 0956-053X

Case study

Resource exchange based on “by-product” and other resource exchange concept (4 industries: construction, electronics, photovoltaic, automotive)



CS1 D4R Laptop ➔ 56% GWP reduction vs. baseline

iamecov3 demonstrates the design capacity for using innovative materials

ABF-BOKU – Focus of Research

8. Development cooperation and transfer of knowledge

- Challenges in global waste management and measures in **low-income** and **newly industrialising** countries;
- Development of concepts for technological (e.g. decentralised composting), organisational (e.g. documentation system for hazardous wastes) and educational measures (e.g. curriculum development, training courses).
- ABF-BOKU„s main research in this field focuses on the collection and analysis of data related to **informal waste management systems**.

ABF-BOKU – Focus of Research

Lead Projects

- **Sustainable Solid Waste Management – Composting of Local Organic Waste in Addis Ababa**
- **Educational film on compost**
- **Project on EU-China Ship Recycling**
- **Evaluation of strategic options for waste management Zanzibar**

Main Publications

- Linzner R., Lange U. (2013). Role and size of informal sector in waste management - a review. Proceedings of the ICE - Waste and Resource Management. Themed issue: Waste Management in Developing Countries. In press.
- Linzner R. and Obersteiner G. (2012): Die unsichtbare Hand – Informelle Arbeit in der Abfallwirtschaft. Zeitschrift „politische ökologie“ Nr. 129 – 2012, Rohstoffquelle Abfall - Wie aus Müll Produkte von morgen werden, pp. 71-78. Verlag oekom.(Invisible hands – informal work in waste management).

Organic waste collection, processing and analysis in Addis Ababa

Organic waste collection, processing and analysis in Addis Ababa

Main components:

- Source separation of organic household waste in Kolfe Keranyo;
- Testing different mixtures at the compost facility;
- Process control, sampling procedure and laboratory training for compost quality tests (January 2012);
- Trainings for households and waste collectors;
- Market assessment of compost (competing products, willingness to pay analysis, pricing)
- Scaling up and compost quality network for Ethiopia

Main components:

- Informal (waste) sector in China – history and future developments
- Case study: informal collection in Beijing (district Haidian): analysis of system, stakeholders and estimation of collected amounts
- Extrapolation for urban Beijing

Sustainable ship recycling by adopting integrated waste management approaches in China

Main components:

- Develop guidelines and tools based on EU and Chinese best practices
- Datasets in ship-recycling: Material Flow Analyses
- Implementing guidelines and tools and Third Party Inspection System
- Sustainability Assessment of ship-recyclers and policy dialogue

Institute of Waste Management - Team

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Thank you!

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