SE Biomethane

Small but efficient – Cost and Energy Efficient Biomethane Production

Background

1. The agricultural sector represent a big resource for biogas production through energy crops, plant residues and manure.

2. Treatment on site represents the most energy efficient solution.

3. The development of farm based biogas production is restricted by lack of energy efficient, low cost, small scale technological solutions, particulary techniques for gas upgradation

4. Ligocellulosic material for biogas production often results in low gas production rate with low degree of degradation, . i.e. low efficiency.

5. Anaerobic digestates are diluted with low nutrient content per volyme unit.

SE Biomethane - Aims

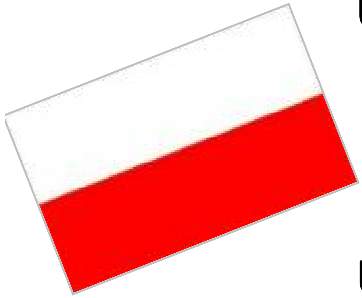
To find

- New concepts for pre-treatment of cellulose based materials
- New stategies for management of biogas processes
- New digester concepts specifically adopted to lignocellulose rich materials
- New low cost systems for small scale upgrading to fuel gas quality
- New solutions for dewatering and concentration of the digestate

Partners

Sweden

SLU- Swedish University of Agricultural Sciences
JTI – Swedish Institute of Agricultural- and Environmental Engineering
Triventus Biogas AB (SME)
Ultuna Egendom, Lövsta Biogas plant (SME)



Poland

UMW- University of Warmia and Mazury
Institute of Energy Ltd. (SME)

Germany

DBFZ- Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Ventury (SME)

Start date 1 February 2013

SE Biomethane

Kick off 5-6 March 2013 at SLU/JTI in Uppsala, Sweden

Project set up

Five workpackages

1. Cost and energy efficient pre-treatment methods for lignin and cellulose rich substrates

2. Optimal co-digestion conditions for efficient digestion of lignin and cellulose rich substrates

3. Simple and low cost upgrading system at small scale biogas plant

4. Efficient use of anaerobic digestion residue

1. Project management and coordination

Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

DBFZ

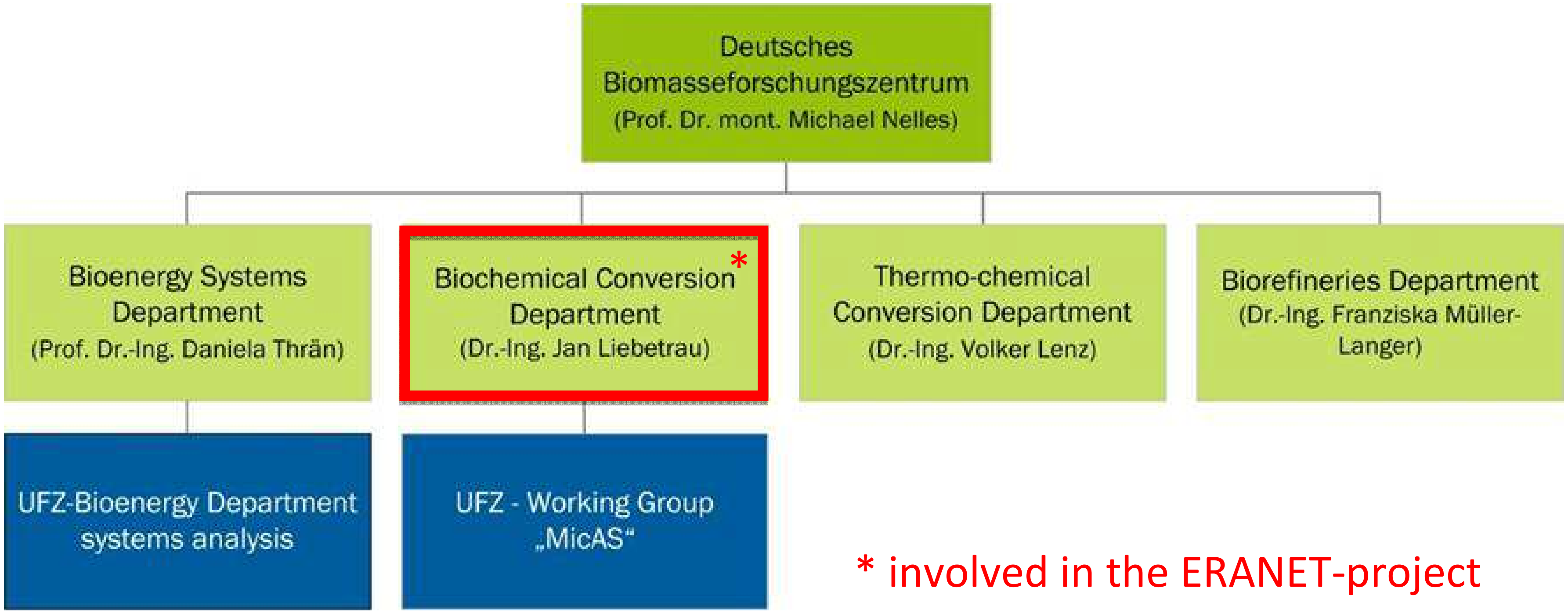
Research for the energy of the future

Dr. Britt Schumacher, Erik Fischer, Harald Wedwitschka




Objectives and departments of the DBFZ

- Sustainability / Sustainability assessment
- Innovative bioenergy sources
- Needs-based technologies and master concepts for the supply of usable energy
- Monitoring



* involved in the ERANET-project

UFZ = Helmholtz Centre for Environmental Research (UFZ)

Applied research at the DBFZ

Biogas pilot plant

Analytical lab

Biogas lab

Laboratory work

Methanisation test bed

Biofuels lab

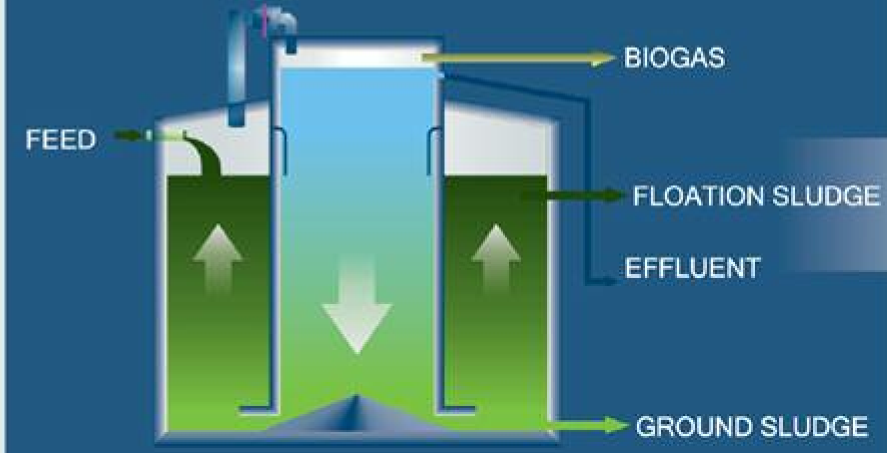
Services

- Basic engineering: planning and customer care in all phases of the project
- Project development
- Method determination and pre-planning
- Approval planning
- Final Design
- Supervision of the construction process
- Start-up
- Plant survey and monitoring, optimisation in process, facility management

ventury gmbh
energieanlagen

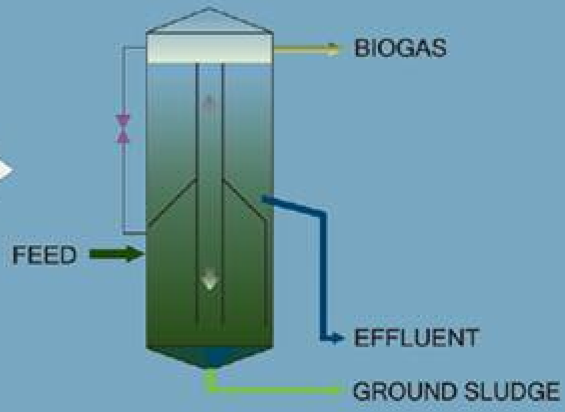
DIGESTION PROCESS WITHOUT MIXING UNITS

Digestervolume 1.000 up to 6.000 qm



- without electrical consumption
- separation in process of sediment and floating sludge

Digestervolume 100 up to 300 qm



- without mixing unit
- separated digestion zones
- recycling of microorganism
- recycling of process water
- sludge separation in process
- low cost control system

WP 1: Cost and energy efficient pre-treatment methods for lignin and cellulose rich substrates

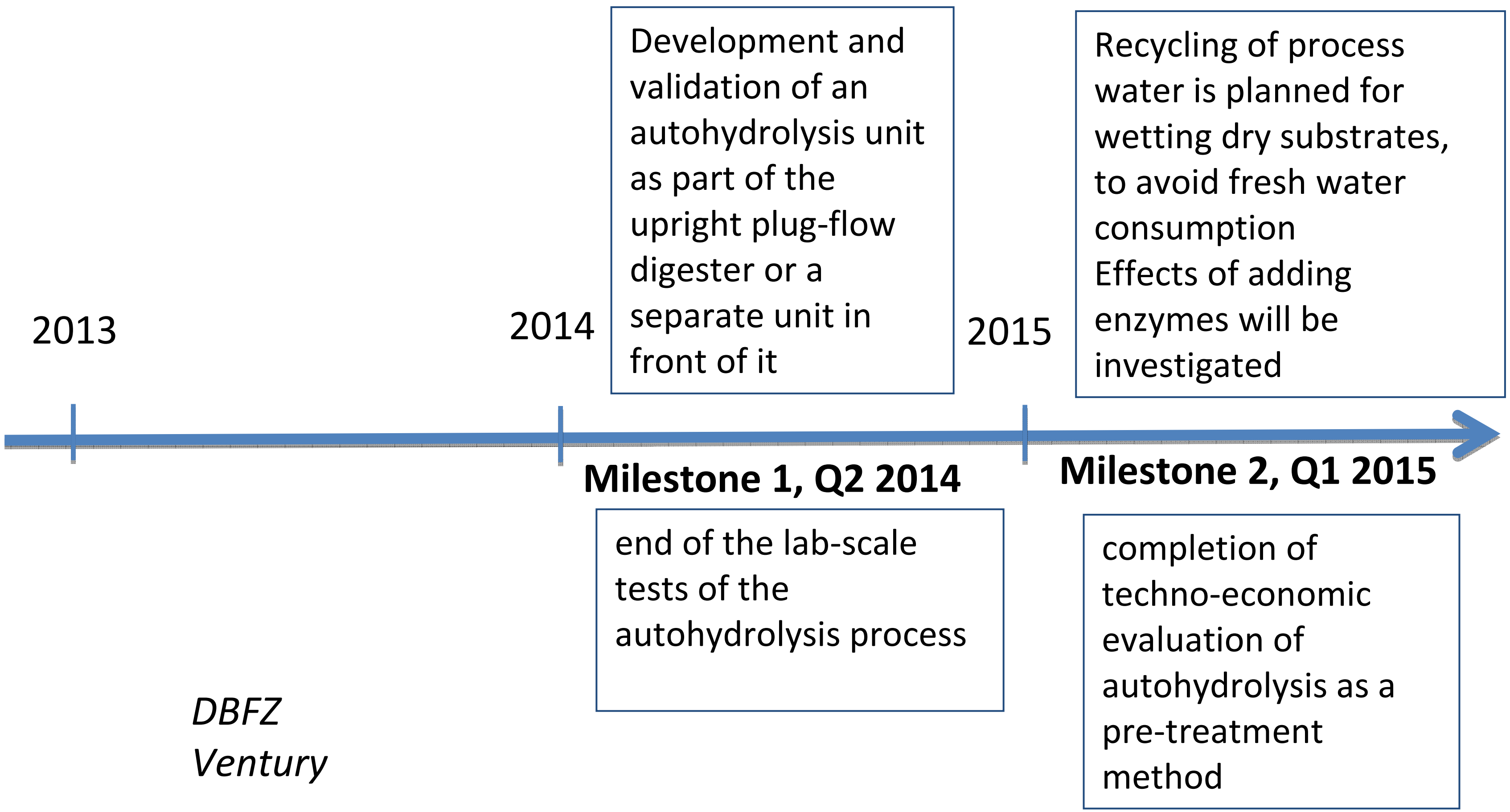
The degradation of lignin- and cellulose rich substrates, e.g. manure and straw, are restricted in the biogas process and thus plant operating with high proportions of these material often have low economical outcome.

In order to improve efficiency, new and cost efficient pretreatment solutions requiring low energy input have to be developed.

The overall objective for this WP is thus to generate innovative and cost effective solutions for pre-treatment of cellulose rich substrates at farm-scale.

Thermal pressure hydrolysis
Ventury GmbH Energieanlagen

Task 1.a. Pre-treatment by Autohydrolysis



Task 1.b. Mechanical size reduction

2013

particle size is < 10 mm to maintain suspension of the particles in the digester and enable complete mixing

Milestone 3, Q2 2013

completion of a suitable solid manure conversion and particle size reduction system at Lövsta

2014

Designing and proving a system capable of reducing all particles to < 10 mm and reducing electricity consumption of this mechanical pre-treatment process to below 5% of the biogas energy

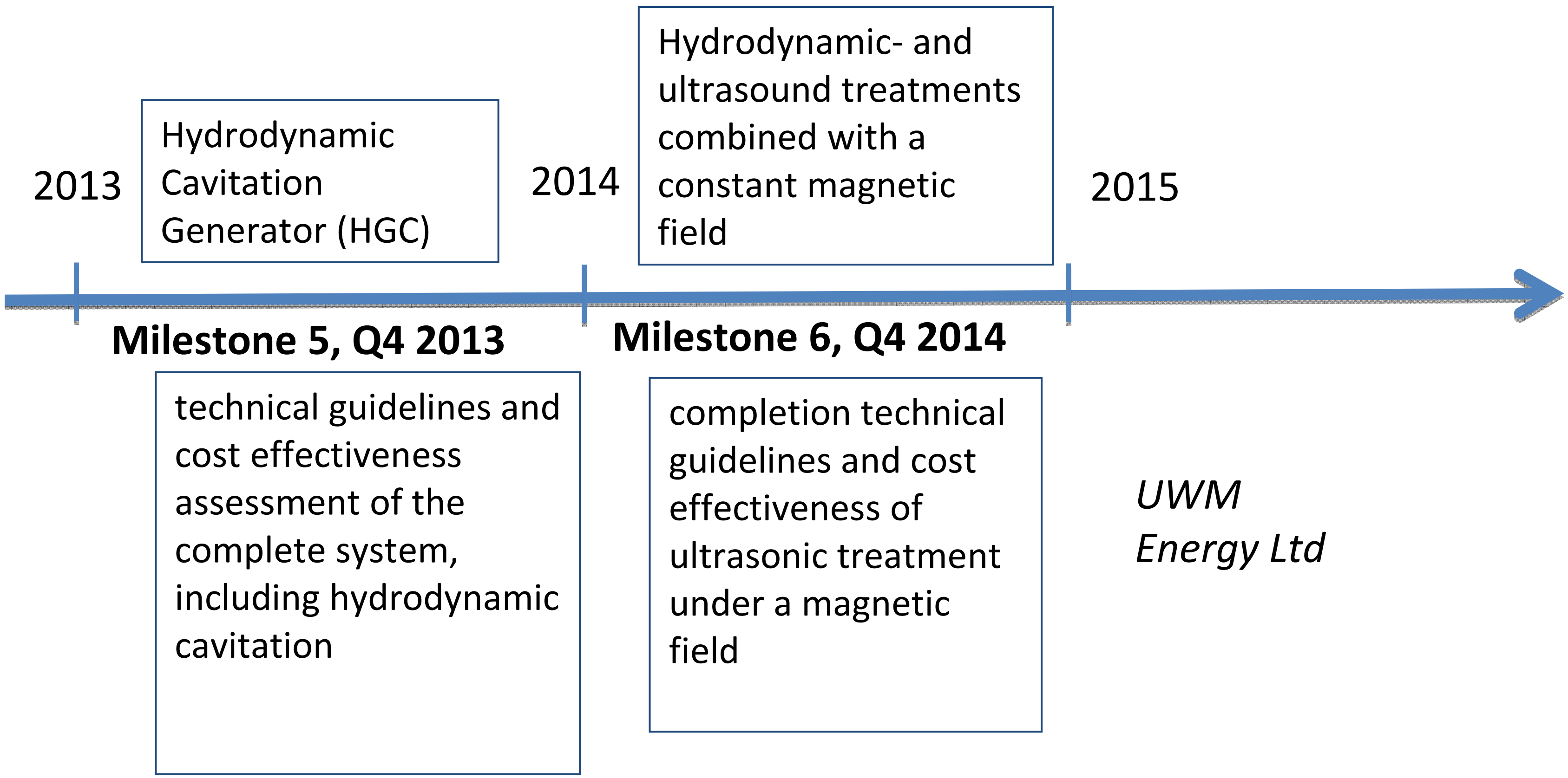
Milestone 4, Q1 2014

quantification of achieved electrical consumption, particle size and conversion capacity

2015

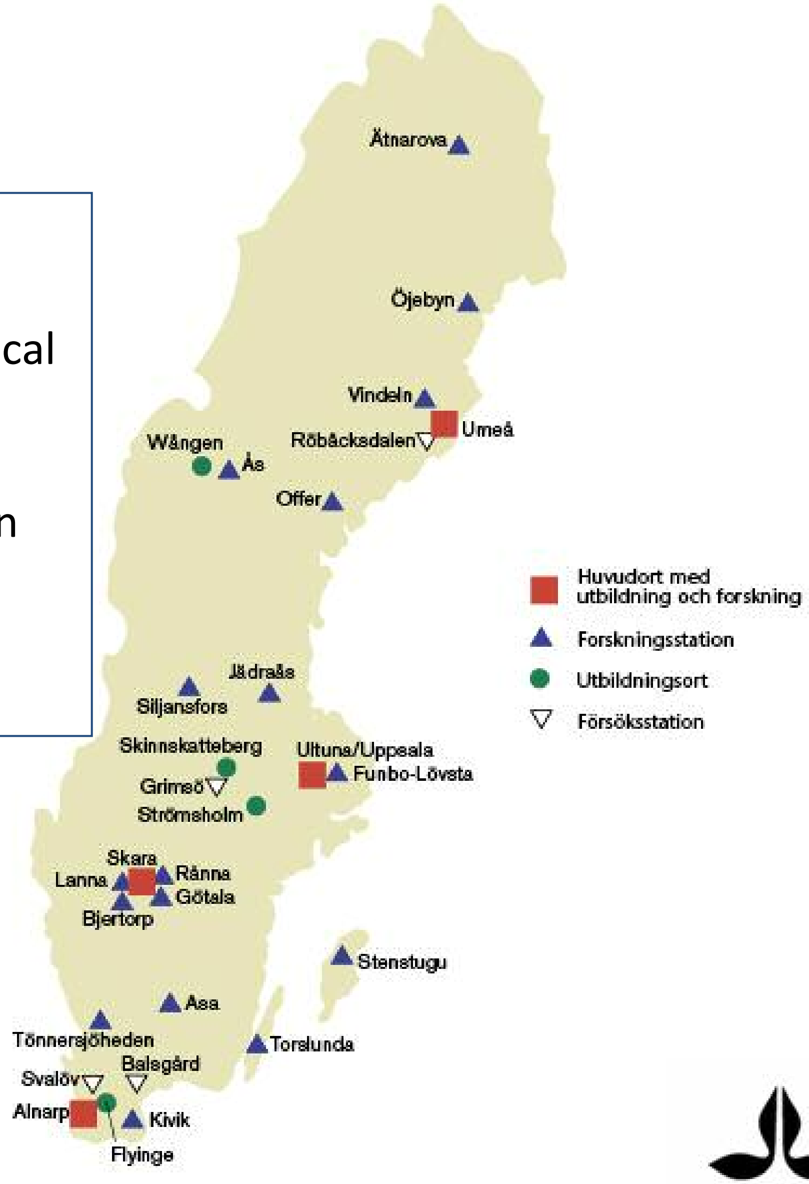
JTI
Triventus
Ultuna Egendom

Task 1.c. Pre-treatment by hydrodynamic cavitation and ultrasound treatment



Sweden and SLU (Swedish University of Agricultural Sciences)

Mission Statement
SLU develops the understanding and sustainable use and management of biological natural resources. This is achieved by research, education and environmental monitoring and assessment, in collaboration with the surrounding community.



SLU
3000 employee (230 Professors)
4000 students
750 PhD students

JTI – Swedish Institute of Agricultural and Environmental Engineering

JTI is part of the SP-group

Nine companies: JTI, SIK, CBI, Glafo, YKI, SMP, SP, AstaZero och SP Danmark

Over 1 000 employees

Turnover of 1 billion SEK

Biogas reseach at Ultuna campus

- Department for Microbiology, SLU
- Department for Energy and Technology, SLU
- JTI (Swedish Institute of Agricultural and Environmental Engineering)

SLU

Fundamental research | Applied research | Technology

JTI

Anna Schnürer, SLU
Li Sun, SLU
Åke Nordberg, SLU/JTI
Gustav Rogstrand, JTI
Mats Edström, JTI
Henrik Olsson, JTI
Johan Andersson, JTI

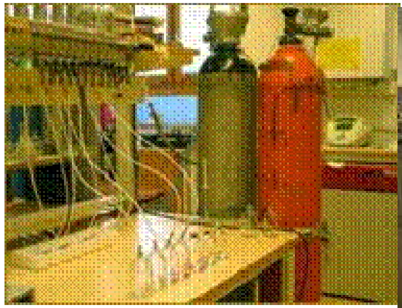
Biogas resources at Ultuna campus

SLU

RESOURCES

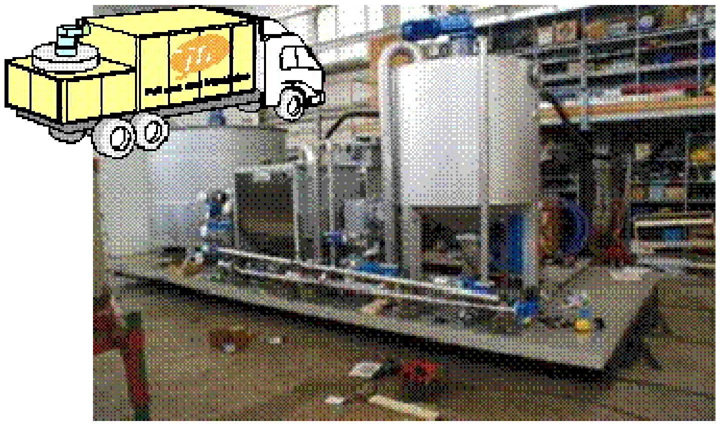
Process evaluation systems

Emission measurements in field and storage tanks



Equipment for anaerobic cultivation

Surveillance and analysis of biogas processes/microorganisms



Mobil biogasplant (JTI) and large-scale biogas plant (SLU)

SLU Ultuna Egendom and Lövsta Biogas plant

- Agribusiness on 1.300 hectares of crop land, 220 hectares of pasture and 850 hectares of forest
- 6 employees
- Biogas plant, misSLUrry!
- Wood chip boiler, 1 800 kW installed effect
- Turnover per year: 2.500.000 €

mis**SLU**rry

- 3 600 m^3 reactor volume
- 21 000 tons substrates per year
- 1 800 000 Nm^3 raw gas per year
- 3 400 MWh electricity per year
- 3 500 MWh heat per year
- Investment: 3.180.000 €

Andreas Grybäck, Ultuna Egendom

Triventus AB

Holding company

Triventus Wind Power AB

- Lease agreement
- Project
- Sales
- Holding

Triventus Consulting AB

- Project development
- Permissions & Building permit
- Wind measurements
- Implementation

Triventus Hydro Power AB

- Owns
- Certificates
- Upgrades
- Operation & Service

Triventus Biogas AB

- Project design
- Construction
- Own
- Operation & Service

Triventus Service AB

- Maintenance
- Operation & Monitoring
- Inspections

http://www.triventus.com/biogas

Lars-Erik Jansson

Triventus Biogas AB-Vision

- To project design, build, own and operate biogas plants
- To collaborate with other stakeholders to develop biogas and creating new business concepts

65% of BroGas AB, Gotland

34% of Vadsbo Biogas AB, Mariestad

+ 5 ongoing projects

Triventus®

WP2

Optimal co-digestion conditions for efficient digestion of lignin and cellulose rich substrates

Develop practical strategies for optimizing biogas yield and cellulose digestion by management of microbial communities in CSTR- reactors.
The goal is to investigate importance of inoculum, having different microbial composition, importance o co-substrate as well as bioagumentation with efficient cellulose degraders.

*Develop a high organic loading plug-flow digestion system for lignin rich substra*tes
The goal is to develop a biogas reactor system in a low-cost tower silo design with minimal space requirements that fits perfect with the autohydrolysis unit developed in WP1

WP2 a **Develop practical strategies for optimizing biogas yield and lignin digestion by management of microbial communities**

2013

Investigation of the importance of inoculum for the efficiency of ligno-cellulose degradation. Experiment in lab scale CSTR

Milestone 7, Q4 2013

Clarification of importance of choice of inoculum for cellulose degrading efficiency and to the stability of cellulose degrading bacterial populations.

SLU

2014

Investigation of the importance of co-substrate or bioagumentation for the deg. efficiency Experiment in lab scale CSTR

Milestone 8, Q4 2014

Clarification of the effect of bio-agumentation/co-digestion on long-term stability of highly efficient cellulose degrading populations

SLU

2015

Most promising set-up based on results from 2013-2014 will be tested in a pilot plant, situated at Lövsta biogas plant

Milestone 9, Q4 2015

Completed pilot scale tests

SLU
JTI
Lövsta
Triventus

WP2 b **Develop a high organic loading plug-flow digestion system for lignin rich substrates**

Design a biogas reactor system(plug flow) in a low-cost tower silo design fits perfect with the autohydrolysis unit developed under task 1.a.

Investigation of efficiency in continuous tests in lab-scale as well as in pilot-scale

Investigation of parameters like fermenter design, fermenter operation mode, hydraulic retention time and temperature as well as micro- and macronutrient supply will be .

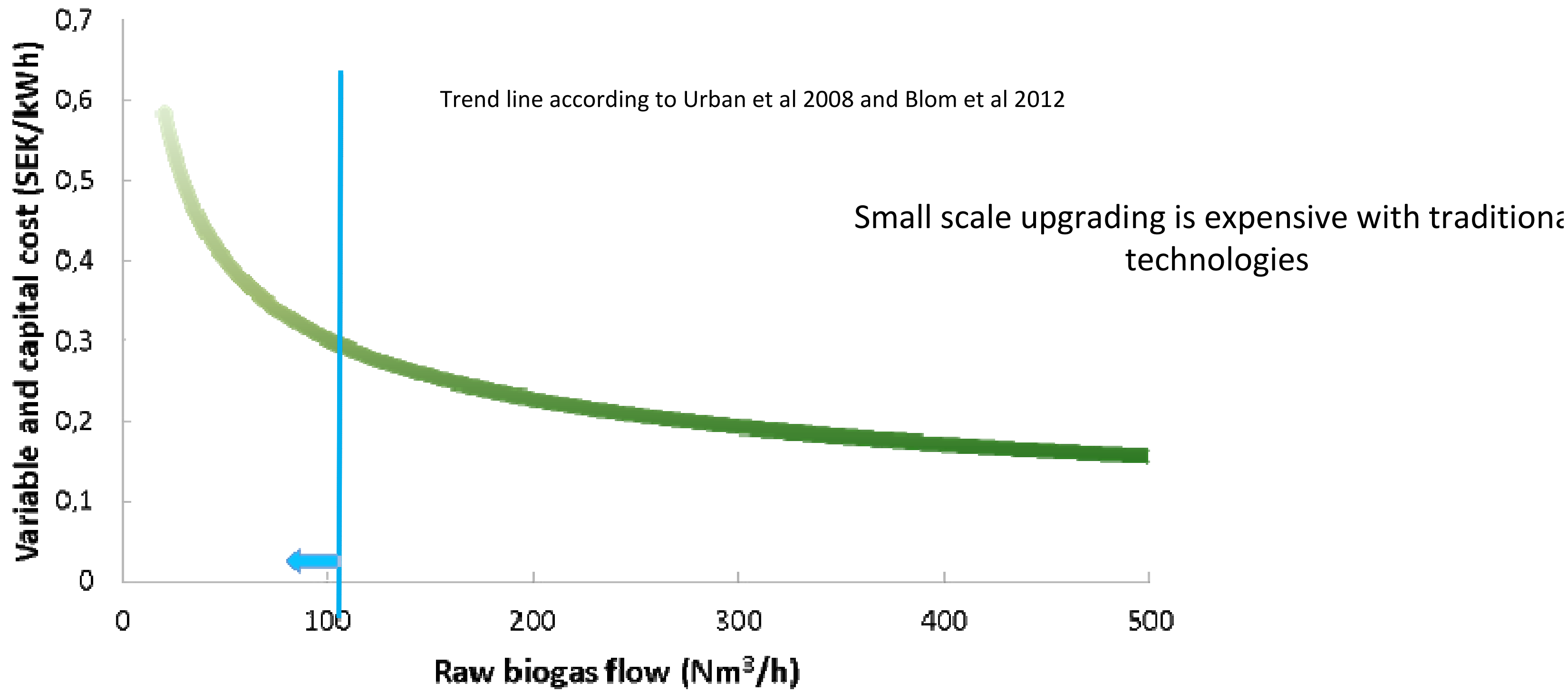
Milestone 10, **Q2 2014** - development of process designs of the plug-flow-reactor, the process water recovery and process control

Milestone 11, Q1 2015 - data collection for the evaluation of digestion efficiency and micro nutrient dynamics as well as the data acquisition for the determination of suitable setting parameters

Involved partners;
DBFZ- Experimental design, Lab.-trials
Ventry – System design, Pilot scale experiment

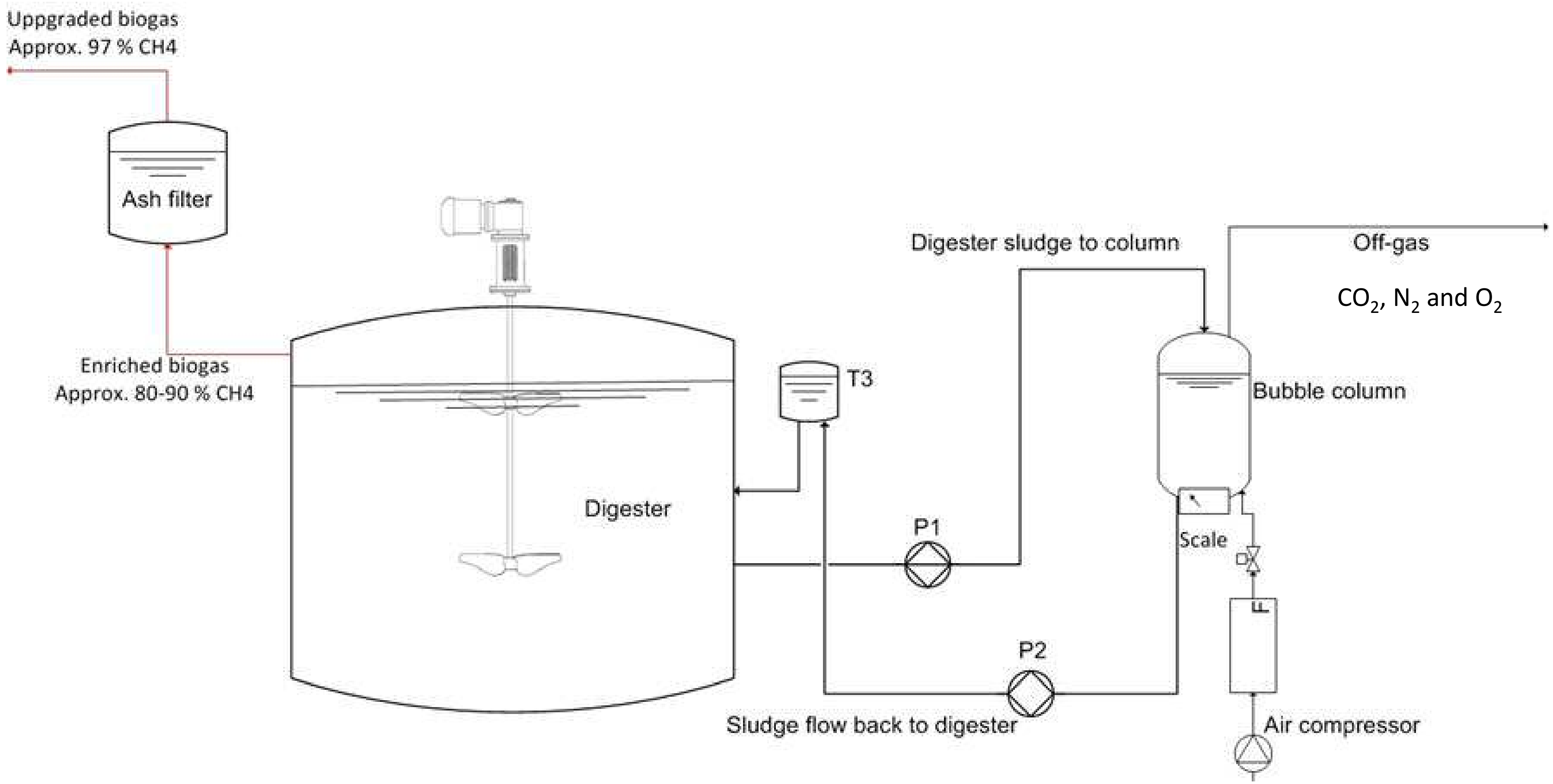
WP3

Simple and low cost upgrading system
at small scale biogas plant.



Hypothesis: In situ methane enrichment combined with wood ash filter can be a cost and energy efficient technology for small scale upgrading of biogas to vehicle fuel

Pilot tests combining methane enrichment and ash-filter for small scale biogas upgrading



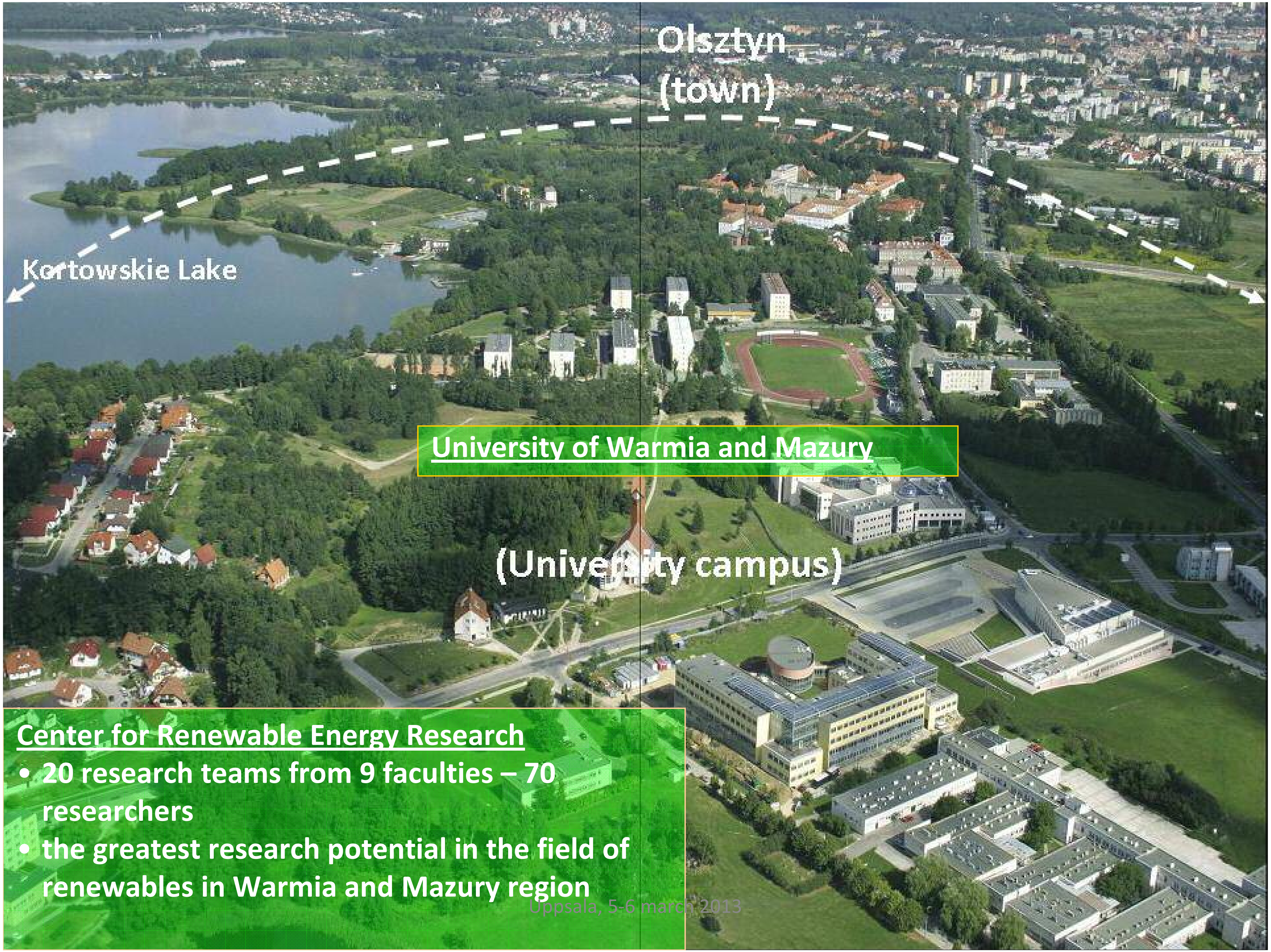
Goals

•Stable and efficient digestion process

•Determination of optimal design parameters for constructions of robust system for biogas upgrading, 10-40 m^3 raw biogas/h

•Reach 97 % methane

•CH_4 losses lower than 2%



University of Warmia and Mazury

Center for Renewable Energy Research

- 20 research teams from 9 faculties – 70 researchers
- the greatest research potential in the field of renewables in Warmia and Mazury region

6th ERA-NET Bioenergy Joint Call

SE Bioemethane
Small but Efficient – Cost and Energy Efficient Biomethane Production

University of Warmia and Mazury
In Olsztyn, Poland
Center for Renewable Energy

Research team:
Janusz Gołaszewski (coord., WP4)
Marcin Dębowski (WP1c)
Marcin Zieliński (WP1c)
Dariusz Wiśniewski (WP4a)
Mariusz Stolarski (WP4b)
Michał Krzyżaniak (WP4b)
Ewelina Olba-Zięty (administr.)

Andrzej Białowiec (Institute of Energy)

WP4: Efficient use of anaerobic digestion residue

Task 4.a. Dewatering of digestate combined with heat treatment for further drying of dewatered solids

•digestate will be centrifuged, using a prototype that will be developed and adapted to the UWM digester (cooperation with the Institute of Energy Ltd.)

- the liquid reject from the centrifuge will be treated by integration of a system of shallow, horizontal subsurface flow artificial wetlands to remove nitrogen
  - the treated liquid will be then recycled back to the digester to reduce the use of fresh water for dilution of substrate.
    - the dewatered solid fraction will be further dried at different temperatures, using a tube dryer that has been developed at UWM

WP4: Efficient use of anaerobic digestion residue

Task 4.b. Dried digestate as a fertilizer and soil amendment in energy crop production

•field trial will be established: different perennial lignocellulosic crops with biofertilizer application (WP4a), the feed stock may compose substrate for biogas plants (WP1c) will be grown

- the influence of different forms and application rates of biofertilizer on physical and chemical soil properties and the impact on crop yield will be analyzed

  (resulting data will be combined with data from task 4.a.)

  •Life Cycle Assessment of digestate conversion and utilization as fertilizer will be done

- 3-year field experiment will be established in the spring of 2013 at the UWM experimental station in Łężany
- Three factors will be studied: **1. most suitable crop** (perennial lignocellulosic crops: *Sida hermaphrodita*, *Miscanthus*, *Helianthus tuberosus*, *Helianthus salicyfolius*) **2. most suitable fertiliser** (five treatments: three variations of biofertilizer produced by drying at three different temperatures, one type of mineral fertilizer and one plot with no fertilizer) **3. most suitable fertiliser application rate** (two application rates: 85 kg N/ha and 170 kg N/ha)

Institute of Energy

Activities

- Waste biodrying technology for efficient production of high quality RDF and SRF
- Solutions for RDF and SRF final thermal reuse (gasification, pyrolysis and torrefaction).
- Waste treatment technologies: Composting System, Landfill reactor
- Wastewater treatment technologies; Treatment in constructed wetlands.

www. instytutenergii.pl

Scientific and development research:

- modeling and steering of biodrying, biostabilisation, and composting of waste.

- thermal waste and biomass treatment in processes of: pyrolisys, gasification, and torrefaction.

- operation of landfill bioreactors.

- waste morphological composition, and physical, and chemical properties.

Thank you for listening!