The project BioBoost – Optimisation of biofuel production from residues and waste materials

A. Niebel, R. Stahl, A. Kruse
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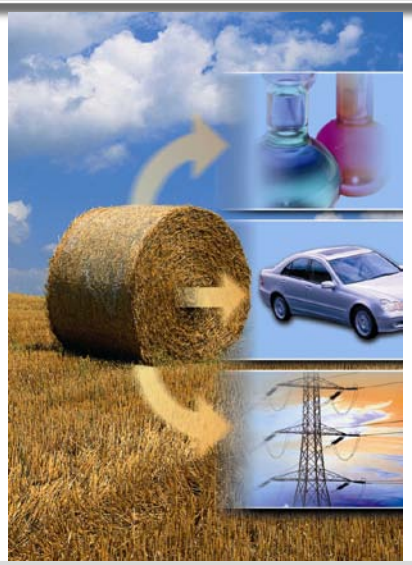
Institute of Catalysis Research and Technology (IKFT)



A European R&D project funded under contract 282873 within the Seventh Framework Programme by the European Commission.

The project BioBoost – Optimisation of biofuel production from residues and waste materials

Karlsruhe Institute of Technology

Outline:

I. General information on the project

Objectives, structure, consortium

II. Thermo-chemical conversion processes

a: Fast pyrolysis

Feedstock & energy carriers, utilisation, realisation

b: Hydrothermal carbonisation

Energy carrier, properties & utilisation, realisation

Objectives of the project

BioBoost is to pave the way for **de-central conversion** of biomass to

- Optimised, high energy density carriers
- Utilisation in
  - large scale applications for the synthesis of transportation fuel and chemicals
  - small-scale combined heat and power (CHP) plants

The project aims at making a substantial improvement towards **increasing the efficiency of the use of biomass and residues in the future**.

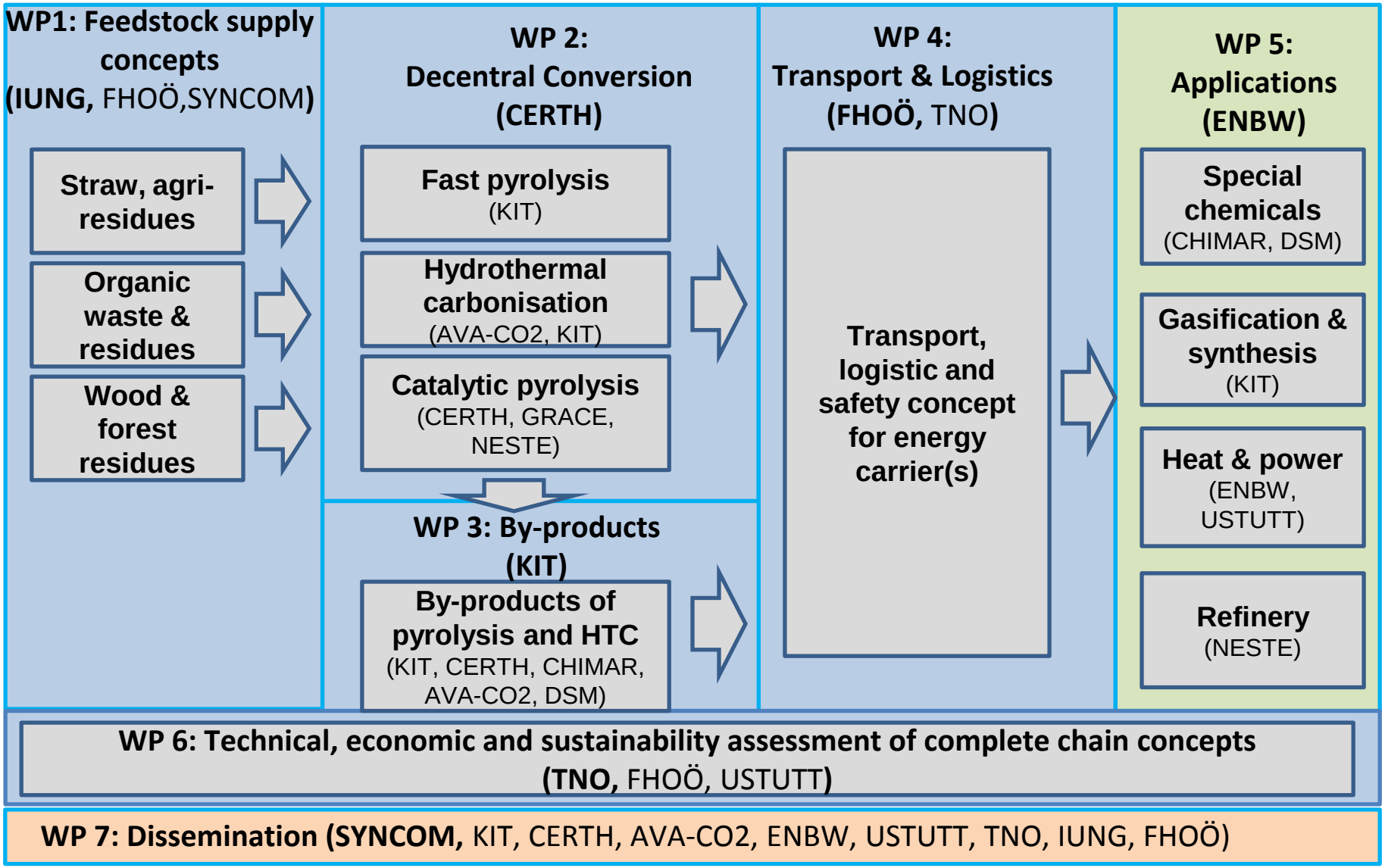
Study the conversion of dry and wet **residual biomass and wastes** to intermediate energy carriers by:

- **fast pyrolysis**
- **catalytic pyrolysis**
- **hydrothermal carbonisation**

Major activities include the:

- Optimisation of the logistic chains and
- Techno-economic, social and environmental assessment of complete chains

Project structure

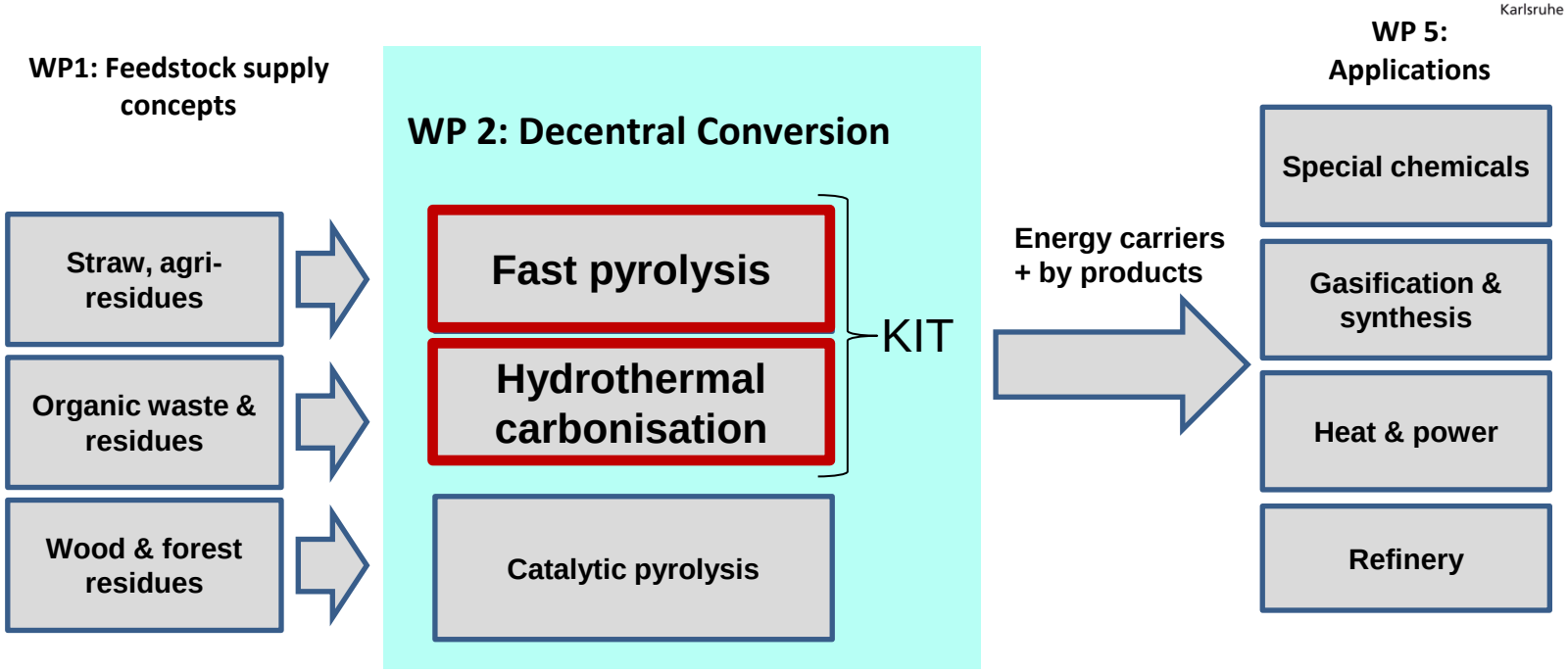


Consortium

13 partners from 6 countries from R&D and industry

01 Karlsruher Institut für Technologie (KIT)
02 Center for Research and Technology Hellas (CERTH)
03 AVA-CO2-Forschung GmbH (AVA-CO2)
04 CHIMAR Hellas SA (CHIMAR)
05 ENBW Energie Baden-Württemberg AG (ENBW)
06 Nederlandse Organisatie voor Toegepast Natuurwetenschppelijk Onderzork – TNO (TNO)
07 GRACE GmbH & CO KG (GRACE)
08 Instytut Uprawy Nawozenia I Gleboznawstwa, Panstwowy Instytut Badawczy (IUNG)
09 FH OÖ Forschungs & Entwicklungs GmbH (FHOÖ)
10 Neste Oil Corporation (NESTE)
11 SYNCOM Forschungs- und Entwicklungsberatung GmbH (SYNCOM)
12 DSM Chemical Technology R & D BV (DSM)
13 Universität Stuttgart (USTUTT)

Thermo-chemical conversion processes



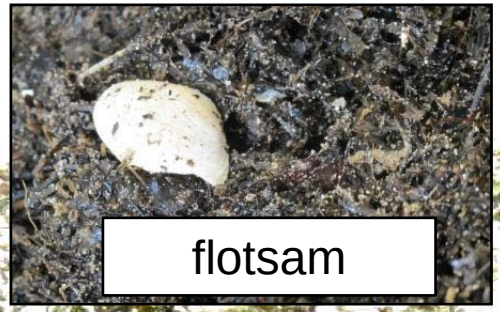
KIT+AVA-CO2:
Investigation of the conversion of residues and waste by

- Fast pyrolysis (FP) appropriate for feedstocks with low moisture
- Hydrothermal carbonisation (HTC) appropriate for feedstocks with high moisture

→ Production of different energy carriers for various applications → flexibility!

Fast Pyrolysis: Flexibility of feedstock


wheat straw


flotsam


corn stover

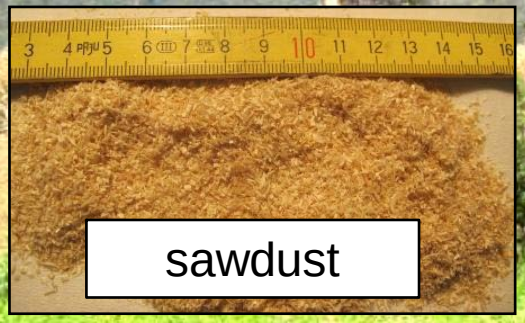

rape straw

wide variety of dry residues and waste materials usable

→ higher security of supply

→ stabilisation of feedstock costs


waste wood


sawdust


empty fruit bunches


eucalyptus

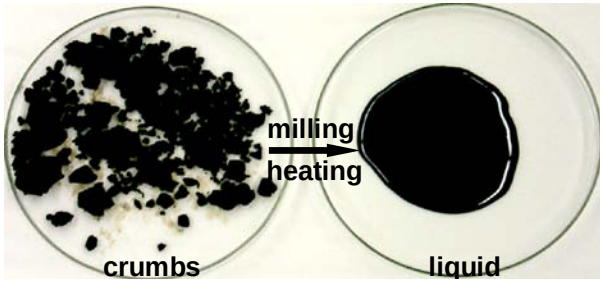
Fast Pyrolysis: Flexibility of products

Possible energy carriers

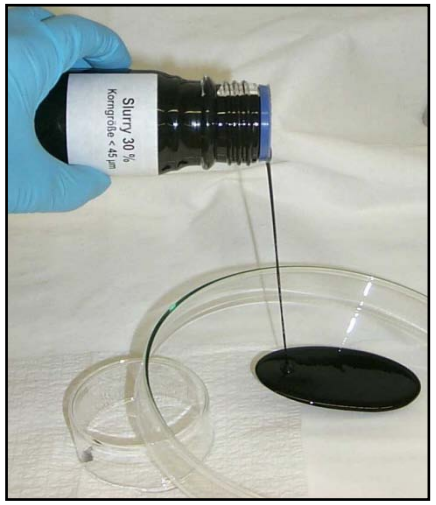
- Depending on precipitation and further manufacturing of products, different energy carriers are possible:
  - Char
  - Pyrolysis oil
  - BioSynCrude
  - Crumbs
  - Pastes

Combination of products

Char

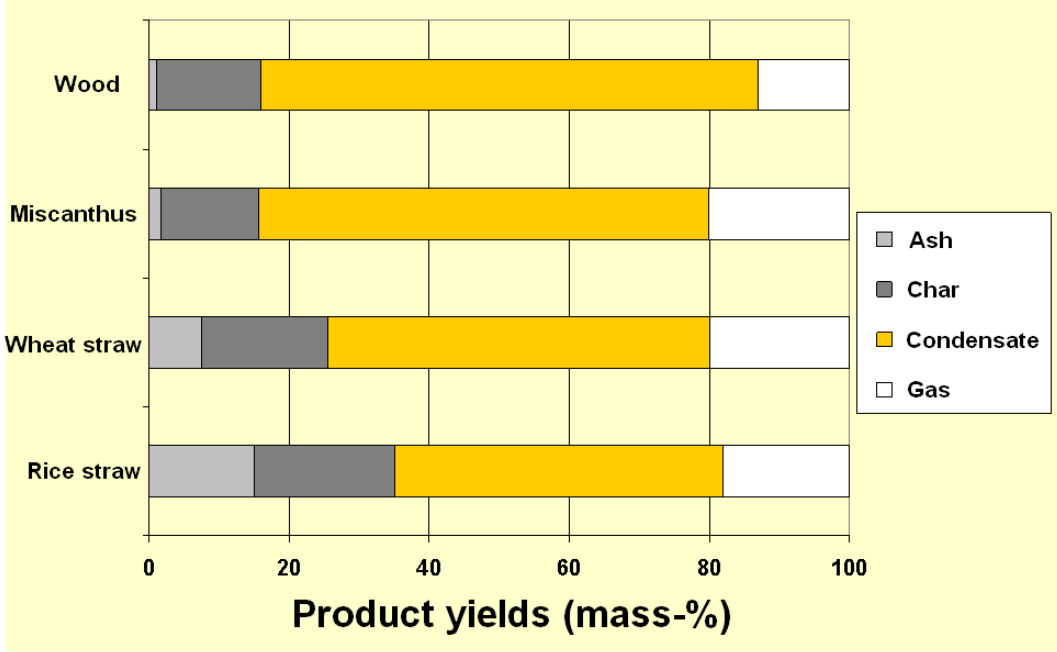


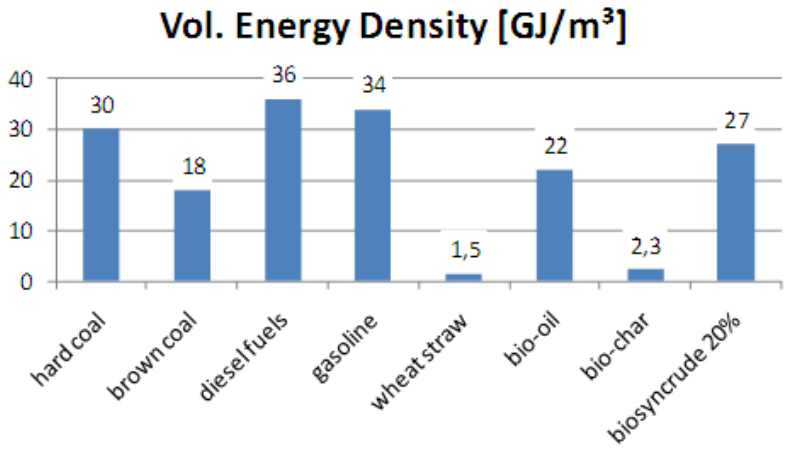
BioSynCrude
= Slurry of Char
+ Pyrolysis oil



Fast Pyrolysis: Flexibility of products

Yields of products and energy density of different energy carriers





- Energy densified *biosyncrude* (= Mixture of pyrolysis oil + char) as feed for entrained flow **gasifier** in the bioliq®-process
- High energy density carriers for **synthesis of transportation fuel** and **chemicals** or direct use in small-scale combined **heat and power plants**

Fast Pyrolysis: Process development
Pilot plant at KIT (500 kg/h Biomass)

Karlsruhe Institute of Technology

Biomass preparation

Fast pyrolysis reactor

Pyrolysis product recovery

Feed stock storage

Biosyncrude preparation

Hydrothermal carbonisation

Energy carrier: **HTC Coal**

To investigate:
Combustion in CHP plants (designed for brown and black coal)

Advantages HTC coal:

- Energetic utilisation of organic waste materials
- Higher heating value than biomass
  → more economic transport than biomass
- Reduced content of minerals like potassium salts and chlorine
  → more favorable combustion behaviour than biomass

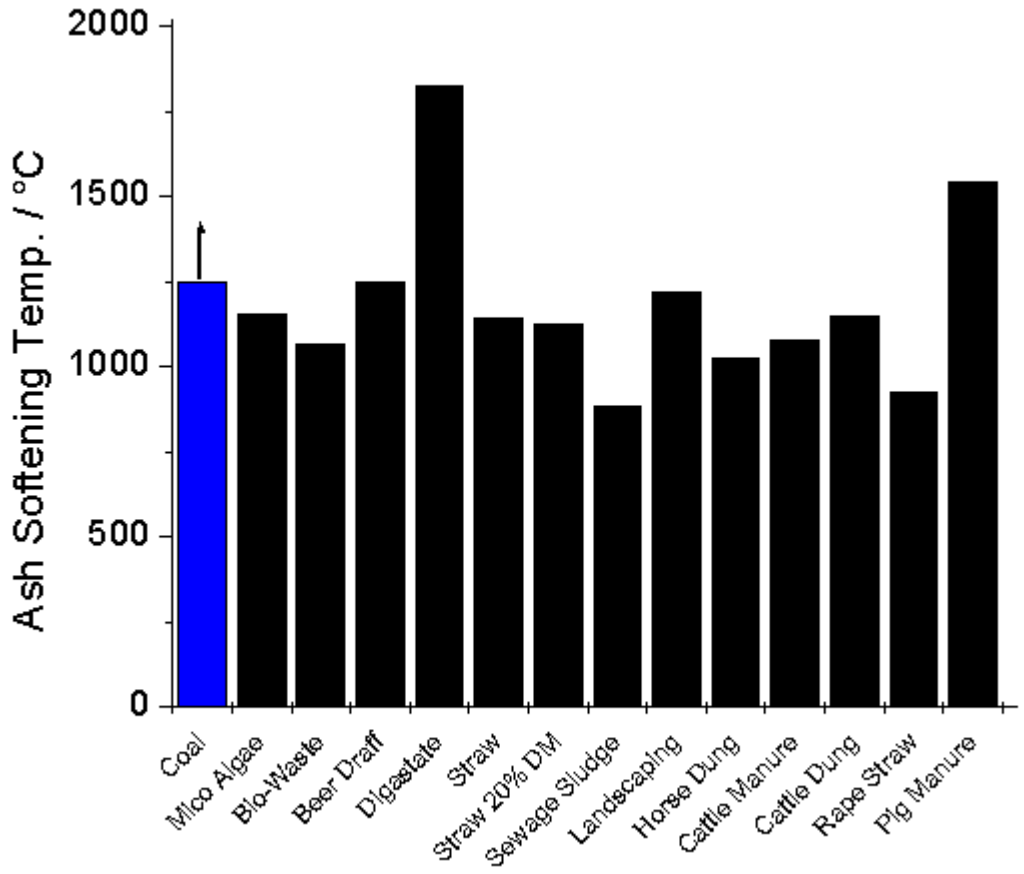
Issues in combustion devices:
Slagging, fouling, corrosion, emissions…

Properties of interest:
Heating value, moisture, ash content, ash melting behaviour, volatiles content, concentration of certain elements…

Hydrothermal carbonization

HTC coals: Fuel property *Ash softening temperature*

Comparison fossil coal with HTC coals



- Similar to brown coal
- Much more suitable for co-firing than biomass

But: High amount of volatiles

→Limitation of share in co-firing

→Combustion experiments with mixtures of fossil coal and HTC coal necessary (co-firing)!

Investigation in the BioBoost project

Hydrothermal carbonization: Process development
Plants at AVA-CO2-Forschung in Karlsruhe

“*HTC0*”: Industry size reaction plant

Capacity: ca. 1 t HTC coal per batch

An industry plant consists of 6 reaction tanks

“*K3*“: Test reactors (335 l)

Test facility for different feedstocks and reaction parameters (more than 100 biomasses tested)

Thank you for your attention! Questions?

Project facts:
Project Acronym: BioBoost
Project Reference: 282873 in FP7

THEME, ENERGY.2011.3.7-1:
Development of new or improved sustainable bio-energy carriers

Contract type:
Collaborative project
Co-ordinator:
Karlsruhe Institute for Technology (KIT)

Start: 01/2012
Duration: 42 month

Budget: 7.3 Mio €
Funding: 5.1 Mio €

13 Partners from 6 countries

http://www.bioboost.eu

BioBoost

We are open to collaborations and future projects!

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