Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

DBFZ

Wood fibres as an example for innovative sector coupling

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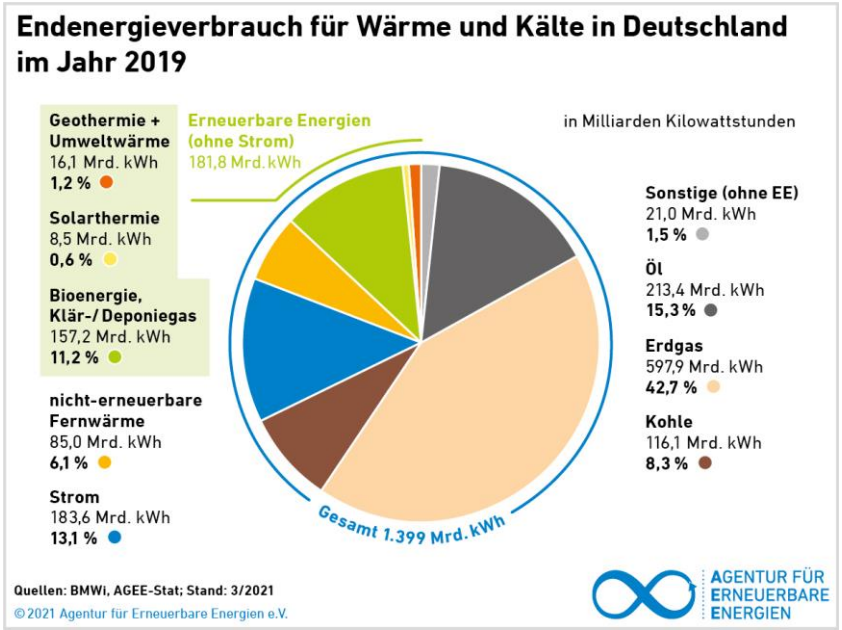
Introduction

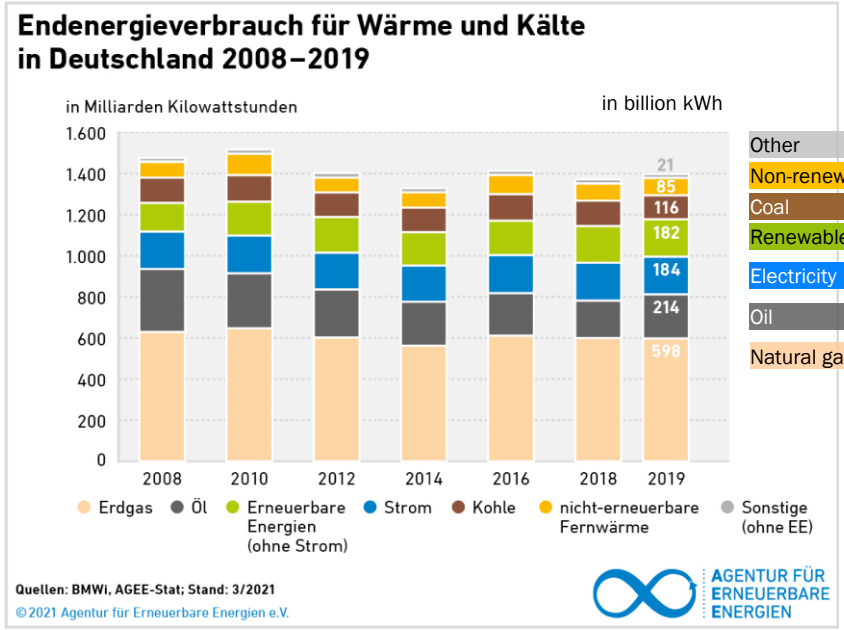
Wood fibres as an example for innovative coupling of the energy sector and the horticultural sector

Basic data:

- energy consumption for heating and cooling in Germany
- growing media consumption in Germany

Final energy consumption for heating and cooling in Germany

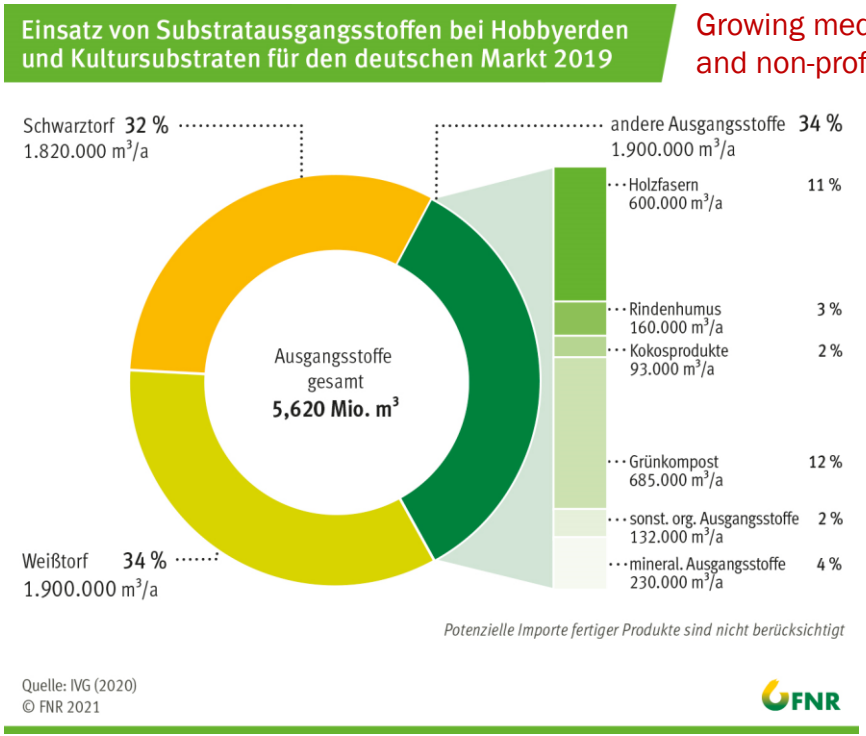




https://www.unendlich-viel-energie.de/mediathek/grafiken/endenergieverbrauch-fuer-waerme-und-kaelte-in-deutschland-2019 (download: 08/2021)

The figures were created in the frame of the project „Kommunale Wärmewende“ supported by Deutsche Bundesstiftung Umwelt (DBU).

Growing media in Germany



Growing media use in professional and non-professional sector

black peat

white peat

other raw materials (sum)

wood fibre*

*mostly coniferous wood

bark humus

coco products

green compost

other organic materials

mineral materials

Source: Fachagentur Nachwachsende Rohstoffe e.V. (FNR)
https://mediathek.fnr.de/grafiken/daten-und-fakten/moor-torf.html (download: 08/2021)

PapIGas project at a glance

With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

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Full title: **Biomethane and peat substitute from poplar wood**

Supported by Federal Ministry of Food and Agriculture by decision of the German Bundestag

Funding code: 22038318

PaplGas

VATTENFALL

1913
we make it grow

With support from
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Biomethane and peat substitute from poplar wood (PaplGas project)

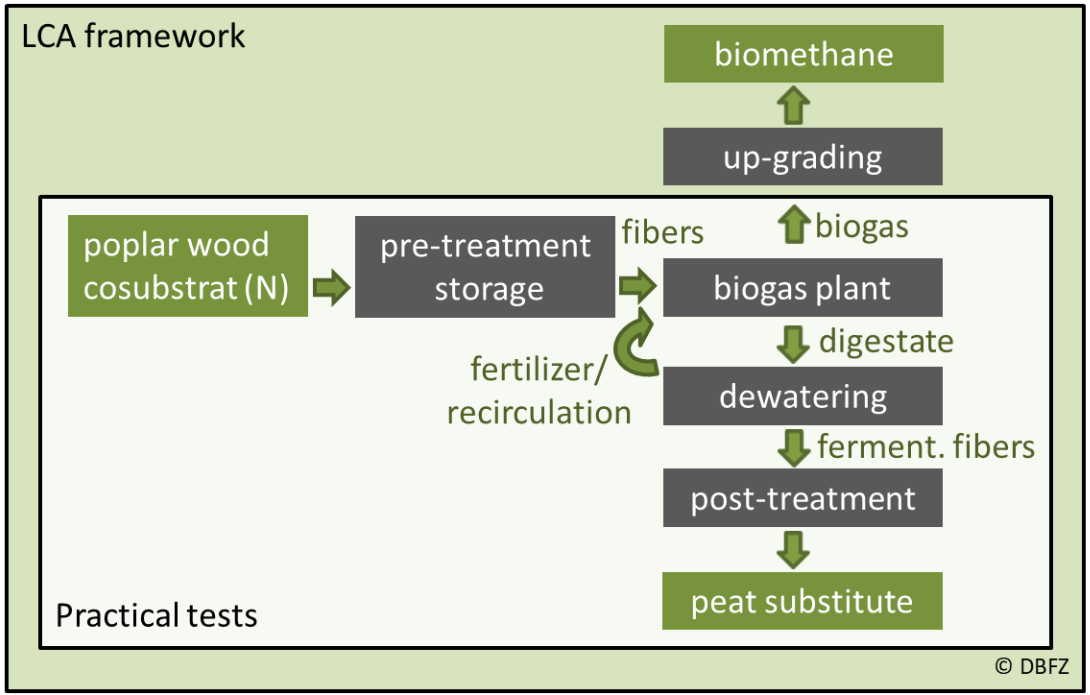
Partner: DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Vattenfall Energy Solutions GmbH (ESG)
Klasmann-Deilmann GmbH (KD)

Main objectives:

- Development of a process for the continuous, stable, and high-yield anaerobic digestion of poplar wood fibers to biogas
- Development and testing of crop cultivation utilisation concepts for fibrous fraction of digestate as peat substitute

Duration: 04/2019 - 06/2021

PapIGas - Process chain



Innovations

- biogas production via anaerobic digestion of poplar fibres from short rotation plantations
- material use of the digested wood fibres as a peat substitute

Poplar wood and mechanical pre-treatment

- harvest from short-rotation coppice close to Berlin/Germany by Vattenfall Energy Solutions GmbH (ESG) / Energy Crops GmbH (ENC)
- extrusion by Leibniz-Institut für Agrartechnik und Bioökonomie e.V. (ATB), Potsdam/ Germany, with a twin screw extruder MSZK B90e, power 90 kW
- 3 extruder gap sizes: 15, 20 and 25 mm

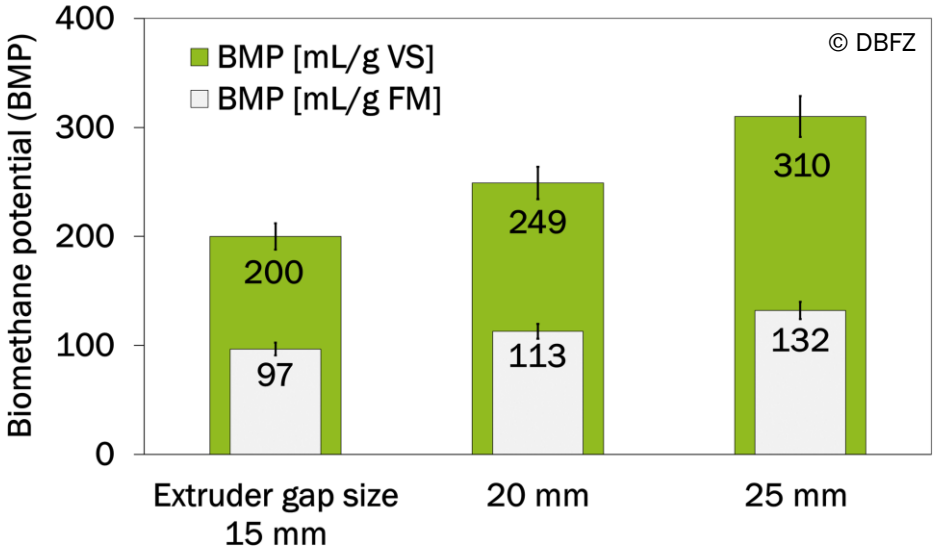
Poplar wood chips and fibres after extrusion [ATB, Pecenka 12/2019]

Biochemical methane potential (BMP)

Biochemical methane potential (BMP) tests in laboratory scale in accordance with the VDI guideline 4630 (2016) in triplicates each were conducted in AMPTS II device (Bioprocesscontrol, Lund, Sweden, temperature set on 39 ° C ±1 ° C). The methane potentials were standardized (dry gas, 273.15 K, 1013.25 hPa).

Batch-Test with AMPTS II-equipment by Bioprocesscontrol [DBFZ]

BMP results



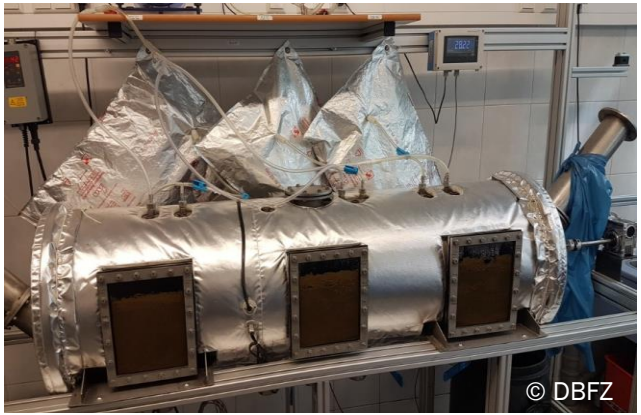
Surprisingly, the methane potentials rose with increased particle size and water content. The best case, with a gap size of 25 mm, reached methane potentials of 310 mL/gVS and 132 mL/gFM.

3 extruder gap sizes: 15, 20 and 25 mm

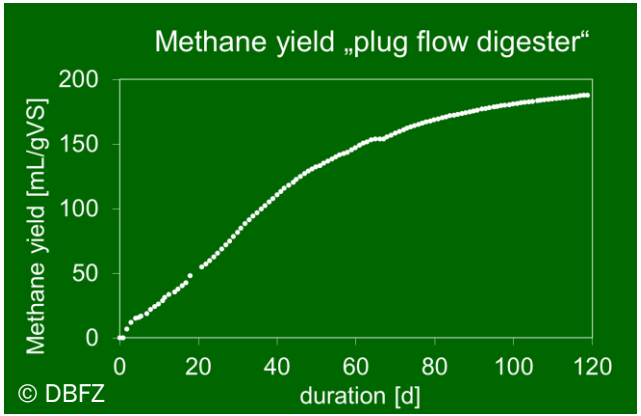
dry matter content: 49.3, 46.4 and 43.5 % of fresh matter

Batch-Test with 160 L „plug flow digester“

Production of digested fibres as peat substitute for horticultural use



Batch-Test with 160 L „plug flow digester“ [DBFZ]

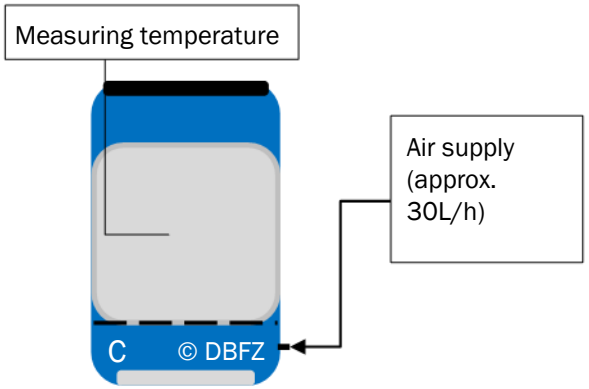


standardized methane yields (dry gas, 273.15 K, 1013.25 hPa)

	Liter	Kg FM
wood fibres	120	18
inoculum	140	140

Results of the trial with inoculum-wood fibres-mixture:
approx. 4.1 m³ biogas, methane content 57 %, 193 mL/g VS methane yield

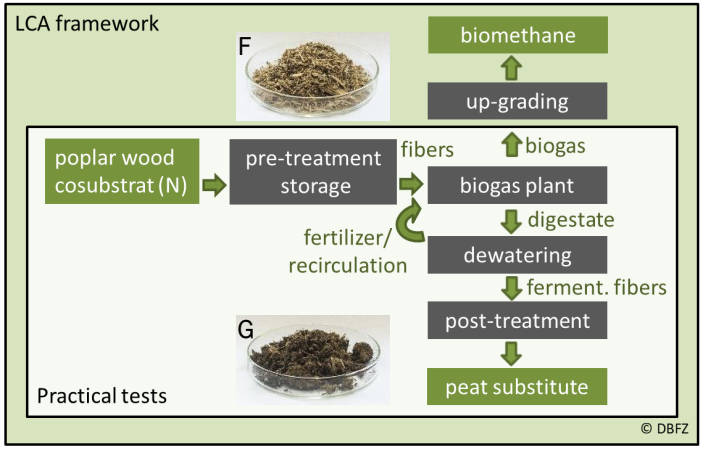
Separation & composting of the digestate



A) Solid-liquid separation via sieving, B) lab-scale composter, C) scheme lab-scale composter [DBFZ]

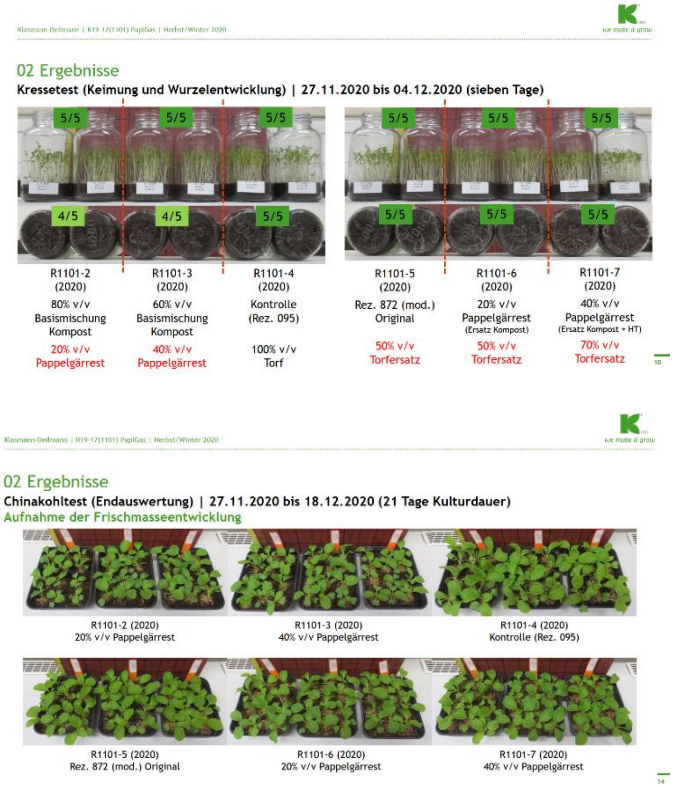
1. Vibrating sieve and ambient air drying -> approx. 16 kg fibres DM 12 % of FM, VS 92 % of DM
2. Composting of the digested fibres together with plastic carriers in a tempered (36 ° C with heating mat) and aerated (30 L/h with compressed air) plastic barrel -> DM 15 % of FM, no self-heating occured
3. Opening of the digester to lower the water content -> no self-heating occured
4. After 6 weeks of composting -> DM 32 % of FM; VS 97% of DM, 2.6 kg VS IN/1.2 kg VS OUT, VS reduction 46%

From fibre to peat substitute



A) poplar fibres, B) digestate, C) liquid digestate, D) solid digestate, E) peat substitute, F) detail poplar fibre, G) detail peat substitute [DBFZ]

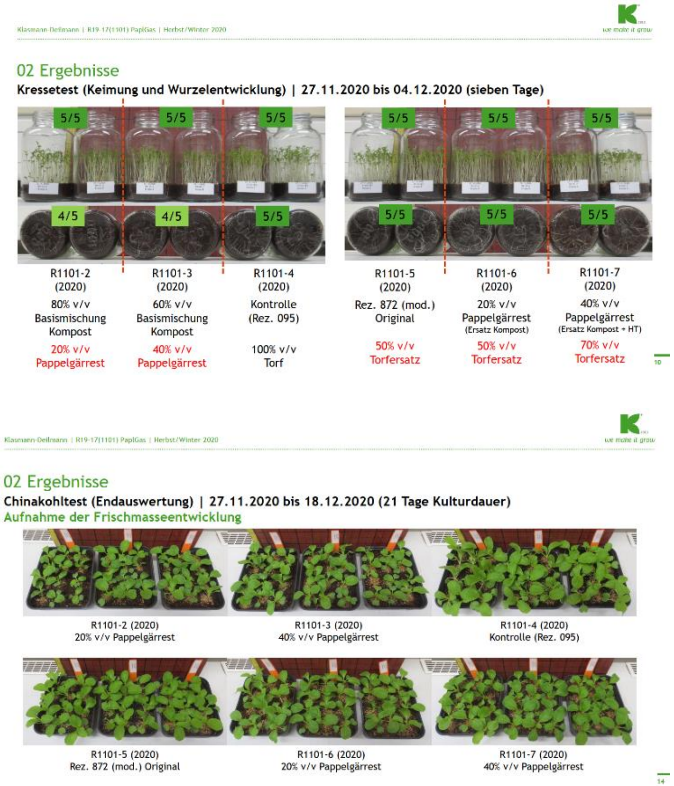
Peat substitute test with cress and cabbage



Successful plant tests with cress and Chinese cabbage [KD, Nordzieke 12/2020]

- physical, chemical and biological characteristics +
- water content −
- optical/haptical structure and color (similarities to white peat) +
- germination success and no phytotoxic effects on growing +

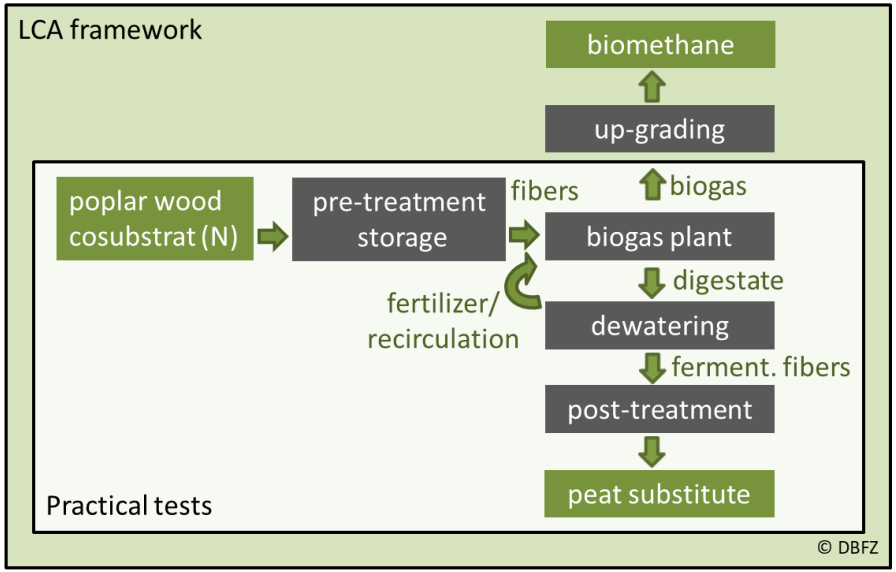
Peat substitute test with cress and cabbage



Successful plant tests with cress and Chinese cabbage [KD, Nordzieke 12/2020]

- nitrate level dependent on co-substrate
- 20 d N-immobilisation <100 mg N/L
  -> max. 40 Vol.-% in growing media mix
- Further improvement by the use of horn meal as co-substrate
- no specialties in fungus

Promising process chain



Pre-treatment: chopping + extrusion

Storage: “wet”, air-tight

Biogas digester: plug flow

Dewatering: sieving + drying

Post-treatment: composting

Conclusion

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- Fundamental feasibility of the whole process chain from short-rotation coppice poplar wood to peat substitute via anaerobic digestion in lab-scale could be demonstrated
- Further improvements are needed, e.g. higher methane yields in semi-technical and full-scale AD-processes
- The 1st phase (PaplGas) of the project has been finished in 06/2021.
  The project report in German language will be published next year.

Outlook

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- Further investigations are planned.
- The evaluation of the application for part 2 of the project (PapIGas2) is ongoing.
- There will be a great demand of peat substitutes as well as energy carriers like biomethane in future to save moors and protect the climate.
- Wood fibres are one example for innovative coupling of the energy sector and the horticultural sector. -> A closer cross-sectoral cooperation of several players is essential for a fast bioeconomic transformation.

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Smart Bioenergy – Innovations for a sustainable future

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