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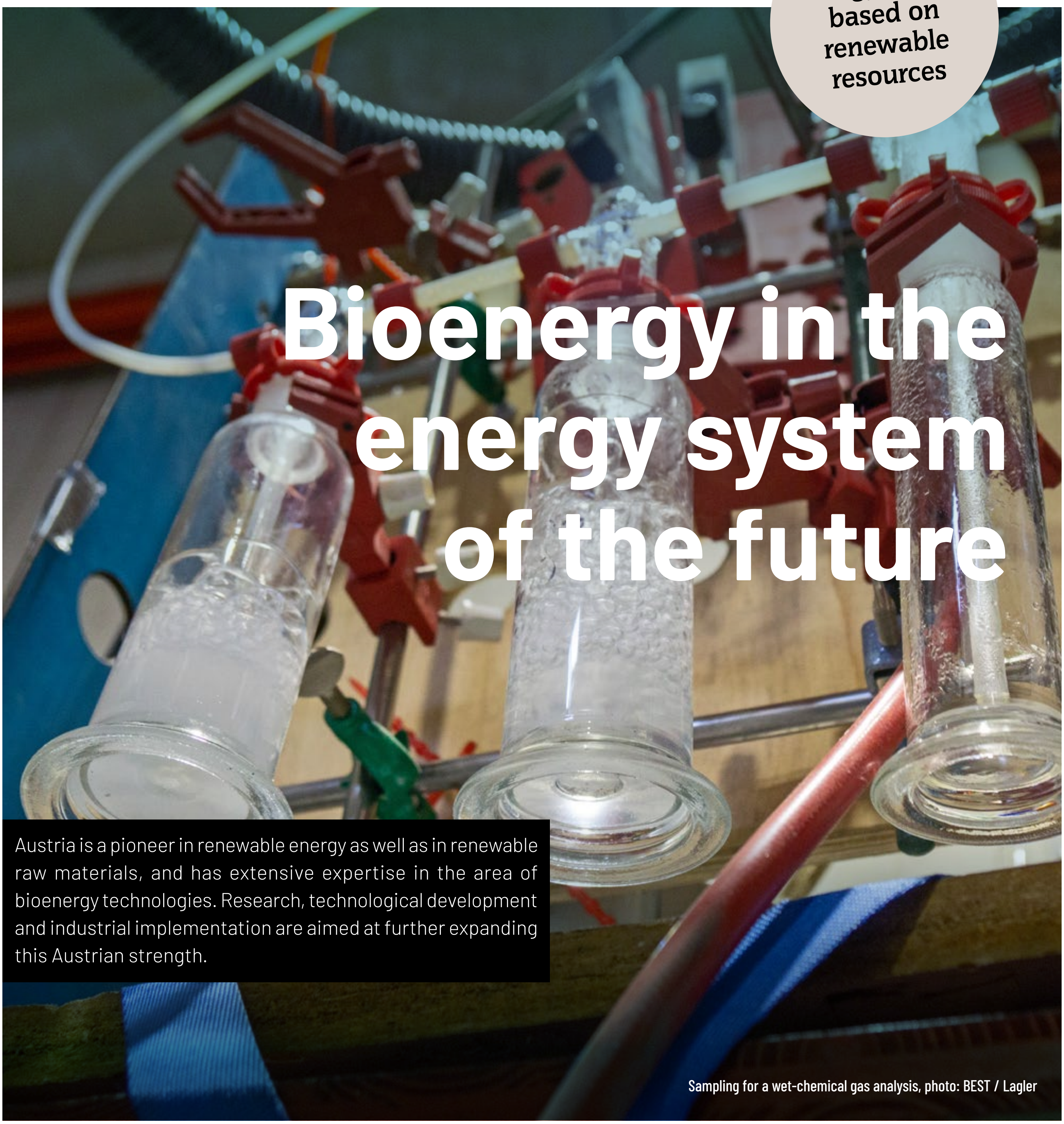
Current developments and examples of sustainable energy technologies

Federal Ministry Republic of Austria Transport, Innovation and Technology

klima+ energie fonds

Energy supply based on renewable resources

Bioenergy in the energy system of the future



Austria is a pioneer in renewable energy as well as in renewable raw materials, and has extensive expertise in the area of bioenergy technologies. Research, technological development and industrial implementation are aimed at further expanding this Austrian strength.

Sampling for a wet-chemical gas analysis, photo: BEST / Lagler

Photo: BEST / Lagler

Bioenergy: Technology of the future

R&D in the efficient use of renewable resources

Achieving the national climate goals and the transition to a decarbonised economy require increased utilisation of renewable energy sources, expanded infrastructure and improved storage capabilities, as well as measures aimed at maximising energy and resource efficiency.

The Climate and Energy Strategy #mission2030, passed by the Austrian government in 2018, defines the core action areas and goals for the transformation of the energy system.[1] Austria's potential for innovation will drive the development of forward-looking technologies and solutions to an ecologically sustainable, competitive, safe and affordable energy future.

The efficient use of renewable resources plays a critical role. In 2019, as a key component of the Austrian Climate and Energy Strategy, a bioeconomy strategy was developed with the goal of a sustained reduction in fossil energy use and consumption of materials produced from fossil fuels.

BIOENERGY LEADER

Austria is an international leader in the use of renewable energy and resources, with extensive expertise and years of experience in research, technological development and industrial implementation. The field of bioenergy is one of Austria's particular strengths, and one with great potential for the future. Bioenergy has developed in recent years into one of the most important sources of domestic energy, and is a major portion of the energy supply. The percentage of bioenergy within total energy consumption (including transportation) increased from 9% in 1990 to 17% in 2017.[2]

After the decision to draft a Renewable Energies Expansion Act (EAG) in 2018, the biogenic portion of energy production can be expected to grow further still in the coming years. The use of biomass to produce energy contributes to reduced greenhouse emissions, and therefore to meeting climate goals while also lowering the dependence of the domestic economy on energy imports.

Bioenergy has the potential to interlink the sectors of electricity, heat and mobility as part of an integrated energy system in future energy scenarios. Biomass fuels are an easily storable energy source that can supplement wind and solar power: as a fuel, to generate heat for industrial processes, or as a backup for an energy supply based on fluctuating renewable sources.

BIOECONOMY STRATEGY FOR AUSTRIA

The bioeconomy strategy lays out concrete measures to further establish Austria's bioeconomy, with the goal of boosting sustainable growth in bio-based products, bioenergy use and associated technologies and services. At the same time the goal is to make the Austrian economy more competitive on the global market by positioning Austria in the top ranks in terms of bioeconomy.

www.bmvit.gv.at/themen/innovation/publikationen/energieumwelttechnologie/biooekonomiestrategie.html

Photo: BEST / Lagler

WHAT IS BIOMASS?

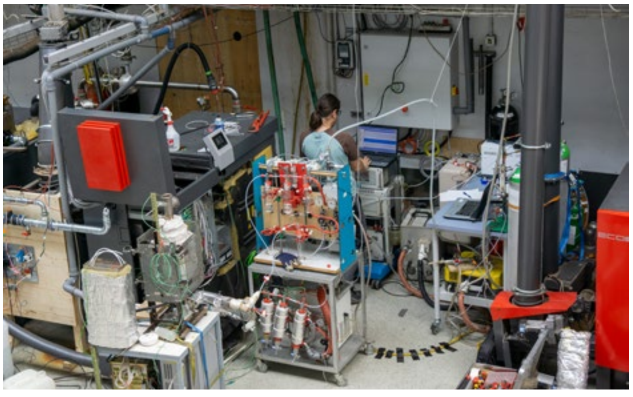
Biomass is stored solar energy in the form of wood, energy crops or biogenic by-products like straw, biowaste and liquid manure. Modern technologies make it possible to generate heat and electricity, as well as to produce chemical products like synthetic biofuels or hydrogen from solid, liquid or gaseous biomass.

JOBS AND VALUE CREATION

Bioenergy creates local value and jobs, especially in rural regions. The Austrian bioenergy industry offers roughly 20,000 green jobs today, with an annual turnover of about 3 billion euros.[3]

Bioenergy innovations developed in Austria are in demand throughout the world. Technologies for the use of bioenergy are the basis for numerous patents, and have enabled the establishment of leading market players. Research and development in all sectors of the bioeconomy help improving the prospects for Austrian companies to expand into global export markets.

Wood gas CHP plant: Wood gas processing via hot gas filtration, photo: BEST / Lagler



Measurement setup for evaluating the wood quality via online and offline analysis methods, photo: BEST / Lagler

RESEARCH AND DEVELOPMENT

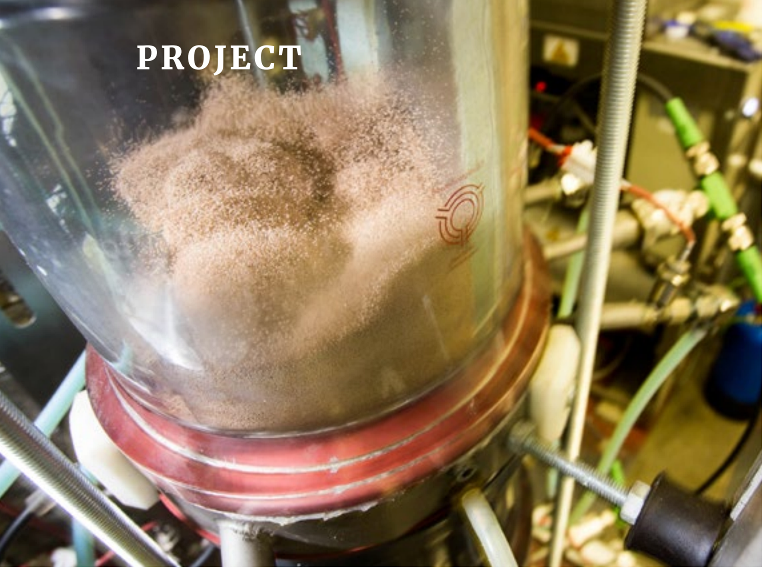
The efficient use of renewable resources for energy production has been at the heart of Austrian FTI initiatives for several years, with continued development efforts directed at all energy forms (solid, liquid and gaseous bioenergy). Austrian researchers and companies are working intensely on developing and testing innovative concepts for a most efficient use of biomass with minimal environmental impact.

Austria takes part in the international research networks ERA-NET Bioenergy und IEA Bioenergy (see page 4 und 9). This edition presents a number of transnational projects with Austrian participation which are carried out within the framework of ERA-NET Bioenergy. The focus lies on industrial applications and large-scale bioenergy plants. ●

ENERGY RESEARCH EXPENDITURES 2018[4]

Total	EUR 144.1 million
Energy efficiency	EUR 66.9 million
Transport & storage	EUR 22.4 million
Renewable energy	EUR 22.4 million
Bioenegy	**EUR 7.8 million**

[1] mission2030.info
[2] Bioökonomie – Eine Strategie für Österreich; BMVIT, BMBWF, BMNT 2019; www.bmvit.gv.at/themen/innovation/publikationen/energieumwelttechnologie/biooekonomiestrategie.html
[3] Study. Bioenergy in Austria, BEST - Bioenergy and Sustainable Technologies GmbH, 2019
[4] Energy Research Survey 2018 - Public Expenditures in Austria, Austrian Energy Agency, Vienna 2019



Detailed view of a fluidised bed, photo: TU Wien (Vienna University of Technology), Institute of Chemical Process Engineering and Energy Technology

OxyCar-FBC

New processes for thermal utilisation of biomass

In the ERA-NET project OxyCar-FBC[1], an Austrian-Swedish consortium of research institutions and industry players is developing two new processes for efficient and climate-friendly generation of energy from biomass. TU Wien (Vienna University of Technology), Institute of Chemical, Environmental and Bioscience Engineering is working together with Bertsch Energy (Bludenz), Chalmers University of Technology (Göteborg) and the energy supplier Göteborg Energi.

INNOVATIVE CONCEPT

The fluidised bed method, a robust, flexible and low-emission combustion technology, is frequently used today for the combustion and gasification of biomass. Quartz sand generally serves as the fluidised bed material. The key approach of OxyCar-FBC is to replace the typical bed material partially or entirely with metal oxides. These "oxygen carriers" are oxidised when they come into contact with air, and reduced when they come into contact with fuel, thus allowing them to act as selective oxygen transporters. These attributes will be leveraged to make the fluidised bed method more efficient, and to separate out the CO_2 produced by combustion directly within the process. The "OCAC" method could be implemented on an industrial scale in a short period of time, and the "chemical looping combustion" technology has the potential to make thermal biomass utilisation significantly more efficient and environmentally friendly over the long term.

OXYGEN CARRIER AIDED COMBUSTION (OCAC)

In typical fluidised bed combustion setups for biomass or waste, one of the greatest challenges is mixing the fuel and air needed for combustion sufficiently. A local oxygen shortage often arises in the vicinity of the fuel infeed, while a large excess of air prevails in areas farther away. There are also fluctuations due to the fuel composition (e.g. the water content) and the quantity of fuel. To even out these fluctuations, a 20% excess of air must be present in the combustion chamber. In the OCAC method, the typical bed material is replaced by an oxygen carrier that can buffer the oxygen and transport it within the fluidised bed. This substance absorbs the oxygen in the fuel lean zones and releases it again in the fuel rich zones, solving mixing problems and making the combustion more efficient.

ERA-NET BIOENERGY

ERA Net helps to support the coordination of national and regional funding programmes (within the framework of the EU Horizon 2020 programme), thereby fostering cross-border research and technological cooperation in Europe. ERA-NET Bioenergy is a network of national funding agencies taking forward the development of bioenergy technologies. By participating in this international cooperation, the Climate and Energy Fund and the Federal Ministry for Transport, Innovation and Technology (BMVIT) are supporting the coordinated funding of transnational research and development projects for sustainable use of bioenergy. Participating countries are Germany, the Netherlands, Austria, Poland, Sweden, Switzerland and the United Kingdom.

www.eranetbioenergy.net

Fluidised bed test system for chemical looping combustion and biomass gasification, photo: TU Wien (Vienna University of Technology), Institute of Chemical Process Engineering and Energy Technology

Fluidised bed test system for chemical looping combustion and biomass gasification (without insulation), photo: TU Wien (Vienna University of Technology), Institute of Chemical Process Engineering and Energy Technology

Initial tests have shown that the excess air ratio can be reduced and CO peaks can be avoided. With fewer temperature hot spots thanks to more homogeneous combustion, the nitric oxide emissions can be reduced by 30%. Suitable oxygen carriers have been identified in the project, and the next step is to begin trials on an industrial biomass plant with a fuel power of 100 MW.

CHEMICAL LOOPING COMBUSTION

The second method is an entirely new combustion technology in which the resulting CO_2 is separated directly. The combustion is divided into two reaction zones (e.g. two fluidised beds). An oxygen carrier is also used as bed material in this process. In the "air reactor", the carrier is oxidised by the combustion air, while in the "fuel reactor" it is reduced through contact with the fuel. The result are two exhaust gas flows: The exhaust gas from the air reactor consists of nitrogen and residual oxygen, while that of the fuel reactor consists exclusively of the combustion products CO_2 and water vapour. After the steam condenses, one is left with a highly concentrated flow of CO_2. The CO_2 is separated at almost no additional energy cost and can subsequently be used for synthesis processes (carbon capture and utilisation - CCU) or stored (bioenergy carbon capture and storage - BECCS). In the case of BECCS, it is even possible to achieve negative CO_2 emissions with this process.[2]

The chemical looping combustion process takes place at temperatures between 900 and 1,000 °C. A heat recovery steam generator produces high-pressure steam, which can then be converted into electricity and heat. This method was employed successfully within the framework of the project on an 80 kW pilot plant at the TU Wien (Vienna University of Technology), and a fuel conversion of 90% was quickly achieved.

The successful results of the project lay the foundation for the industry partners to explore more extensive technical and economical possibilities, including an analysis of the conditions under which both methods could be used economically. ●

In 2018, Austria saved roughly 9.9 million tonnes of CO_2 equivalent through the use of solid biogenic fuels.

www.bmvit.gv.at/themen/innovation/publikationen/energieumwelttechnologie/biooekonomiestrategie.html

[1] Oxygen Carriers in Fluidized Bed Combustion of Biomass for Higher Efficiency, Reduced Emissions and (or) Negative CO_2

[2] Net negative emissions can be achieved when more greenhouse gases are bound up in reaction products than enter the atmosphere. With BECCS, in other words bioenergy with carbon capture and storage (CCS), CO_2-neutral biomass is burned in power plants that immediately separate the CO_2 and is stored in deep geological reservoirs. In Austria, geological storage of CO_2 is currently only permitted for research purposes and only with a planned total storage volume of up to 100,000 tonnes.

Wood gas CHP plant, photo: BEST / Lagler

BIO-CCHP

Electricity, heating, and cooling from biomass

One well-established technology for the generation of electricity and heat from biogenic resources is combined heat and power (CHP) in bioenergy plants. However, the coupling of biomass combustion and ORC or steam turbines can only achieve a very low electrical efficiency of about 10-25%. The electrical efficiency is also limited to about 30% in biomass gasification plants coupled with gas engines.

EFFICIENT AND FLEXIBLE SYSTEM

In the ERA-NET project BIO-CCHP (Combined Cooling Heat and Power), researchers and industry partners from Austria, Poland and Sweden are working under the direction of the Graz University of Technology[1] to develop a new biomass-based CHP technology for the production of electricity, heat and cold that promises a significantly higher electrical efficiency (> 40%), as well as reduced costs compared with typical bioenergy systems. The technology should also offer maximum flexibility in terms of the biogenic fuels used and the operating conditions.

This innovative concept is based on the coupling of a biomass gasification plant with solid oxide fuel cells (SOFC) and a cooling unit. As a result of climate change, a rising need for cooling can be expected in the future (in buildings, hospitals, supermarkets and for the food industry). There are very few biomass combustion plants currently in Austria that can generate cooling from waste heat.

[1]**PROJECT PARTNERS:** Graz University of Technology/Institute of Thermal Engineering, BEST – Bioenergy and Sustainable Technologies GmbH (AT), HARGASSNER GmbH (AT), SynCraft Engineering GmbH (AT), Institute of Power Engineering (PL), Modern Technologies and Filtration Sp. z o.o (PL), RISE Research Institutes of Sweden, Energy and Circular Economy (SE), Cortus Energy AB (SE)

CENTRAL RESEARCH TOPICS

> Optimisation of various gasifier types for coupling with solid oxide fuel cells and for a greater fuel range
> Development of a mobile high-temperature gas cleaning system for removing product gas contaminants for studies on various gasifiers of the project partners
> Optimisation of the operating conditions of an SOFC for various gas compositions with a long-term test (> 300 h) and CFD modelling to achieve an efficiency of > 40% with maximum fuel cell lifespan
> Solutions for integrating a cooling unit into the process under specific local conditions

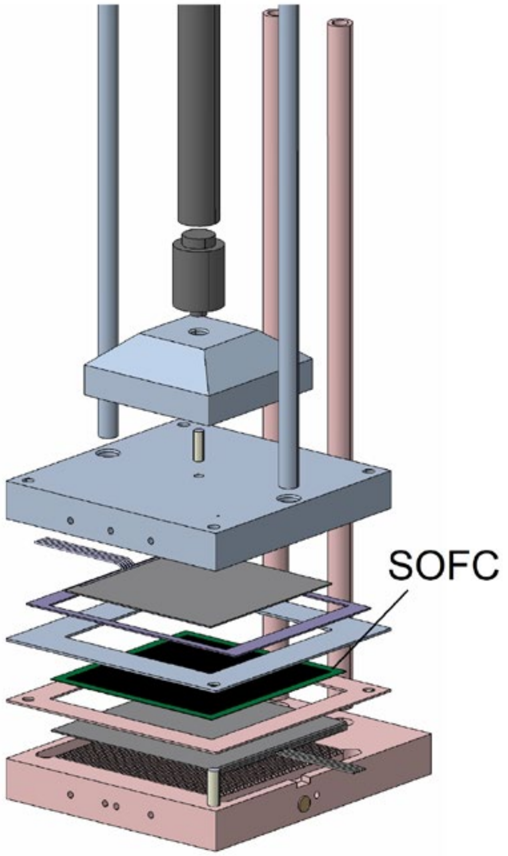
The project work will also include an analysis of the raw materials, technologies and obstacles to market introduction in various countries, and the creation of an industrialisation plan. The new technology should enable sustainable and competitive use of biogenic resources and has the potential to make a major contribution to a CO_2-neutral energy supply.

INITIAL RESULTS

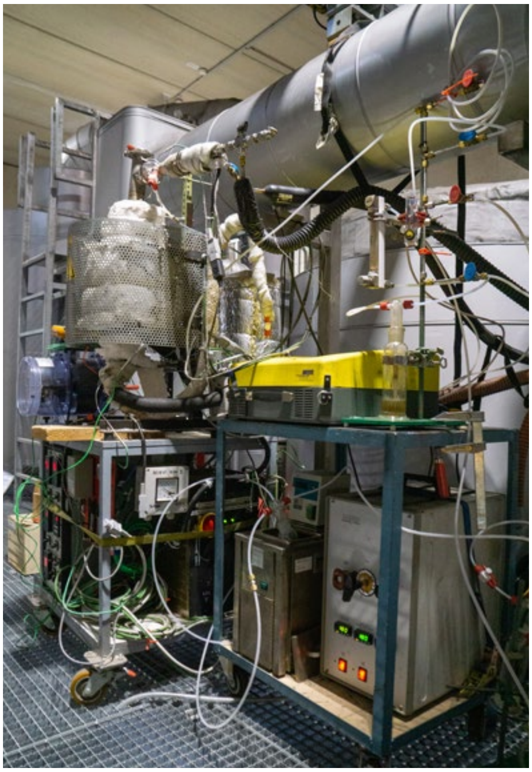
In the first project phase, the partners' various gasification technologies were analysed, and an extensive evaluation of gas compositions and contaminants (e.g. tar and sulphur) was carried out. Fuel cells are sensitive to such contaminants in the gas, making the correct treatment of the gas critical for prolonging cell lifespan. Special methods for gas cleaning and improving the product gas quality were tested.

An appropriate fuel cell type was identified and optimal operating conditions for the implementation of an SOFC in the system were defined. A 500-hour operating run with a synthetic product gas from a fluidised bed steam gasifier was conducted, as well as CFD (computational fluid dynamics) simulations. The data that was gathered will help to improve the understanding of the electrochemical processes in the cell and to identify the optimal operating points for efficient coupling of biomass gasifiers with SOFC systems. ●

www.bio-cchp.net



Single-cell housing for SOFC tests,
Fig.: Graz University of Technology, Institute of Thermal Engineering



Test setup for adsorptive desulphurisation with online gas analysis (FTIR), photo: BEST / Lagler

35% of the heating demand, 6.4% of the electricity demand and 6.7% of the fuel demand in Austria were supplied by biomass in 2016.

Study "Bioenergy in Austria",
BEST - Bioenergy and Sustainable Technologies GmbH, 2019

carbonATE

Enzymatic CO_2 separation and production of biomethane

Microbiological methanation is a method for producing methane with the help of highly specialised microorganisms. The required archaea[1] can be obtained from the fermentation of biogas plants. In combination with an electrolysis plant, biomethanation can be used as a complement to biogas plants. When there is too much electricity, hydrogen (H_2) is produced in power-to-gas systems (P2G) by using electrolysis. Methanogenic archaea can then be employed in a microbiological process to convert CO_2 and H_2 to biomethane.

It is important for the production and utilisation of the renewable gas that the carbon dioxide used is free of the contaminants (O_2 and N_2). Oxygen is harmful to the anaerobic microorganisms and suppresses the process of methanation. Excessive levels of nitrogen reduce the caloric value of the biomethane. However, purification technologies for extracting pure CO_2 are expensive and energy-intensive, making the concept uneconomical. In the ERA-Net project carbonATE, researchers and corporate partners from Austria and Switzerland are working under the direction of the University of Natural Resources and Life Sciences[2] to develop a new, enzymatic CO_2 separation process and to investigate the impacts of this process on the microbiological methanation.

COST-SAVING AND ENERGY-EFFICIENT

The use of enzymes for the separation of CO_2 is a way to obtain carbon dioxide from combustion gases and bind it in liquids inexpensively and with relatively little energy demand. The first usable enzymes were identified within the framework of the project, then cultivated through the fermentation of corresponding organisms, purified, and used for carbon dioxide binding.

In the next step, the bound carbon dioxide is converted microbiologically into methane. The researchers will then investigate various methanogenic archaea and determine how the microorganisms can utilise the bound carbon dioxide. Different types of reactors are being tested at laboratory and pilot scales, along with optimisation of the assorted process systems.

The project team is pursuing two approaches to the research. Firstly, they are using pure cultures for the methanation. Secondly, they are using mixed cultures obtained from communities of anaerobic microorganisms containing a wide variety of different bacteria and archaea. The mixed cultures may offer advantages over pure cultures with regard to stability and conversion rates. Both approaches will be analysed and compared. The data will serve as the basis for a profitability analysis as well as a life cycle analysis, and the most economical variant will be pursued. ●

Bio-trickling filter and CSTR (Continuous stirred-tank reactor) at small scale, photo: University of Natural Resources and Life Sciences, Institute of Environmental Biotechnology

Bio-trickling reactor scale-up, photo: University of Natural Resources and Life Sciences, Institute of Environmental Biotechnology

[1] Archaea are unicellular organisms; together with bacteria and eukaryotes, they form one of the three domains into which all cellular organisms are divided.

[2] **PROJECT PARTNERS:** University of Natural Resources and Life Sciences, IFA Tulln, Institute for Environmental Biotechnology, BEST – Bioenergy and Sustainable Technologies GmbH (AT), EVM Energieversorgung Margarethen (AT), AAT Abwasser- und Abfalltechnik GmbH (AT), Zurich University of Applied Sciences, Institute of Chemistry and Biotechnology and Institute of Natural Resources Sciences (CH), Paul Scherer Institute (CH)

DINA BACOVSKY

BEST – Bioenergy and Sustainable Technologies GmbH
Exco representative in the IEA bioenergy technology programme

Photo: BEST

You have just conducted a study on the bioenergy situation in Austria. How has the bioenergy industry developed in recent years?
Bioenergy is a great success in Austria. We produce heat, electricity and biofuels in over 2,000 biomass heating or CHP plants, roughly 300 biogas plants, 9 biodiesel plants and one ethanol plant. At the same time, roughly 20 Austrian research institutions, 40 institutes at universities and universities of applied sciences as well as 100 companies are developing and distributing bioenergy technologies both on the domestic market and abroad. And yet the sector must continue to grow. Bioenergy can and must make a major contribution to meeting the goal of 36% lower greenhouse emissions in 2030 compared with 2005.

How do you assess the raw material situation in Austria? What is the potential of biomass?
Austria is rich in timber resources, with almost half of the land area forested. The use of by-products of the forestry and lumber industries currently contributes about 130 PJ to energy production, and another 20 PJ is obtained from the utilisation of various types of waste. The potential of biomass falls well short of covering the current total final energy demand of about 1,100 PJ, but it can make a considerable contribution. In the future, an additional 50-100 PJ of energy can be sustainably provided by biomass. Sustainability must be ensured through accompanying measures, such as optimisation of supply chains, recirculation of ash, renaturation, etc.

Which role can bioenergy play in an integrated energy system of the future?
Biomass is a universally exploitable energy source that can be stored and transported in various forms. Electricity production from biomass should always be coupled with the provision of heat. Cooling can additionally be produced via adsorption systems. Biomass power plants can compensate for fluctuations of other renewable forms of energy (wind, solar), hereby stabilising the power grid. Biofuels can lower the greenhouse emissions of the transport sector, and electrofuels, which are produced by combining hydrogen from electrolysis with carbon, can transfer renewable energy from the electricity sector to the transportation sector. Because biomass is storable and can be converted into many different energy forms, it will play an important role in the energy system of the future.

You are the Austrian representative in the technology collaboration programme IEA Bioenergy of the International Energy Agency (IEA). How does the Austrian bioenergy economy benefit from this cooperation?
Austrian researchers and all companies developing and offering bioenergy technologies benefit from extensive sharing of information in IEA Bioenergy. They obtain information on international developments and trends early on, and are able to base their research on state of the art technologies, as well as to establish contacts to other countries and potential export markets. Austrian technologies for combustion and gasification of biomass are well known and in use throughout the world.

IEA BIOENERGY
The technology collaboration programmes (TCPs) of the International Energy Agency are global research networks that bring together experts from the participating countries and enable information exchange and collaborative projects. The goal of IEA Bioenergy is to promote the use of environmentally friendly and competitive bioenergy as the basis for the sustainable utilisation of biomass, thereby making a substantial contribution to the future energy supply.

Tasks with Austrian participation:
Task 32: Biomass combustion and co-combustion
Task 33: Thermal gasification of biomass
Task 37: Energy from biomass
Task 39: Commercialising Conventional and Advanced Transport Biofuels from Biomass
Task 40: Deployment of biobased value chains
Task 42: Biorefining in a Circular Economy
Task 44: Flexible Bioenergy and System Integration (BIOFLEX)

nachhaltigwirtschaften.at/de/iea/
www.ieabioenergy.com

EnCat

New technology for the production of high-quality bio-oil

The ERA-NET project EnCat is dedicated to the development of a new concept for producing high-quality pyrolysis oil from biomass at high yield. The Austrian company BIOS Bioenergiesysteme GmbH is part of an international joint project along with eight industry and research partners from four European countries.[1]

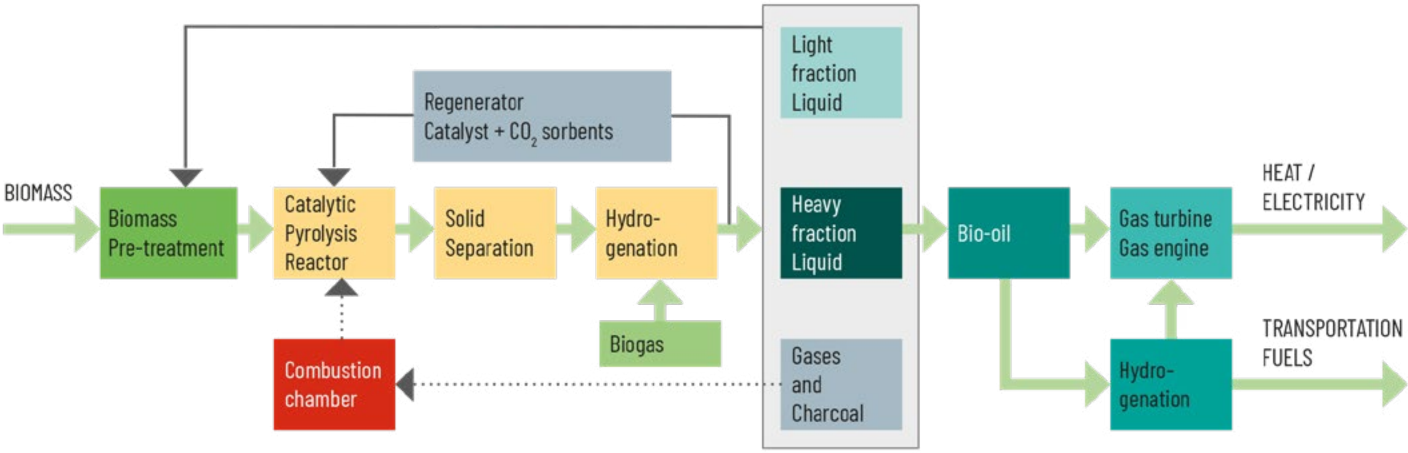
The bio-oil produced with current pyrolysis processes has some disadvantages when used for electricity and heat generation or as an automotive fuel. These include high levels of oxygen, water and water-soluble components (acids), poor miscibility with fossil fuels, insufficient chemical stability, and high viscosity. The goal of the EnCat technology is to generate a higher quality bio-oil from biomass that is suitable for diverse applications.

BIOMASS PYROLYSIS

Bio-oil is produced via biomass pyrolysis, a thermo-chemical process in which the biomass is split into solid, liquid and gaseous components at high temperatures without the presence of oxygen. With fast pyrolysis, the biomass is rapidly heated to about 500 °C for a high pyrolysis oil yield. There are a number of ways to process and utilise bio-oils. Alongside use for energy purposes as fuel or heating oil, it can also serve as a raw material for various chemical applications.

INNOVATIVE PROCEDURE

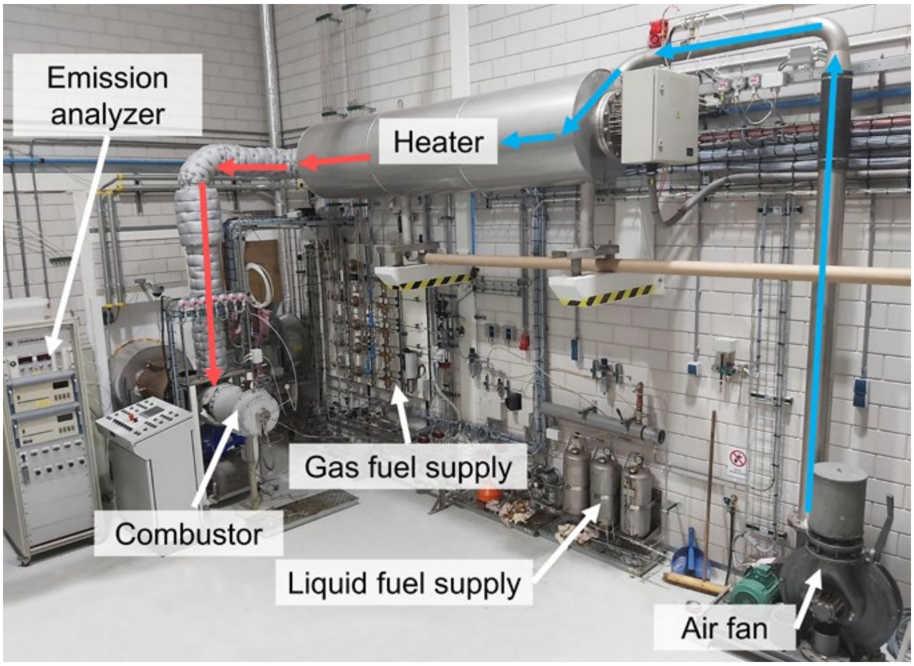
To utilise both wood biomass and agricultural by-products within the new concept, special pre-treatment steps are developed for the biogenic raw materials. The pre-treated biomass should then by pyrolysed in a reactor, using deoxidation catalysts. The concept foresees a simultaneous CO_2 capture with sorbents and in-situ hydrogen generation through the water-gas shift reaction. The oil obtained after condensation can either be purified and hydrogenated to produce higher-quality bio-oil for various applications, or it can be used directly in gas engines and gas turbines. Modified burners for gas turbines are also being developed as part of the project for this purpose.



EnCat process, image source: BIOS Bioenergiesysteme GmbH

[1] **PROJECT PARTNERS:** BIOS Bioenergiesysteme GmbH (AT), University of Twente, UT (NL, coordinator), Alucha Management B.V. (NL), OPRA Turbines International BV (NL), Kungliga Tekniska högskolan, KTH (SE), RISE IVF (SE), Institute for Chemical Processing of Coal, ICHPW (PL), HIG Polska Sp. (PL)

Test set-up for leaching tests, photo: BIOS Bioenergiesysteme GmbH



Combustion chamber test bench for gas turbines, photo: OPRA Turbines B.V.

BIOMASS PRE-TREATMENT

BIOS Bioenergiesysteme is testing various methods for biomass pre-treatment to reduce the contents of alkali and alkaline earth metals (AAEMs, i.e. potassium, sodium, calcium and magnesium) in the biomass. These elements promote reactions that lower the quality of the pyrolysis oil. The test runs showed that the amounts of AAEMs in woody biomass can be reduced by roughly 75% through extraction (known as leaching) under moderate temperature and residence time conditions using simulated wood acids, which are a result of the pyrolysis process, and can be separated from the pyrolysis oil (light liquid fraction, largely acetic acid). Leaching with water allows approximately 33% of the AAEMs to be removed. For agrofuels, which show significantly higher contents of AAEMs, reduction rates of about 85% were seen when treated with the simulated light liquid fraction, and 60% when leached with water.

CATALYTIC PYROLYSIS

The quality and yield of the resulting bio-oils can be improved through the use of deoxygenation catalysts and CO_2 sorbents in the pyrolysis process. The project partners University of Twente (NL) and KTH Kungliga Tekniska högskolan (SE) are conducting laboratory tests with various catalysts and process parameters in order to optimise the process. Initial tests with pre-treated biomass showed positive results with regard to high achievable conversion and reaction rates, compared with pyrolysis of untreated biomass.

COMBUSTION OF BIO-OIL IN GAS TURBINES

The company OPRA Turbines (NL) develops and produces gas turbines that can utilise a wide range of liquid and gaseous fuels. Computational fluid dynamics (CFD) simulations carried out by BIOS and UT, as well as experimental research, should generate insights into the atomisation and combustion of bio-oil in gas turbines. A gas turbine system for the use of bio-oil from catalytic pyrolysis is being optimised at the OPRA test bench. The main challenge lies in developing a combustion chamber and an air staging concept that ensure complete combustion with low CO and NO_x emissions. Measurements of bio-oil atomisation (UT) and test runs with grid measurements of the temperatures in the burner (BIOS) support the development of a new burner design.

REFINING BIO-OIL

To obtain a higher-quality bio-oil for various applications, the produced pyrolysis oil should be catalytically hydrogenated, and associated testing of various processes and catalysts is under way at the Institute for Chemical Processing of Coal ICHPW (PL).

The international collaboration should result in a full-scale concept for the EnCat technology. The development of a technically and economically competitive technology is further supported by accompanying techno-economic analyses and life cycle assessments of the entire process chain (from the feed material to electricity and heat production via turbines and engines or bio-oil utilization as transportation fuel). ●

You can also visit us at:

www.energy-innovation-austria.at

INFORMATION

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energy innovation austria presents current Austrian developments and results from research work in the field of forward-looking energy technologies. The content is based on research projects funded by the Austrian Federal Ministry for Transport, Innovation and Technology and the Climate and Energy Fund.

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