VTT Technical Research Centre of Finland

Drivers and barriers for implementation of bioenergy technologies in rural bioeconomies

Kiviranta, Kirsikka

Published: 06/06/2023

Document Version
Other version

Drivers and barriers for implementation of bioenergy technologies in rural bioeconomies

VTT

www.vttresearch.com

Kirsikka Kiviranta

Research Scientist, M. Sc. (Tech)

EUBCE
31st European Biomass Conference & Exhibition
IN PERSON, ONLINE
Bologna 2023

5 – 8 June | Conference & Exhibition
9 June | Technical Tours

Introduction to BRANCHES project

BRANCHES - Boosting rural bioeconomy networks following multi-actor approaches

BRANCHES
BOOSTING RURAL BIOECONOMY NETWORKS

- HORIZON2020 project
- 12 partners for Finland, Germany, Italy, Poland, Spain
- Duration 1.1.2021-31.12.2023
- Total budget 2 M€
- **www.branchesproject.eu**

Luke Natural Resources Institute Finland
VTT
Consiglio Nazionale delle Ricerche Istituto per la BioEconomia
W-MODR
DBFZ
circe Research Centre for Energy Resources and Consumption
University of Warmia and Mazury in Olsztyn
MTK
aveBiom Spanish Biomass Association
UFZ
ITABIA Italian Biomass Association
BioEconomy Cluster

Background and aim

- Bioenergy technologies are becoming more **innovative, advanced and diverse**
- **New technological progress** and **knowledge** to foster rural bioeconomies has been created in scientific projects
  - The generated information and knowledge is in danger of remaining **untapped**
- BRANCHES **fosters knowledge transfer** of innovative bioeconomy practices in agriculture, forestry and rural areas to strengthen the connections between science and practice
  - Aim to **foster renewable energy uptake** in rural areas and **boost the regional bioeconomy**

BRANCHES-consortium has 12 partners from five European countries: Finland, Spain, Italy, Poland and Germany.

BRANCHES
BOOSTING RURAL BIOECONOMY NETWORKS

EUBCE 31st European Biomass Conference & Exhibition
IN PERSON, ONLINE
Bologna 2023

Approach

- Information of **currently available** and **innovative** bioenergy technologies and recent research findings are **screened** and **summarized**
- The **practice-oriented knowledge** of the most innovative and cost-efficient solutions are shared to farmers, foresters and practitioners via:
  - **Practice Abstracts**
  - Bottom-up oriented activities such as **workshops** and **showcases**

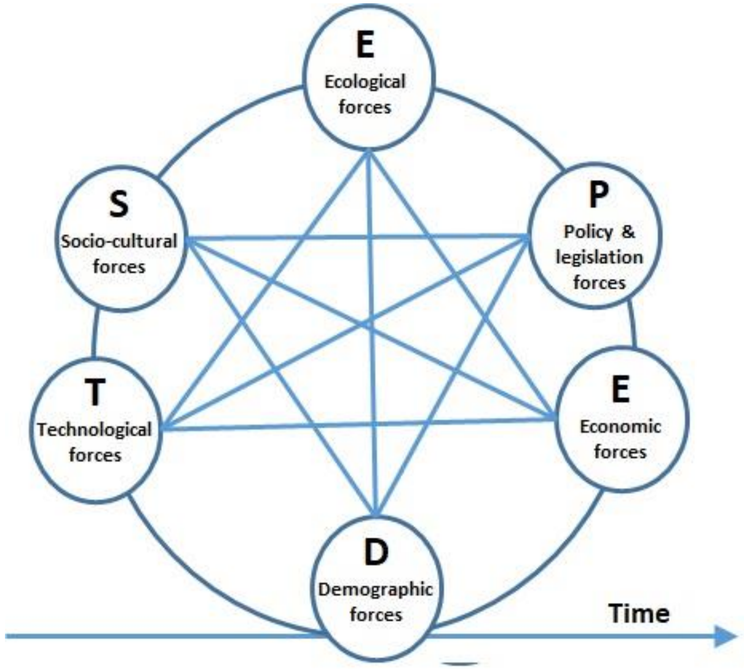

BRANCHES
BOOSTING RURAL BIOECONOMY NETWORKS FOLLOWING MULTI-ACTOR APPROACHES
31
PRACTICE ABSTRACT
Climate-smart food production
The Ovidja organic farm is a pilot farm that follows the innovative principle, taking into account both nutrient recycling and carbon sequestration. The aim of the farm is to mitigate climate change and to increase biodiversity. In addition, emissions to Baltic Sea are minimized.
Cows, horses and sheep graze on the farm. Carbon sequestration and biological cultivation is the aim in the fields. All the fields (180 hectares) are on grassland, which aims to improve the structure of the land. The farm is gradually switching into a crop rotation with the emphasis on native species and nitrogen-binding plants.
In addition to food production, the farm has a biogas plant and a wood gasification plant, from where the gas is ulilized in electricity and heat production. The farm also utilizes solar power.
Grass and manure from the farm are used as a feed for the biogas plant. The produced biogas is upgraded, after which biomethane can be used as a vehicle fuel or on heat and electricity production.
Biogas contains always around 40% of carbon dioxide. Instead of releasing it to the atmosphere, in Ovidja the carbon dioxide is fed to OPower's biological methanation pilot plant, which utilizes microbes to produce methane from carbon dioxide and hydrogen. Hydrogen for the pilot plant is obtained from electrolysis and from the wood gasification unit. Plant's efficiency is 82%, and at its best, the methane production can be doubled.
Digestate from biogas plant is used as fertilizer on the farm. By improving the soil structure and using recycled fertilizers according to plant needs, nutrient leaching is minimized and carbon sequestration in the fields is increased. All work is done for the climate and the Baltic Sea, biodiversity being the foundation for all actions.
KEY WORDS
Biomethane, carbon neutral agriculture
COUNTRY
Finland
AUTHOR
Saija Rasi (Luke)
saija.rasi@luke.fi
DISCLAIMER
This Practice Abstract reflects only the author's view and the BRANCHES project is not responsible for any use that may be made of the information it contains.
DOWNLOAD
www.branchesproject.eu
ADDITIONAL INFORMATION
ABOUT BRANCHES
THE PARTNERSHIP

A minimum of 25 Practice Abstracts (PAs) are produced to distribute knowledge of innovative bioenergy technologies. Find all available PAs here.

Workshops are organized to share information and collect feedback of the innovative solutions.

Drivers and barriers

- In addition to knowledge transfer, BRANCHES aims also to understand the **drivers and barriers** behind the innovative and available bioeconomy practices
- The drivers and barriers are based on discussions with **practitioners or related technology providers** while summarizing the information for the Practice Abstracts and while discussing the practices in workshops
    - In addition, the **technical and sectorial partners** of the BRANCHES consortium can evaluate drivers and barriers according to their expertise



DEPEST analysis tool is used for collecting the drivers and barriers of the shared practices.

Objectives of the presentation

Objectives of the presentation

- Explore **drivers** that promote the adoption rural bioenergy technologies
- Discuss the **barriers** that hinder their widespread implementation
- Presents **case examples** of rural bioenergy solutions in which certain driver or barrier applies

Drivers for Rural Bioenergy Technologies

Drivers for Rural Bioenergy Technologies

Environmental Benefits

Economic opportunities

Energy Self-Sufficiency and Security

Bioenergy technologies play role in mitigating climate change. Photo: VTT.

Environmental benefits

- Bioenergy production provides **ecological benefits** and **reduction of carbon footprint** in **heat, power** and **transportation fuel production**
- Benefits can be achieved **throughout the overall value chains**
  - Farmers, municipalities, industries..
- Harnessing value from agricultural side products has also positive impacts on **waste management**
  - Reduces e.g., fire risk and need for landfilling

Read more: Grass factory – from meadow grass to innovative materials

Economic opportunities

- Rural bioenergy production can create **employment** and hence foster **economic growth** in rural areas
- Farmers can obtain new sources of income by e.g.:
    - Supplying **feedstock** for bioenergy/bioeconomy plants
    - Producing **energy** (electricity/heat)
    - Producing t**ransportation** fuels such as biomethane
- An innovative example comes from Germany, where local farmers cultivate meadow grass and sell it for a local bioeconomy company Biowert for biobased thermoplastics and biogas production as a source of income

Harvesting meadow grass. Photo: Biowert.

Straw is a by-product of agriculture, that can be used for local energy production. Picture CIRCE.

Read more: From cereal straw to district heat: case Kisielice & Increasing energy independency in a rural municipality: case Barciany

Energy Self-Sufficiency and Security

- Using local biomass sources:
  - Promotes **energy independence** in rural communities
  - **Reduces reliance** on imported fossil fuels and volatile energy markets, at the moment, the cost of fossil energy is high
- As an example, a municipality of Kisielice in Poland has replaced fossil fuel use in district heating with heat generated from local by-product straw
  - Cereal straw is bought from local farmers
  - Ash returned for free to be used as fertilizer in the fields
- Another Polish municipality Barciany has steadily developed its energy independence and replaced coal use in heating by:
  - Biomass-based district heating using wood chips from trimming roadside shrubs, and forest and garden residues as raw materials
  - Geothermal heat pumps and solar PV supply heat for municipal buildings

Barriers for Rural Bioenergy Technologies

Barriers to Rural Bioenergy Technologies

Financial Constraints

High investment costs

Accessing finance

Technological Challenges

Technology maturity, scalability, cost-efficiency, lack of replicates

Policy and Regulatory Framework

Inconsistent regulations

Barriers to Rural Bioenergy Technologies

Financial Constraints	**Financial incentive programs** **Collaboration and partnerships**
Technological Challenges	Technology maturity, scalability, cost-efficiency, lack of replicates
Policy and Regulatory Framework	Inconsistent regulations

Barriers to Rural Bioenergy Technologies

Financial Constraints	**Financial incentive programs** **Collaboration and partnerships**
Technological Challenges	**Piloting projects and demonstrations** **R&D to foster innovation and research**
Policy and Regulatory Framework	Inconsistent regulations

Barriers to Rural Bioenergy Technologies

Financial Constraints	Financial incentive programs Collaboration and partnerships
Technological Challenges	Piloting projects and demonstrations R&D to foster innovation and research
Policy and Regulatory Framework	Financial support mechanisms Streamlined permitting and approval processes Policies to facilitate R&D

Case Examples to Overcome Barriers

Read more: Hybrid solution to ensure energy self-sufficiency in a berry farm

Incentive Programs

- **Investment costs** for bioenergy production can be high
  - Financial constraints can prevent uptake of the technologies in rural regions
- **Incentive programs/financial mechanisms** such as **grants** to support the investment costs can encourage the adoption of rural bioenergy technologies
- Investment grant from Rural Development Fund was an important driver for investment in a Finnish berry farm
  - The farm invested into a hybrid energy solution consisting of solar PV and a wood gasification unit for combined heat and power production
- The farm consumes a lot of electricity throughout the year due to berry freezing
  - The hybrid solution enables the farm to obtain energy self-sufficiency and to financially secure the operation of the berry farm from increasing electricity prices

The berry farm is energy self-sufficient thanks to the hybrid solution. Photo: Luke

Wood gasifier starts operating in late summer when the berry season reaches its peak and is operated for 9-10 months. Photo: Luke

Cow manure can be used as a feedstock for rural biogas and biomethane production. Photo: Valio

Milk truck refuels its tank while it collects the milk. Photo: Sweco

Read more: Manure-powered milk logistics

Collaboration and Partnerships

- Collaboration and partnerships bring together different stakeholders to share financial burden and create shared benefits
- **Collaboration** between food company and farm has enabled rural biomethane production in Finland
- Biomethane production has a **chicken-egg** problem
  - **Guaranteed** and **stable demand** is a prerequisite to make the production profitable
- A milk truck of a food company Valio has **committed to buy biomethane** generated at a dairy farm
  - New business opportunities and sources of income for the farmer
  - Reduced carbon footprint for the food company

Read more: Agricultural cooperative biogas plant

Collaboration and Partnerships

- Another example of a successful partnership can be found from Theuma, Germany
- Partnership between **municipal government** and **agricultural cooperative** has created a supply chain to process locally sourced agricultural residues into biogas
- **Big parts of the community** are involved in the value chain and are benefiting from it:
    - Farmers find use for agricultural and livestock residues
    - Biogas and CHP plants provide employment in the community
    - Electricity and heat in the municipality are produced and sourced locally, excess heat used by local industries, e.g., wood chip drying
    - Digestate from biogas production used as fertilizer in local fields

Biogas production in Theuma. Photo: Sachsen.de

Read more: Climate-smart food production

Research and Development

- R&D needed to **advance** bioenergy technologies to overcome technological challenges (e.g., maturity and scalability) and to make technologies more cost-efficient
- Qvidja experimental farm in Finland provides premises for **versatile R&D** for rural bioenergy production:
  - Biogas production
  - Biological methanation
  - Wood gasification
- In biological methanation, microbes are utilized to produce methane (CH_4) from carbon dioxide (CO_2) and hydrogen (H_2)
  - The plant can utilize CO_2 separated from biogas process
  - Hydrogen for the pilot plant is obtained from electrolysis
  - Aim to obtain more biomethane from organic feedstock and to reduce the demand of CO_2 purification

Qvidja farm provides a R&D environment for various renewable energy technologies. Photo: "The farmer isn't the problem, they are the solution"

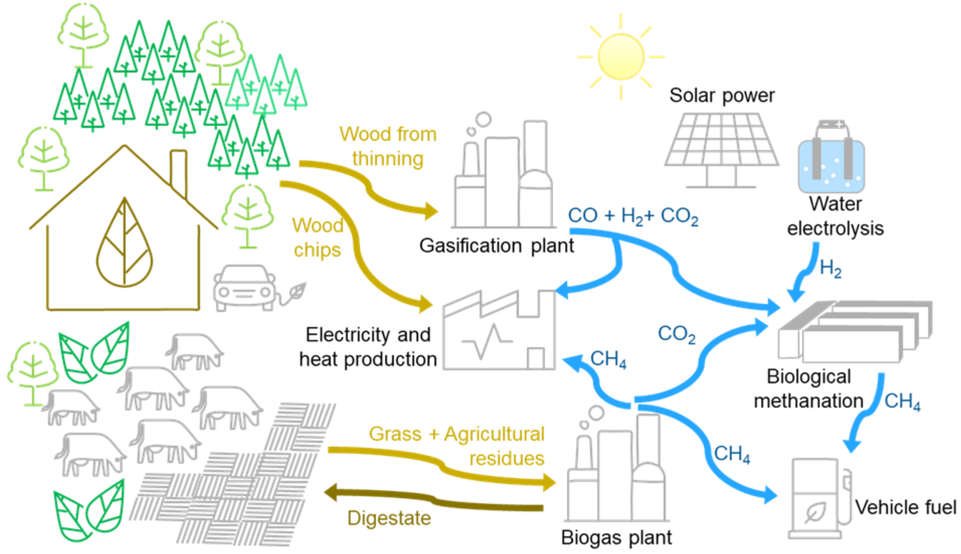


Illustration of energy production R&D at Qvidja farm. Disclaimer: The figure reflects only VTT's view Source: VTT.

Conclusion and next steps

- **BRANCHES** project fosters knowledge transfer of innovative bioeconomy practices in agriculture, forestry and rural areas
- Based on the on-going research in the project, main drivers and barriers identified for rural bioenergy technologies are:

Main drivers

  - Environmental benefits
  - Economic opportunities
  - Energy self-sufficiency and security

Main barriers

  - Financial constraints
  - Technological challenges
  - Policy and regulatory framework

- Several good case examples already exist on how the barriers have been solved
- Elaboration of drivers and barriers continues in the BRANCHES project
  - Final results at the end of the project in 12/23
- In addition to identifying drivers and barriers, BRANCHES project will create policy recommendations for selected biomass value chains in agriculture and forestry

BRANCHES
BOOSTING RURAL BIOECONOMY NETWORKS

www.branchesproject.eu

Thank you

EUBCE
31st European Biomass Conference & Exhibition
IN PERSON, ONLINE 2023 | BOLOGNA. ITALY.

eubce.com