ETIP Bioenergy
European Technology and Innovation Platform

Biofuel Fact Sheet

Bioenergy RES hybrid facilities

Definition

An integrated bioenergy hybrid is defined as an energy production facility that utilizes at least two different types of energy inputs, one of which is bioenergy. The term bioenergy RES (renewable energy source) hybrid can be used, if all energy inputs are from renewable sources.

Introduction

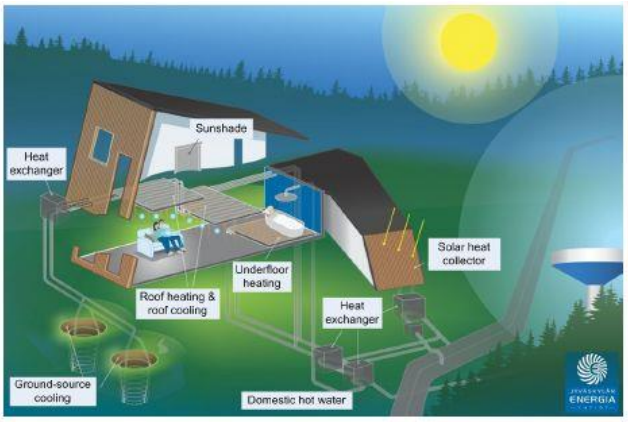
The increasing production of energy from variable renewable energy sources leads to an increasing variation in electricity and heat supply during the course of the day. As the share of variable energy supply is projected to increase, there is a need to find ways to ensure the stability and reliability of energy supply. Flexible renewable energy technologies can serve this purpose.

Biomass is an easily storable source of renewable energy that can be used to bridge temporal imbalances between energy supply and demand. Combining bioenergy with other renewable energy forms (bioenergy RES hybrids) can offer the required flexibility in energy production, while maintaining GHG benefits and low costs. A large number of different combinations is already commercially available. Currently, the main applications of bioenergy RES hybrids are domestic heating applications.

Examples of bioenergy RES hybrid technologies are mentioned in the box on the right side. Some of them are particularly well suited for certain scales of operation, such as domestic, residential (several households), farm and industrial scale. The scale for each technology is indicated in brackets.

Integration of several energy sources into one process offers flexibility. It can e.g. increase the energy self-sufficiency of farms, reduce emissions, avoid costs for purchasing electricity (especially during peak hours), allow for optimized dimension of system components, avoid investment in storage systems and allow for better waste management.

Figure 1: Schematic example of an integrated bioenergy hybrid, Jyväskylä Energia, domestic scale



Bioenergy RES hybrid technologies

On market

- Biomass + solar thermal (domestic)
- Biomass + additional heat supply through district heating (domestic)
- Biomass + heat pump (domestic, farm, industry)
- Biomass + photovoltaic (domestic, farm, industry)
- Biomass + waste heat recovery (domestic, residential, industry)
- Biomass + wind (farm)
- Power to gas (farm)

Ongoing developments

- Prosumer integration (requires optimized control algorithms)
- Power-to-liquid/biofuel (electrofuels)
- Biomass drying

Ongoing developments

Besides the well-established technology combinations mentioned in the box on the previous page, further bioenergy RES hybrid concepts are currently under development. These include the following:

Prosumer integration. A prosumer is someone, who is both, a producer and a consumer. For example, private producers of heat could be integrated into the district heating through a two-way connection. Excess heat of the prosumer can be provided to the district heating grid; vice versa, if required, the prosumer can consume heat from the district heating grid. The operator of the district heating grid can operate his own heat production according to resulting demand and thus save on fuel costs. To achieve this, optimized control algorithms are needed. The technical and economical evaluation of such systems is currently being elaborated.

Biomass-based flexibility options are not only confined to energy generation, but also include solutions for electric energy storage. Chemical storage of electricity through hydrogen into biofuels and through drying of biomass are discussed as **biomass-based energy storage concepts**:

Chemical storage of excess electricity in liquid transport fuels using the **power-to-liquid/biofuel** technology is based on expanding the quantity of biofuel produced by adding renewable hydrogen produced through electrolysis from excess electricity. Biomass is gasified to produce a synthesis gas which is then mixed with hydrogen from the electrolysis. In the subsequent methanation, synthetic natural gas is produced. Other process variations produce methanol, synthetic gasoline and DME instead of methane.

Using variable renewable energy to **dry solid biomass** is a potential long-term and low-cost form of energy storage. In practice this is best done in small units (farm scale). An existing biomass dryer can be connected to a solar heat collector so that renewable heat is used for drying. Alternatively, excess waste heat from a CHP (particularly during summer time) can be used for drying. Drying the biomass increases the heating value, the quality of the biomass fuel and its storability.

RES hybrid facilities

Prosumer Integration

Austria (Groß-schönau)	KLIEN/FFG Residential scale Implementation of decentralized heat producers into an existing heating grid Heat pump, biomass boiler (wood chips) and existing solar collector field will be connected to the heating grid

Power-to-liquid

Germany (Prenzlau)	Enertrag hybrid power plant Industrial scale Conversion of excess wind power into hydrogen as fuel, or for heat & power generation with combined combustion of electrolysis hydrogen and biogas

Biomass drying

Finland	VTT Farm scale Connection of a solar heat collector installation and an existing biomass dryer for drying wood chips

Solar biomass hybrid

Finland	VTT Industrial scale Connection of solar heat and a superheater of a solid biomass CHP boiler to increase efficiency and save fuel

Further information

Read further information about hybrid facilities at: http://task41project7.ieabioenergy.com/wp-content/uploads/2017/03/IEA-Bioenergy-RES-hybrids-FINAL-report.pdf