ProEcoPolyNet Best practice Sheet "Pellet-Stirling-Storage-CHP"

RTD Project Identification

RTD Project Name: Pellet-Stirling-Storage-CHP (PeStiS)

RTD Contract No.:

Programme: InnoNet-programme of the Federal Ministry of Economics and Technology

Short description of the project

The consortium (2 scientific and 7 industrial partners) is developing a storage-integrated micro CHP (wood pellets as fuel) and components for installation in smaller residential buildings including prototype

Project data

Duration: 01.01.05 – 31.12.07

Project costs: 2 Mio. €

Federal Contribution: 1,165 Mio. €

Operating principle

The system is composed of a pellet-furnace, a Stirling engine and a hot-water storage tank. The Stirling engine transforms a part of the heat from the flame and the fumes into electricity via a generator. The engine is cooled down by water. The heat from this cooling loop and from the exhaust fumes is introduced into a hot-water layer storage tank which is used for domestic hot water production and for room heating. The control of the components pellet-furnace, Stirling engine and hot-water tank is a major task of the project. The objective is a minimisation of the fuel consumption, a power modulated operation, optimised electricity production and low-cost maintenance. To achieve that, the following concepts are investigated:

- the pre-heating of the combustion air makes possible to raise the temperature in the combustion chamber, which increases the effectiveness of the Stirling engine.
- anti-adhesive surfaces of the heat exchanger for exhaust fumes ensure a good heat transfer with long intervals of cleaning.
- an optimisation of the interaction between the two heat sources of the storage tank ensures a simultaneous charging of it.
- a smart operation management algorithm based on the charging of the storage optimises the run-time of the plant. The reduction in stops and starts of the system leads to an increase of the plant lifetime. Besides that, overall plant efficiency and electricity production raises significantly and the emission rate drops down.
- timely adjusted production of heat at peak load hours of the public grid guaranties for the future higher remuneration for electricity fed-in (virtual power station approach).

Technical characteristics of installation

- *Type*
- *Electrical output capacity Target 1 (kW)*
- *Thermal output capacity Target 14 (kW)*
- *Thermal Input capacity (kW)*
- *Cooling to heat ration*
- *Electrical efficiency (%)*
- *Thermal efficiency (%)*
- *Total efficiency (%)*
- *Marginal electrical efficiency (%)*
- *Power to heat ratio*
- *Noise emissions (dB)*
- *Weight (kg)*

Location and use

- *With a thermal capacity of approx. 14 kW and around 1 kW electric, the PeStiS system is suitable for:*
- *one-family houses with rather high heat load for room heating (i.e. not refurbished*

houses) to accommodate the requirements of regulation for modernisation of water boilers (such as the German standards EnEV)

► *low-rise multiple-family houses with low specific heating load (for example 3 Litre house standards, passive house standards)*

► *different kind of process heat load with rather constant profile around the year: PeStiS for base heat load and an additional boiler for peak load*

Capital investment and maintenance costs

► *Capital investment*

Cost of unit (€)

Specific cost of unit (€/kWe)

Installation cost (€)

Total Cost (€)

► *Avoided capital investment if any*

Avoided Specific cost (€/kWe)

Avoided Installation cost (€)

Value of avoided investment if any(€)

► *Total capital investment*

Total capital investment (€)

Total capital investment (€/kWe)

► *Maintenance*

Specific maintenance costs (€c/kWhe)

Total maintenance costs (€/a)

State of Development/Market implementation

► *Prototype will be developed and optimisation concepts tested*

Operational data

► *Average hours of operation (h/a)*

► *Fuel input (kWe/a)*

► *Electricity output (kWe/a)*

► *Heat output (kWe/a)*

► *Cooling output (kWe/a)*

► *Electricity self-consumption (%)*

► *Electricity self-consumption (kWh/a)*

► *Electricity exported to grid (kWh/a)*

CO2 and primary energy savings

Fuel (kg/kWh)

CO2 emission factor (kg/a)

CO2 emissions (kg/a)

Benefits and obstacles

- Pellets fired (very low CO_2-emission footprint)

- is intended to produce as much electricity as consumed by an average household

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Obstacles: development state of some system components. Further R&D is needed to solve basic problems.

Contact and further information

Name and contact details

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