



SUCCESS STORY:

# BioSol made small scale wood gasifiers possible

## POLICY CASE

### Title:

Bavarian demonstration programme for small scale wood fuel gasifier CHP's (BioSol)

### Year (commissioned):

2013

### Location:

State of Bavaria, Germany

### Stakeholders:

1. Emanuel Schlosser (Technology and Support Centre of Renewable Raw Materials, TFZ, Straubing): General concept development and implementation
2. Gilbert Krapf (C.A.R.M.E.N. e.V., Straubing): Technical program advisor
3. Dr. Rupert Schäfer (Bavarian Ministry of Agriculture and Forestry, Munich): Program embedding into political framework, financing

### Authors:

Hans Hartmann  
Emanuel Schlosser  
[www.tfz.bayern.de](http://www.tfz.bayern.de)

Bavaria, a Southern state in Germany with high share of forest, has a long tradition of using wood for energy, and fuel producers are constantly looking for new business opportunities. High electricity prices (for consumers) and attractive feed-in tariffs (for producers) have stimulated several SME companies to develop small scale CHP-technology based on wood gasifiers combined with gas piston engines. However, trust in reliability and function of the technology was low at the beginning, and adventurous investors were scarce in the early stage of market introduction. Good examples of successful operations were needed. At the same time the CHP-manufacturers themselves were lacking a sound perspective for continued R&D activities in this field.

### BioSol programme

Therefore the Bavarian Government decided to launch the regional subsidy programme "BioSol" for small scale wood gasifier CHP's. The main conditions for the one-time non-refundable subsidy were:

- Maximum electrical power output: 250 kW<sub>el</sub>.
- Funding conditions: 30 % of eligible investment (max

200 000 € per installation).

- Funded objects: Gasifiers for natural untreated wood chips or for wood pellets used in a combined heat and power production (CHP)
- Operation: Minimum 5 000 annual full load hours and 60 % heat used.

### The results and benefits can be listed as follows:

- 16 small scale fixed bed gasifier plants were funded during the program.
- The plants were provided by 4 different manufacturers, which were thus encouraged to develop the market. Three manufacturers were from the State of Bavaria (small distance to market), one from Austria.
- Gained market experience has enabled the manufacturers to be internationally active today.
- Direct feedback of plant operators to manufacturers was encouraged and has stimulated the development.
- The restriction to the Bavarian state has created a regional focus area, which stimulated good communication among the plant operators (e.g. via "regular's table").
- All plant operators received feedback from the funding

**Fuel type:**

- Wood chips, wood pellets

**Feedstock origin:**

- Domestic silviculture residuals from thinning, tops, branches etc
- Domestic forestry by-products/residuals: bark, wet wood chips, etc
- Domestic sustainable energy crop (agriculture or forest)

**Conversion system:**

- Pyrolysis, e.g. for use in a boiler or combined heat and power (gas-engine)

**Co-fire:**

- Heat generator (i.e. boiler) is 100 percent biomass-fired.

**Heating system heat sources:**

- Heat generator is part of a system with fossil fuel fired boilers
- Heat generator is part of a system with heat pumps
- Heat generator is part of a system with solar heat collectors
- Heat generator is part of a system with other heat sources

**Comments:**

- The program would have allowed a combination of different heat sources, as mentioned above, but it wasn't necessarily realized in practice.

agency via annual evaluation of their performance data.

- The fact that governmental funding became available increased trust in the technology which had previously been criticized for being unreliable.
- The monitoring of the program still provides useful data for the ongoing consultation process, even after termination of the funding period.

## The policy and its mechanisms

The Bavarian demonstration program for small scale wood fuel gasifier CHP's ("BioSol") provided a one-time non-refundable governmental subsidy for investors. The subsidy was 30 % of eligible investment costs. The maximum subsidy per installation was 200 000 €.

Subsidies were granted for

- Combined heat and power plants (CHP's) using gasifier-technology with piston engines for wood chips or for wood pellets; the gasifiers were erected within the state of Bavaria.
- Maximum electrical power output: 250 kW.
- Operational requirements: The potential to achieve a minimum of 5 000 h of annual full load operation. This was to be proven by technical documents during the application phase, but no further inspection was then made during the operational phase.
- Heat use: Investors needed to satisfactorily prove that 60 % of the heat produced can be used for meaningful purposes (e.g. a drying of the wood chips fuel directly used in the gasifier was not accepted).
- Fuels: Only natural untreated wood fuels as chips or pellets were applicable (i.e. no waste).
- Demonstration requirements: Investors had to guarantee access for an interested public for 8 years.
- Appropriation: A minimum of 8 years operation is required; if projects are stopped earlier the subsidies have to be refunded proportionally.
- Overall cap: A maximum of 32 installations could be funded, each at a different location, of which a maximum



## Relation to Sustainable Development Goals:



**Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**



**Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**



**Ensure sustainable consumption and production patterns**



**Take urgent action to combat climate change and its impacts**

of 8 installations should belong to each of 4 module classes (<20 kW<sub>el</sub>, >20 - 50 kW<sub>el</sub>, > 50 - 150 kW<sub>el</sub>, >150 - ≤ 250 kW<sub>el</sub>).

- Reliability: The CHP-manufacturer of the installation needed to provide a proof of minimum 3 reference installations that all had recorded a minimum operation time of 3 000 full load hours (i.e. no prototypes were fundable).

The call was open from June 2013 till Dec. 2014 and it was well received. After the program publication on the TFZ homepage it was advertised through press releases, specific workshops and funding directories or via the equipment manufacturers of the gasifier-CHP's, which were also mainly located in the state of Bavaria. During the application phase, each investor had undergone a specific consultation process with C.A.R.M.E.N. e.V., the Bavarian Agency for Biomass and Bioenergy, who acted as a technical program partner for TFZ. For the full application, several deliverables were required: a detailed project description with applied technology and area plan, a heat demand calculation, a manufacturer's proof of 3 successful reference plants, an economic viability calculation on excel basis and a proof of available financing.

### Program monitoring

After implementation, an annual report is prepared continuously over the following 8-years-period of operation. This report provides the following information:

- Total fuel consumption (all fuels)
- Total heat and electricity produced
- Number of labor hours spent as documented in timesheet recordings

From this data the program partner C.A.R.M.E.N. e.V. generates an annual monitoring report. As a result, for example in 2017, all 8 installations in the segment below 100 kW<sub>el</sub> had reached an average of 7 540 full load operating hours and achieved a mean annual efficiency of 25 % (electricity) or 53 % (thermal), respectively. On average, the total number of man-hours needed for plant

operation was 241. The specific labor input per MWh<sub>el</sub> was 0.9 h, and the average number of downtime hours was 844.

Also the "learning curve" is evaluated. In the latest trend evaluation a positive development was indicated from 2016 till 2017: the number of full load hours had increased by 500 h, electrical efficiency was up 1, and thermal efficiency was up 5 percentage-points.

The annual monitoring report is regularly made available to the investors. Thus, it also serves as a benchmark for each gasifier-operation, while no confidential information is disclosed to competitors. The monitoring also serves as a database for the permanently ongoing consultation process in the field of small scale gasification. This consultation is performed by partner C.A.R.M.E.N. e.V. and will continue even after program termination.

### Achievements and program termination

A total of 7.0 million € was invested during the BioSol-program (excluding non-gasifier-related expenses as district heating or biomass boilers), of which 2.1 million € (i.e. 30 %) were directly paid as subsidy to the investors. In summary, 16 small scale fixed-bed gasifiers were installed within the BioSol program. All installations were provided by Bavarian manufacturers except for one plant, which was from Austria. The list of projects funded can be downloaded [here](#). The four manufacturers that were eligible were: [Spanner Re2 GmbH](#), [Burkhardt GmbH](#), [Holzenergie Wegscheid](#) and [Fröling Heizkessel- und Behälterbau GmbH](#).

The module class of 20 to 50 kW<sub>el</sub> was filled up to the maximum planned number of 8 installations, further applications for this class had to be rejected. Also, the larger module class of 150 to 250 kW<sub>el</sub> was well received (6 installations), while no installation was made in the smallest category (<20 kW<sub>el</sub>). Nevertheless, it is believed that the existence of the BioSol-program has stimulated the development of this category, too, because shortly after the program ended, a gasifier-CHP with 9 kW<sub>el</sub> was released to the market.

The Bavarian BioSol program was terminated after 19

**Replicability potential:**

- Medium regional replicability
- Medium national replicability

**Scale-up potential:**

- Low regional potential
- Low national potential

**Connection to investment case:**

- Small scale fixed bed gasifier-CHP for a rural biomass-fired district heating network in Bavaria

months, enforced via an order from the Federal Ministry of Economic Affairs. This Ministry deemed the program to be in conflict with the rules of the Federal Renewable Energy Law (EEG), which guarantees fixed infeed tariffs for electricity from biomass.

Although the BioSol program was stopped before available funds could all be distributed, the gained experience and achieved continuous technological progress has helped to sustain a certain level of activity in the industry. During the program the industry was also able to develop some important export opportunities. Furthermore, the German market still provides some business opportunities, despite the fact that the national infeed tariffs for bioelectricity gradually have become unfavorable for small scale gasifier-CHP's. The market for such plants is now driven by high electricity prices, thus creating new business cases through high-value replacement of given electricity purchases.

## Reasons behind the implementation

The program intended to serve several purposes: to stimulate further technological development in the field of small-scale gasification, to replace fossil energy carriers and to stabilize decentralized electricity supply, combined with the aim of creating jobs and income from the use of biomass fuels in rural areas and in related industries. The program was also particularly designed to serve the Bavarian economy, as the recently emerging industry in the field of small scale gasification is mostly located in this state. Together with the regional tradition of wood energy use, the distance to market was particularly close. The requirement that all installations must be located in Bavaria facilitated direct communication and user-feedback between technology developers and plant operators.

Furthermore, the goal was to overcome the threshold of a minimum number of installations that would enable good communication among the plant operators themselves (e.g. via so-called "regular's tables"). A high regional density of installations was also found useful to solve "teething

problems" in this young gasification business. At the same time it was intended to create a positive climate that would allow success stories to become spread, while at the same time knowledge about reliable operational practices is exchanged among users.

Finally, the goal was to increase both visibility and trust in the new gasifier technology through the fact that governmental funding has now become available. The gasification technology had previously been criticized for being unreliable.

## Lessons learned

As a general conclusion, the program was successful and in case of a renewal or continuation no major changes or adaptations are deemed necessary.

An unexpected lesson was learned during program monitoring when labor requirements for operation and maintenance were found higher than advertised by manufactures. Furthermore, it became apparent that small scale gasification is not a technology that allows an easy "press-button"-operation and that the complexity of a biomass gasifier CHP is generally underrated. Therefore, the investor's or operator's capacity for successful plant management should be carefully evaluated during the consultation process. This is to avoid technical and economical failures, which could scare off potential operators. In the case of the BioSol program, however, such disappointments were successfully avoided. All gasifier installations are today (in 2018) still in operation, except for one, where the complete building was destroyed by a fire - but not as a consequence of gasifier malfunction.

Finally it seems to be essential to avoid any conflicts with regulations in other subsidy programs in the field of renewable energy. Or alternatively, any support from other subsidy schemes could be systematically excluded by the funding rules.

**Replicability potential:**

- Medium regional replicability
- Medium national replicability

**Scale-up potential:**

- Low regional potential
- Low national potential

**Connection to investment case:**

- Small scale fixed bed gasifier-CHP for a rural biomass-fired district heating network in Bavaria

## Success factors

A substantial financial support was needed to provide enough incentive for the investors. At the same time, it was helpful that the return of investment could quite reliably be calculated through guaranteed infeed tariffs for the electricity produced. The general investment risk was thus largely reduced by a favorable legal framework and direct funding.

Furthermore, it became obvious that a careful program planning is required, involving consultation of manufacturers, technical agencies and other experts before program publication.

Finally, it was particularly useful that equipment manufacturers need-ed to prove the existence of successful installations, i.e. a minimum of 3 reference plants with more than 3 000 full load hours. By doing so, the number of manufacturers was limited to only four (see above). Several other developers who had also been advertising their gasifier technology were thus rejected. Without this requirement the risk of having demonstrated technical failures would have been too high.

## Constraints

The BioSol program conflicted with the rules of the Federal Renewable Energy Law (EEG), which guarantees fixed infeed tariffs for electricity from biomass. This has led to a program abortion after 19 months.

The abortion might have been stopped if the need for supplementary subsidies had been proven. However, rules for such proof calculation have not yet been issued.



IEA Bioenergy

**Web sites:**

[Funding directive of BioSol](#) (in German)

[List of supported installations](#)

[www.ri.se](http://www.ri.se)

[www.energimyndigheten.se/en/](http://www.energimyndigheten.se/en/)

[www.iea.org/tcp/](http://www.iea.org/tcp/)

[www.ieabioenergy.com](http://www.ieabioenergy.com)

**Contact:**

Hans Hartmann

Emanuel Schlosser

[www.tfz.bayern.de](http://www.tfz.bayern.de)



IEA Bioenergy