

# What is the Biogas Calculator?

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The biogas calculator is a tool for estimating a potential biogas production and is helpful for planning biogas plants. The calculator contains a number of changeable settings (*costs, substrates, engine types*), which allow it to be adjusted for use in any region. The calculation results may be exported to an Excel table.

## Instructions for installing and setting up the Biogas Calculator

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### System requirements:



Microsoft Windows NT, 2000, XP or Vista




Java <http://java.com>

If you have not installed Java yet, click here <http://java.com> to get downloading and installation instructions.

### Setting up the Biogas Calculator:

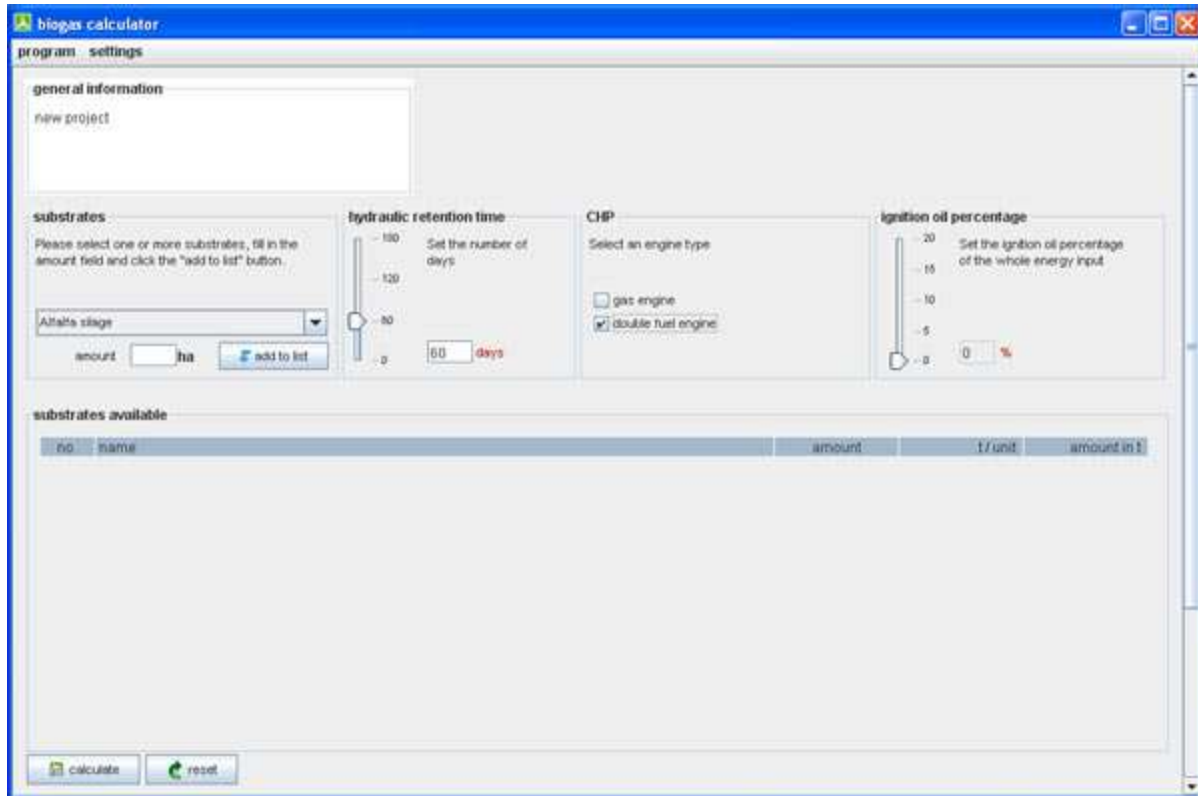
Copy the file  **BioGC.zip** to a temporary directory. The ZIP file contains a folder  **BioGC**. Extract it to a directory of your choice using WinZip or similar. Done!

Find the executable file  **BioGC.exe**. You start the Biogas Calculator by clicking on it. It is also advisable to create a shortcut on the desktop for the file.

# Getting started



To start the Biogas Calculator, click on **BioGC.exe**, or the shortcut on your desktop. You will be prompted by a dialog window to select a language when you start the application for the first time. Following the main window will open.



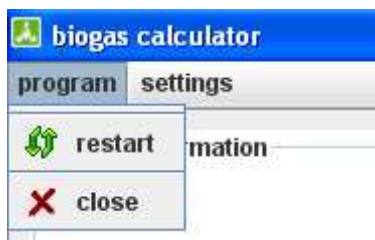
Before starting with the calculations, the settings must be adjusted to your country, region etc.

## Main menu



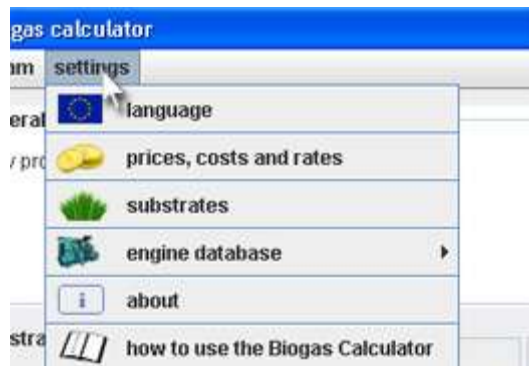
The main menu contains 2 submenus:

### 1. Program



To restart the program, click "restart". To close the program, click "close".

## 2. Settings



### - Language



To switch to another language, click on the item "language". A popup window will open and it is possible to choose between the listed languages by selecting one of the radio buttons. To confirm your selection click the "OK" button. The program will restart automatically.

# Prices, costs and rates

Before starting the calculations please adjust the electricity prices, costs, interest rates etc. Click on the menu item "**prices, costs and rates**". A popup window will open.

Category	Parameter	Value	Unit
costs	electricity price:	15,50	ct/kWh
	oil price:	50,00	ct/l
	bring out costs:	3,00	€/t
	labour costs:	15,00	€/h
	working hours:	4,00	h/d
	maintenance, repair:	2,00	%
	maintenance CHP:	1,00	ct/kWh (el)
selling prices	electricity:	25,67	ct/kWh
	heat:	5,00	ct/kWh
	fertiliser value:	10,00	€/t N
investment costs	interest rate:	6,50	%
	insurance:	0,50	%
other	electricity demand BGP:	5,00	%

Adjust the values and click the "save" button. The program will save the changes and restart automatically. If you don't want to adjust these settings click on "cancel".



Click on the reset button, if you would like to restore the default values (*based on German laws and conditions*). In this case you will be prompted to confirm the action..

**caution**

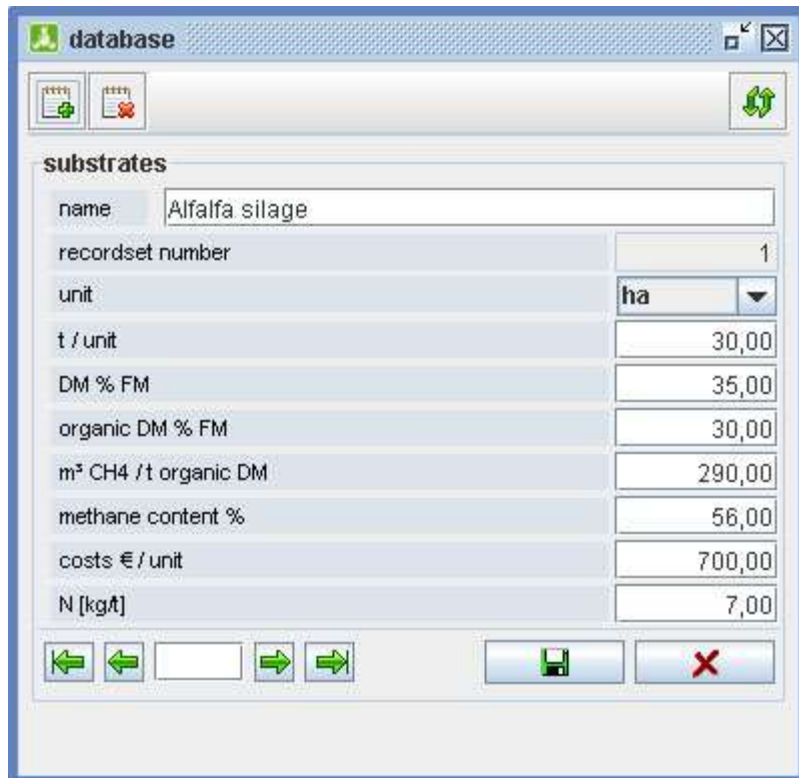
? this operation will reset the database default values!

OK Abbrechen

Click "OK" to confirm or "cancel" to cancel. If you clicked "OK" the program will save the changes and restarts automatically.

# Substrates

Before starting the calculations please check the substrate database. The calculator already has a default database. New substrates can be added, existing substrates updated or deleted. Click on the menu item "**substrates**". A new window will open. The first record set is loaded. Click on the arrow buttons if you want to go to the next, last, previous or first record set. If you would like to go to a particular substrate, input its number into the input field between the arrow buttons and press the "Enter" key.



The screenshot shows a window titled "database" with a toolbar at the top containing icons for adding, deleting, and refreshing records. Below the toolbar is a table with the following fields and values:

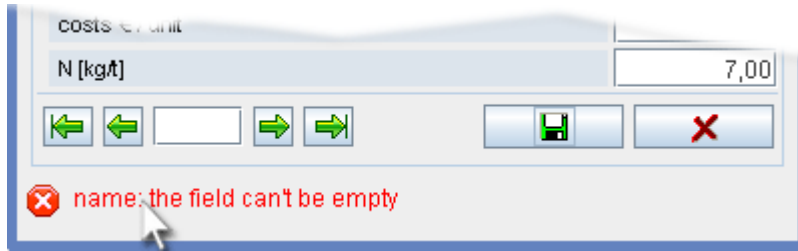
substrates	
name	Alfalfa silage
recordset number	1
unit	ha
t / unit	30,00
DM % FM	35,00
organic DM % FM	30,00
m <sup>3</sup> CH <sub>4</sub> / t organic DM	290,00
methane content %	56,00
costs € / unit	700,00
N [kg/t]	7,00

At the bottom of the window, there are navigation buttons (left, right, first, last) and a search input field. To the right of these are buttons for saving (floppy disk icon) and deleting (red X icon).

Each record set consists of:

- **Name** - the name describes the substrate.
- **Record set number** - this number is given by the program according to alphabetic order.
- **Unit** - you may select between "t", "ha" and "livestock".
- **T/unit** - tons per unit. How many tons of material does a unit contain? (e.g.: 1 ha alfalfa silage contains 30 tons of material).
- **DM % FM** - percentage of dry matter from fresh material.
- **Organic DM % FM** - percentage of organic dry matter from fresh material.
- **M $\blacklozenge$  CH<sub>4</sub> / t organic DM** - methane amount per ton of organic dry matter.
- **Methane content** - percentage of the methane content.
- **Costs  $\blacklozenge$  / unit** - Input a "0" if there are no costs for the substrate. If the substrate brings benefit instead of costs put a minus sign in front of the numeral.
- **N kg/t** - kilograms of nitrogen per ton.

All the input fields must be filled in. If you try to save the substrate with an empty field, the program will stop and show you an error message.



## Updating an existing record set (substrate)

To overwrite a record set adjust the data in the input fields and press the "save" button. The updates will be activated after the program is restarted.

## Adding a new record set (substrate)

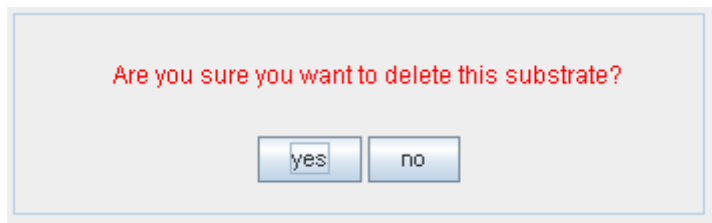


Click on the "new" button. Fill the input fields. Click on the "save" button. The updates will be activated after the restart of the program.

## Deleting a record set (substrate)



Select the substrate, you want to delete. Click on the "delete" button. You will be prompted to confirm this action.

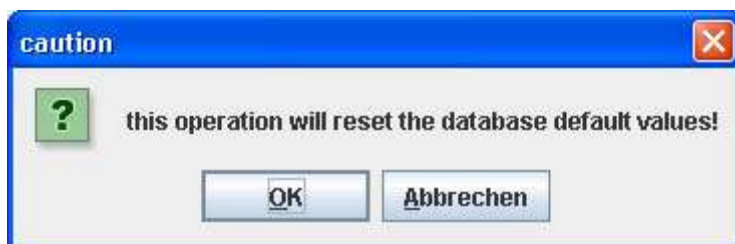


The updates will be activated after the program is restarted.

## Resetting the default database

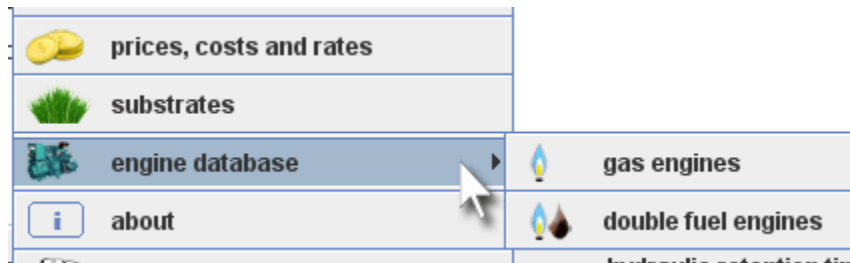


Click the reset button, if you want to restore the default values. In this case you will be prompted to confirm this action.



Click "OK" to confirm or "cancel" to cancel. The updates will be activated after the program is restarted.

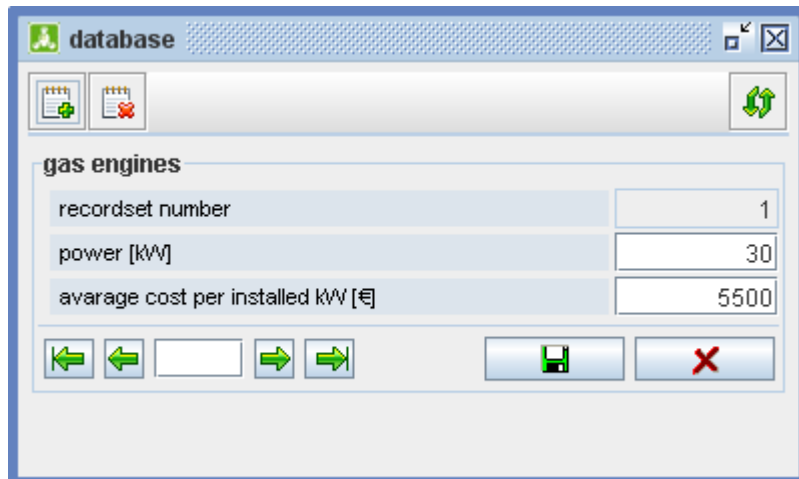
# Engines



The engine database consists of 2 sub databases:

- gas engines
- double fuel engines

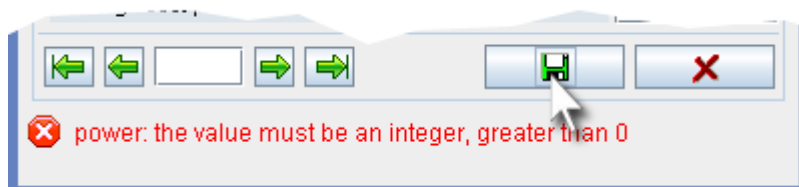
The engine databases contain default values (*based on German conditions*). Before starting the calculations please check them and adjust for your area. New engines can be added and existing engines updated or deleted. Click on the menu item "**engines**" and select the engine type you want to update. A new window will open. The first record set is loaded. Click on the arrow buttons if you would like to go to the next, last, previous or first record set. If you want to go to a particular engine, input its number into the input field between the arrow buttons and press the "Enter" key.



Each record set consists of:

- **Record set number** - this number is given by the program according to order (*the engines are ordered by power asc.*).
- **Power** - power in kW.
- **Average cost per installed kW** - (e.g.: 30 kW = 5500€).

All input fields must be filled in. If you try to save the engine with an empty field, the program will stop and show you an error message.



## Updating an existing record set (engine)

To overwrite a record set adjust the data in the input fields and press the "save" button. The updates will be activated after the program restarts.

## Adding a new record set (engine)

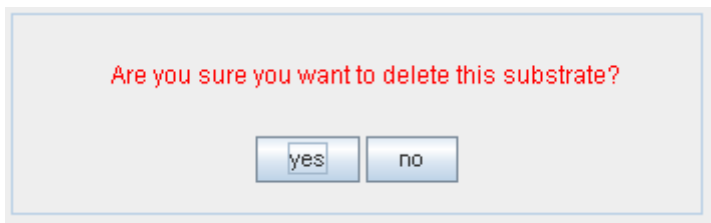


Press the "new" button. Fill the input fields. Press the "save" button. The updates will be activated after the program restarts.

## Deleting a record set (engine)



Select the engine, you want to be deleted. Click on the "delete" button. You will be prompted to confirm this deleting.



The updates will be activated after the program restarts.

## Resetting the default database



Click on the reset button if you want to restore the default values. In this case, you will be prompted to confirm this action.

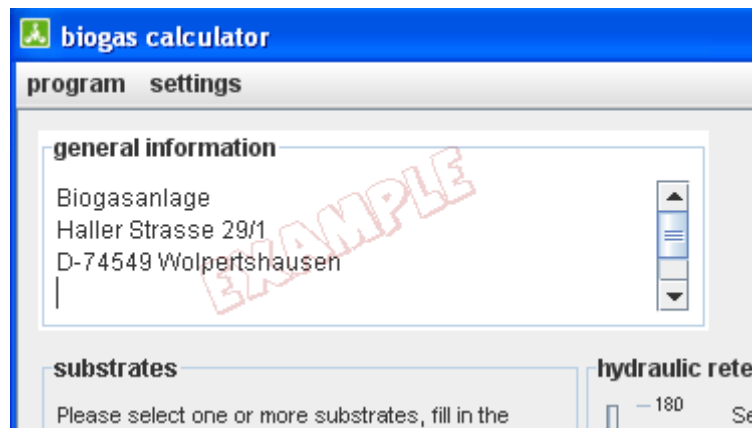


Click "OK" to confirm or "cancel" to cancel. The updates will be activated the program restarts.



# Calculation

**Step 1:** When you are ready with the adjustments, restart the program. Input your project data:



biogas calculator

program settings

general information

Biogasanlage  
Haller Strasse 29/1  
D-74549 Wolpertshausen

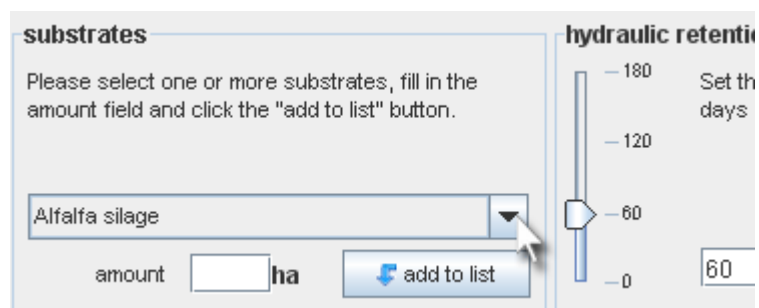
substrates

Please select one or more substrates, fill in the

hydraulic retention time

180 Set the number of days

**Step 2:** Select a substrate in the pull-down menu and then input an amount, and click on the "add to list" button.



substrates

Please select one or more substrates, fill in the amount field and click the "add to list" button.

Alfalfa silage

amount  ha

add to list

hydraulic retention time

180 Set the number of days

120

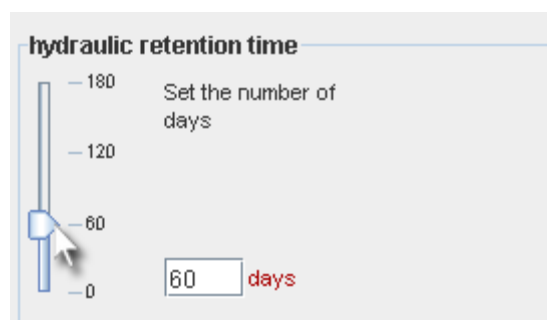
60

0

60

*(Repeat step 2 if you have more than 1 substrate).*

**Step 3:** Set the retention time in days. Use the slider or type the number directly into the input field next to it.



hydraulic retention time

180 Set the number of days

120

60

0

60 days

**Step 4:** Select an engine type.

**time**

number of

**CHP**

Select an engine type

gas engine

double fuel engine

**Step 5:** If you have selected a gas engine, proceed to step 6. In case you selected a double fuel engine, you need to set the percentage of the ignition oil (e.g.: 5%).

**CHP**

Select an engine type

gas engine

double fuel engine

**ignition oil percentage**

Set the ignition oil percentage of the whole energy input

20  
15  
10  
5  
0

5 %

**Step 6:** Click on the calculate button

no.	name	amount	1 / unit	amount in t
1	Atfalla silage	70,00	30,00	2100,00
<b>total:</b>				<b>2100,00</b>

**substrates available**

**general information**

Biogasanlage Wolpertshausen  
Haller Straße 29/1  
D-74549 Wolpertshausen

**CHP efficiency**

electrical 36 %  
thermal 30 %

**initial data**

date: 15/01/2009  
total weight of the material: 2100,00t  
engine type: double fuel engine  
engine power: 80kW  
ignition oil percentage: 5%

**digester size and storage demand**

**digester:**

hydraulic retention time (days): 85  
required working digester volume [m<sup>3</sup>]: **489,04**  
volume load [kg org. DM/m<sup>3</sup>d]: 3,53  
DM content of input mix: 35,00%

**required storage volume:**

total input [t/a]: 2100,00  
mass loss (1,25 kg/m<sup>3</sup>·80) [t]: -407,81  
balance [t/a]: 1692,19  
Volume for 6 month storage: 846,09  
required storage volume [m<sup>3</sup>]: **846,09**

**energy production**

**electrical efficiency**  $\eta_{el} = 36\%$

total electricity production [MWh]: 692337  
electricity demand BGP [kWh] 5%: -34617  
electricity sales [MWh]: **657720**

**thermal energy**  $\eta_{th} = 30\%$

total heat production [kWh]: 578947  
heat demand BGP [kWh] 30%: -173084  
Surplus heat [kWh]: **403863**

**investment costs**

total core biogas plant: 340000,00€

**running costs:**

depreciation period (10 years): 34000,00€  
interest 1/2 ( 6,50% ): 11050,00€  
maintenance, repair ( 2,00% ): 6800,00€  
maintenance CHP ( 1,00€/kWh ): 6923,37€  
insurance ( 0,50% ): 1700,00€  
labour costs (4h/d): 21800,00€  
substrate costs: 49000,00€  
costs ignition oil: 4807,89€  
**total costs: 136181,27€**

**gas utilisation**

biogas amount [m<sup>3</sup> BGA]: 326250,00  
methane content [%]: 58,00%  
methane amount [m<sup>3</sup>]: 182700,00  
methane energy content [kWh]: 1827000,00  
continuous power output biogas [kW]: 75  
with dual fuel engine [kW]: 79  
resulting full load hours [h/a]: 8654  
[h/d]: 24  
corresponding load (CHP): 98,79%

**energy sales**

**income from electricity sales:**

income from electricity sales: 144698,41€  
total income electricity sales: **144698,41€**

**income**

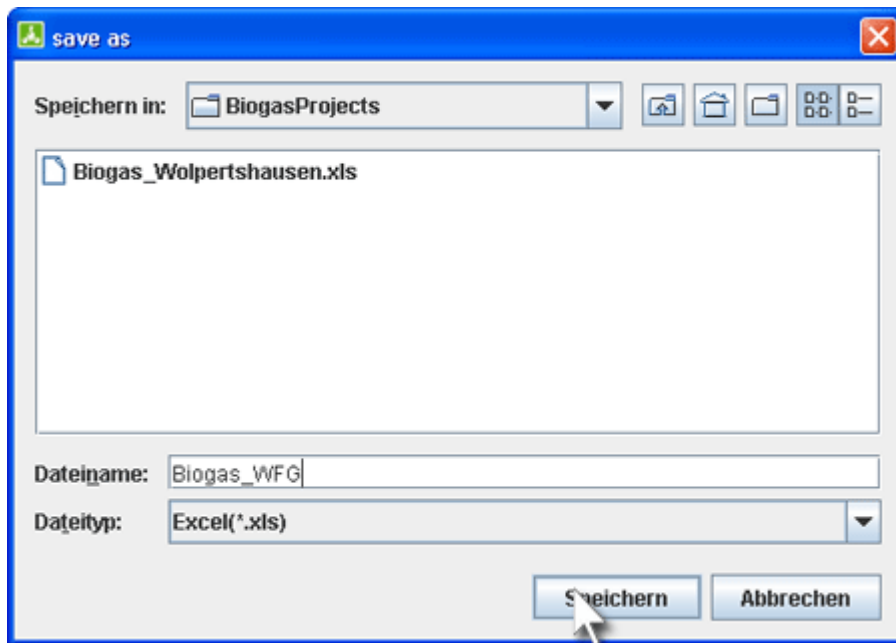
total income electricity sales: 144698,41€  
fertiliser value (10,00€/live stock): 0,00€  
total income: **144698,41€**  
annual income: **8517,14€**

back export to excel

**Step 7:** If necessary set the CHP electrical and thermal efficiency (The default value is 36% for electrical and 30% for thermal. There are engines available in Germany with an output from 28% up to 45%).

The screenshot shows a software interface with two main sections. The left section is titled "CHP efficiency" and contains two rows of input fields. The first row is labeled "electrical" and has a numeric input field containing "36" followed by a percentage sign "%". The second row is labeled "thermal" and has a numeric input field containing "30" followed by a percentage sign "%". The right section is titled "initial data" and contains several labels: "total weight of the n", "engine type:", "engine power:", and "ignition oil percenta".

**Step 8:** Click on the "export to Excel" button. Save the excel file in the directory of your choice.



Done!