



User manual

CHP-GO model
Version 1.11
May 2009

Introduction

This document serves as a Manual for the **CHP-GO model version 1.11, May 2009**¹. The CHP-GO model is an Excel spreadsheet which has been developed for the Association of Issuing Bodies (AIB) to support the development of a European standard for high-efficiency CHP guarantees of origin as proposed by Directive 2004/8/EC (“the CHP Directive”). It contains 7 worksheets:

1. An introduction sheet (“Intro”) with general information (version number and date) and contents of the spreadsheet
2. An input sheet (“input GO”) for filling in permanent registration data of a CHP plant, its operational data for the reporting period and the average ambient temperature per country or country region.
3. A sheet with fixed input from the CHP Directive (“fixed input from the Directive”) in which a number of fixed inputs are listed:
 - the (moving) reference values for separate production of heat and electricity (Commission Decision of 12 December 2006)
 - the thresholds for overall efficiency (Annex II of the Directive) and primary energy savings (Annex III of the Directive)
 - Grid loss factors (to correct the reference efficiency for electricity for avoided grid losses) (Commission Decision of 12 December 2006)
 - input for ambient temperature correction (how to deal with deviations from ISO conditions) (Commission Decision of 12 December 2006)
4. A sheet with other fixed input (“other fixed input”) with the CO₂ emission factors per fuel
5. A sheet with calculation results (“calculation results”) which include the calculation steps for Annex II and III of the Directive as well as the additional calculation steps needed for the guarantee of origin.
6. An output sheet (“guarantee of origin net”) displaying all information that will be put on the guarantee of origin for net high-efficient CHP electricity.
7. An output sheet (“guarantee of origin redeemed”) displaying all information that will be put on the guarantee of origin for redeemed high-efficient CHP electricity.

The worksheets “calculation results” and “guarantee of origin net / redeemed” are hidden until all required input data is inserted.

The model is linked to the Guidelines for implementation of Annex II and Annex III of the CHP Directive prepared as part of the procedure of the European Commission for implementing the Directive.² The final version of Commission Guidelines, which was accepted by all Member States does not cover all issues in detail and leave room for Member State specific choices. This conflicts with the development of a European standard for CHP-GOs. In the CHP-GO model, therefore, explicit choices have been made on these issues to come to a standard. In this manual these choices are highlighted.

In the next section the input fields of the model are described.

¹ When using an older or newer version of the model, this manual will not necessarily be fully compatible.

² Commission Decision, 19 November 2008.

Description of the input fields – sheet <INPUT GO>

Permanent registration data

▪ **Type of technology**

This input field is only used for determining the correct threshold value of overall CHP efficiency (Annex II of the Directive). One can either choose for *combined cycle gas turbine with heat recover* and *steam condensing extraction turbine* (both with a threshold efficiency of 80%) or *other CHP technology* (with a threshold efficiency of 75%). This input is not used on the guarantee of origin.

▪ **Power capacity**

This input field is only used for determining the correct primary energy saving threshold. For CHP plants with a power capacity below 1 MWe the threshold is 0%, whereas for larger CHP plants, the threshold is 10%. “Name plate” (gross) power capacity should be filled in. Values should be given in MWe.

Note that a clear definition of power capacity is neither given in the Directive nor in the latest version of the Calculation Guidelines of Annex II and III.

▪ **Power loss coefficient**

This input field is used for the calculation of the amount of CHP and non-CHP electricity (Annex II). The electrical/mechanical power loss coefficient is the balance between increasing heat energy recovery and reducing electrical/mechanical energy of CHP plants. The power loss factor is defined as the weighted measured value in the reporting period. For CHP plants which do not include fully or partially condensing steam turbines, the power loss [coefficient] is generally zero.

▪ **Place of production / EAN code**

This input parameter is used as output field on the guarantee of origin.

▪ **First year of electricity production**

This input field is used to determine the correct reference values for separate production of electricity. In the Commission Decision of 12 December 2006 the reference efficiency values refer to “year of construction”. In the CHP Committee “year of construction” has been interpreted as “first year of electricity production”.

Data for complex CHP installations with connected prime movers with different “first years of electricity production” should be filled in for each prime mover separately.

▪ **Heat category**

This input field is used to determine the correct reference efficiency value of separate heat production. In this version of the model the dominant heat category should be filled in (simplified approach).

Note that the Commission Guidelines are not prescriptive concerning how to deal with installations that supply different types of heat.

Impact on results – example (1)

Assume both steam and hot water are being produced by a CHP plant where total useful steam production is higher than total useful hot water production; steam should be selected as input field. The number of guarantees of origin for high-efficient CHP will in principle not change (in theory the number of GOs might turn into zero when applying of the higher hot water efficiency values means that the primary energy saving threshold is no longer met; this is possible for plants having their primary energy savings already close to 10% (for large units) when applying the reference efficiency values for steam). The information on the guarantee of origin (PES, CO₂) will be slightly affected.

- **Predominant use of the heat**

This input field is used as an output field on the guarantee of origin and is a requirement of Article 5 of the CHP Directive. For reasons of transparency AIB has added biogas as a separate category.

- **Level of grid connection**

This input field is used to determine the correct grid correction factor which is used to adjust the reference efficiency value for separate production of electricity. The level of grid connection is defined as the voltage level after the transformation station. In this version of the model the dominant grid level (in which the largest share of electricity is fed) should be filled in, in case CHP units feed to different grid levels (simplified approach).

Note that the Commission Guidelines are not prescriptive concerning how to deal with installations that feed into different grid levels.

Impact on results – example (2)

Assume a CHP plants feeds both into a 100-200 kV grid and a 0.4-50 kV grid where the largest share of the electricity is fed into the 100-200 kV grid. In the simplified approach the 100-200 kV grid level should be chosen. This choice implies that correction of the reference values for electricity for avoided grid losses in the calculation will be lower than in the case of (partly) feeding into a 0.4-50 kV grid. The number of guarantees of origin for high-efficient CHP will in principle not change (in theory the number of GOs might turn from zero into some figure when using the 0.4-50 kV grid level; this is possible for plants having their primary energy savings marginally below 10% (for large units) when using the 100-200 kV grid level). The information on the guarantee of origin (PES, CO₂) will be slightly affected.

Operational data of the CHP unit in the reporting period (either monthly, quarterly or annual data)

- **Dates of production**

This input field is used as output field on the guarantee of origin. The model uses a standardised reporting period of one calendar month, one calendar quarter or one calendar year.

- **Fuel source 1, 2, 3, 4, 5**

This input field is used as output field on the guarantee of origin and for determining the correct reference values for separate production of electricity and heat. One has to specify all fuel sources being used in the CHP unit in the reporting period (choose “none” for all input fields not being used). The current model version can deal with 5 different fuels maximum.

- **Lower calorific value**

This input field is used as output field on the guarantee of origin (required by Article 5 of the CHP Directive) and for calculating the amount of fuel used in the CHP process. The lower calorific value should be given in **MJ/kg** or **MJ/m³** or **MJ/litre**.

- **Input fuel source 1, 2, 3, 4, 5**

This input field gives the amount of fuel and is used for determining the amount of fuel used in the CHP process. Fuel for non-CHP heat (boiler heat) should be excluded. The amount of fuel used should be given in **MWh** or **GJ (lower calorific value)**.

- **Gross electricity production**

The gross electricity production is defined as the electricity measured at the outlet of the main generators. This includes the auxiliary consumption of electricity of the CHP plant for pumps, fans, compressors, waste gas cleaning etc. The electricity production should be given in **MWhe**.

- **Net electricity production**

The net electricity production is defined as the gross electricity production minus the auxiliary consumption of electricity of the CHP plant for pumps, fans, compressors, waste gas cleaning etc. The electricity production should be given in **MWhe**.

- **of which exported to the grid**

The amount of electricity (**MWhe**) fed into the public grid. Fill in "0" when none of the electricity is exported to the grid.

- **Mechanical energy production**

The amount of energy (**MWh**) used to directly drive a pump, fan or compressor. Fill in "0" when no mechanical energy production takes place.

- **Total useful heat production**

Only the part of the heat output that is transmitted to a beneficial use and that is emerged from the CHP process can be regarded as useful CHP heat. As a part of the useful CHP heat shall be regarded:

- Heat that is used for process heating, space heating and/or subsequent cooling purposes
- Heat that is delivered to a district heating/cooling network
- Exhaust gases of a CHP process that is used for direct heating and drying purposes. Drying of biomass in biomass-fuelled cogeneration systems should not be considered as useful heat.
- Process heat for production of biogas

Supplementary firing in a cogeneration unit that is used for heat production only should not be considered as useful cogeneration heat.

The heat content of the returned condensate to the cogeneration plant should be subtracted from the heat flow associated with steam production.

Heat production should be given in **GJth**.

Note that the Commission Decision is not prescriptive in useful heat from biomass cogeneration³ and subtraction of the returned condensate in cogeneration plants that produce useful heat.

Input for ambient temperature correction

- **Location or manual input for Long term average ambient temperature**

The current version of the model allows to either choosing the average (monthly, quarterly, annual) ambient temperatures in one of the European capital cities, the ISO standard temperature ("default") of 15 °C or to manually feed-in ambient temperatures.

If manual data are filled in, these data are used for the calculations.

Note that the average ambient temperatures in the European capital cities differ from the country averages. The provided data are just a means to play a little bit around. According to the Commission Decision of 6 December 2006, Member States are allowed to introduce climatic zones constituted by isotherms of the annual average ambient temperature which differ at least 4 °C.

³ In the model biogas is added as a separate category for "predominant use of the heat".



Calculate button

After all input data have been inserted the calculate button should be pushed. This button checks if the minimum amount of input fields has been filled in. If this is true, the calculation results and the information on the guarantee of origin are shown. If any input field is missing, an error message will appear and guide the user to this input field.

Clear input data

This button can be used to clear all input fields. It is advised to use this button before starting to insert a new data set (instead of overwriting the former data set).

Description of the output fields – sheets <Guarantee of origin net / redeemed>

As pointed out in Article 5.5 of the CHP Directive, a guarantee of origin shall:

- Specify the lower calorific value of the fuel source from which the electricity was produced
- Specify the use of the heat
- Specify the dates and places of production
- Specify the quantity of high efficient CHP electricity (Annex II)
- Specify the primary energy savings (Annex III).

Elaboration on the requirements of the Directive

- **Specify the lower calorific value of the fuel source from which the electricity was produced**

The lower calorific value will be expressed in MJ per kg or MJ per m³ or MJ per litre. Although not explicitly stated by the Directive, the fuel source itself will also be recorded on the guarantee of origin. Guarantees of origin cannot be issued for fuel mixes: where CHP units use fuel mixes, guarantees of origin will be issued for each fuel source separately.

- **Specify the use of the heat**

Four heat categories are identified, and these are: heating, including district heating and cooling; industrial use including process heating; agricultural use (all mentioned in Article 5 of the Directive); and biogas (see earlier remarks). Where a CHP unit serves different heat markets, then only the predominant heat category will be recorded on the guarantee of origin.

- **Specify the dates and places of production**

The dates of production relate to the reporting period (first day of a calendar month to the last day of that month, inclusive) of the operational data. The place of production will be expressed as the EAN code of the CHP unit.

- **Specify the quantity of high efficient CHP electricity (Annex II)**

The unit of a guarantee of origin is 1 MWh. This means that for one CHP unit in the same reporting period more than one guarantee of origin can be issued when the production of high efficiency electricity is above 1 MWh. Guarantees of origin shall be issued for 1 MWh or multiple thereof.

- **Specify the primary energy savings (Annex III)**

Both the relative primary energy savings and the absolute primary energy savings (per MWh) will be recorded on the guarantee of origin. The absolute primary energy savings (compared to separate production of heat and power with the same fuel source) shows the contribution of CHP to energy saving objectives.

The following additional fields are included on the guarantee of origin for information purposes:

- **Overall primary energy savings (%).**

According to the calculation methodology of the CHP Directive, non-CHP production should be subtracted from the overall production before calculating whether the CHP production is high-efficient or not. The quality of the non-CHP production is not addressed. To provide full transparency in the operational data of a CHP plant (whether it is operating in CHP or non-CHP mode), the overall primary energy saving (%) is included on the GO as information item.

- **Absolute CO₂ emission reduction (per MWh high efficiency CHP electricity)**

The absolute CO₂ emission reduction (compared to separate production of heat and power with the same fuel source) shows the contribution of high efficiency CHP to CO₂ reduction objectives.

- **CO2 emission per MWh high efficiency CHP electricity**

The CO2 emissions per MWh can be used for the disclosure market. This field makes it possible to rank CHP guarantees of origin from different fuel sources based on CO2 performance, and to compare CHP guarantees of origin with guarantees of origin for other technologies.

Table 1 gives an overview of the information on the guarantee of origin.

Table 1: Information on a CHP guarantee of origin

1.	1 MWh high efficiency electricity from cogeneration
2.	Fuel source
3.	Lower calorific value of the fuel source
4.	Predominant use of the heat
5.	Dates of production
6.	Place of production
7.	Relative primary energy savings
8.	Absolute primary energy savings per MWh
9.	Relative overall primary energy savings
10.	Absolute CO2 emission reduction per MWh
11.	CO2 emission per MWh