

Efficiency Calculation of Wood Gas CHP Systems

As manufacturers use different methods and considerations, this document explains the calculation method of vee GmbH, which is based on physical principles and recognised empirical values.

▪ How is a bulk cubic meter (SRM) of wood chips defined?

The basis is a cube of wood with 1 m side length, i.e. 1 m³ of pure wood.
By shredding (chipping) this cubic meter of wood, 2,5 SRM of wood chips G30 – 50 are produced. This means that most wood chips have a length between 30 and 50 mm.
Detailed information can be found in the European standard EN15149-1.

The loosening factor of 2,5 is a recognized value and means that an SRM wood chip contains 0,4 m³ of pure wood.

▪ From the bulk cubic meter to the energy content (calorific value)

The energy content of wood is linearly related to the weight (without water).
Softwoods (conifers) have a slightly higher energy density per kg of wood than hardwoods.

Softwoods: 5,2 kWh / kg
Hardwoods: 5,0 kWh / kg

However, many hardwoods have a higher density per cubic meter than softwoods (conifers).

Spruce: 427 kg / m³ density
Beech: 650 kg / m³ density

Since the volume of wood chips also changes because of drying, an exact calculation is only possible on the basis of the above mentioned 1 m³ cube and the loosening factor of 2,5.

This results in the following energy contents for 1 SRM of wood chips (= 0,4 m³ of wood):

Spruce: 427 kg / m³ x 0,4 m³ x 5,2 kWh / Kg = **888 kWh / SRM**
Beech: 650 kg / m³ x 0,4 m³ x 5,0 kWh / Kg = **1,300 kWh / SRM**

Therefore, an SRM of wood chips made of beech worth 46% more than an SRM made of spruce!

The calculation of the efficiencies of the Wood Gas CHP Systems refer to these values:

▪ From an SRM of wood chips therefore arises:

Spruce: 888 kWh / SRM x 28% el. efficiency = **248,6 kWh electricity / SRM**
~ **1,45 kWh el / kg wood (0% H₂O)**
888 kWh / SRM x 50% th. efficiency = 444 kWh heat / SRM

Beech: 1300 kWh / SRM x 28% el. efficiency = **364 kWh electricity / SRM**
~ **1,40 kWh el / kg wood (0% H₂O)**
1300 kWh / SRM x 50% th. efficiency = 650 kWh heat / SRM