KARA ENERGY SYSTEMS

COMBINED HEAT AND POWER BY KARA

1

THE BEST OPTION

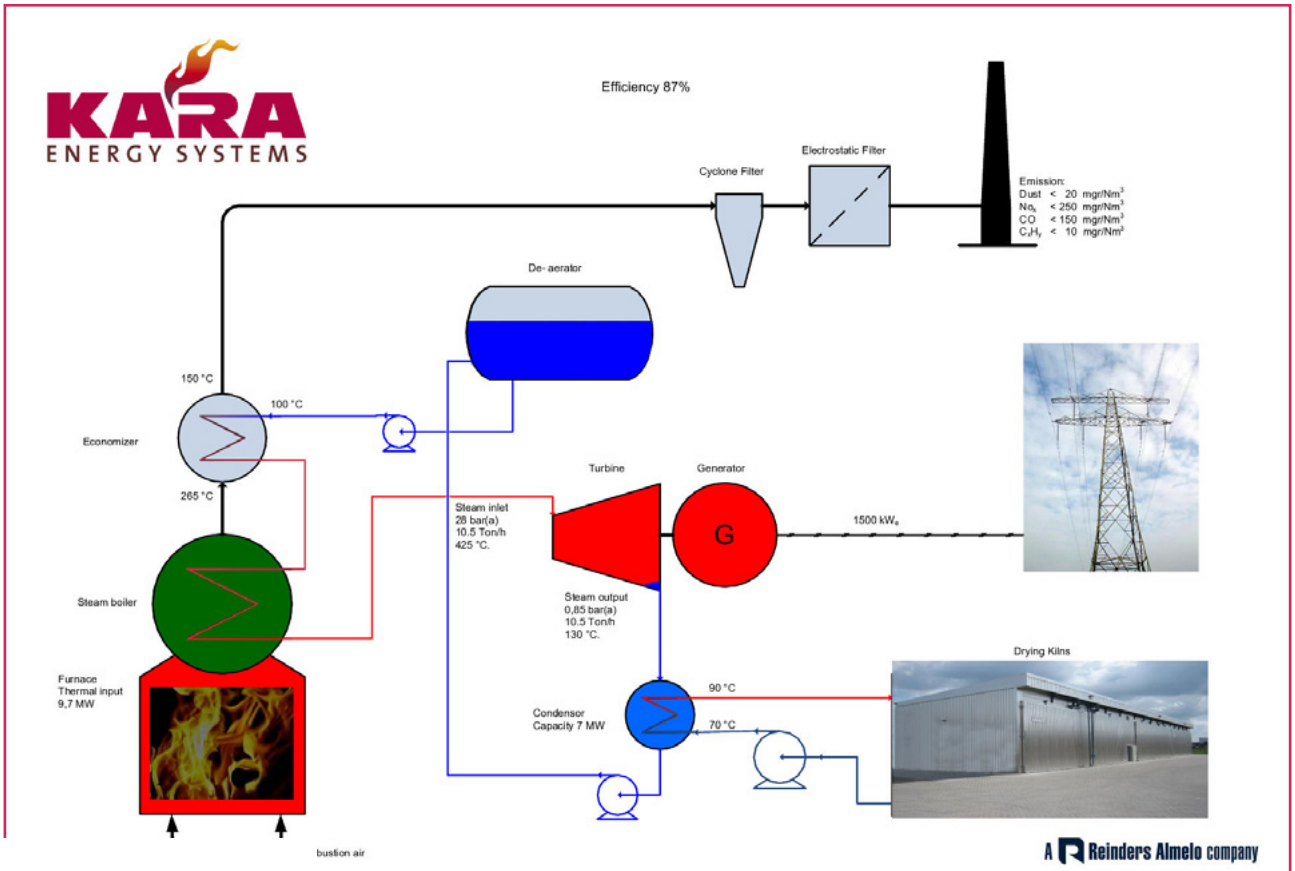
2

1 - CHP plant custom made by KARA
2 - Boiler house of a CHP plant

Renewable Electricity
The market for renewable electricity production is on the move in Europe due to new EC rules, national subsidies, green certificates, carbon trust funds and rising fossil fuel prices. This means that small scale electricity production becomes financial interesting for companies that have enough biomass available for free or that can purchase biomass at a decent price. The produced electricity can be used internally and if the production is higher than the consumption the electricity can be sold to the grid as renewable energy.

For companies with a heat demand, these new developments can be even more interesting. The remaining energy by the production of electricity becomes available in the form of warm water, and the temperature can be adjusted to the personal wishes. For these clients a KARA Combined Heat and Power (CHP) plant is an option. Almost all energy is used useful. Therefore the client and the environment are benefiting from this option.

Principal of CHP
Steam is produced out of water in a biomass fired steam boiler. The steam is lead to a turbine, where the steam is expanded, and thereby producing mechanical energy.



PRINCIPAL OF CHP

1 - **Principal of Combined Heat and Power**

The mechanical energy can be transformed into electricity with a generator. The steam coming out of the turbine is lower in pressure and temperature than the entrance conditions. The pressure drop drives the turbine. The low pressure steam is condensed to produce warm water. The condensate is pumped back to the steam boiler.

KARA Combined Heat and Power Plants

Every CHP plant is built according to the specific demands of the client. This is important to guarantee a system that best fits the need of that customer, because every client has its own heat and power demand, type and quantity of fuel, lay-out possibilities and environmental regulations. KARA designs CHP systems for every type of biomass e.g. sawmill wood residues, MDF dust and pruning wood - up to moisture contents of 55 wt.% on wet basis.

Every KARA system is tailor made and KARA can design, built and deliver the CHP plant on turn-key basis. All major components, like biomass storage, transport system, the furnace, boiler and the flue gas cleaning, except the steam turbine, are engineered and produced by KARA. The main purchase part for KARA is the steam turbine. KARA has a good relation with a steam turbine manufacturer and based on the preferences of the client a steam turbine type is chosen. But only the implementation of the steam boiler with feeding device and flue gas cleaning by KARA is another option, whereby the steam circuit and/or steam turbine is delivered and installed by another manufacturer. The heat and power demand is not always the same and therefore KARA CHP plants can be delivered with air heat exchangers to guarantee at all times the optimum power demand, independent of the heat demand.

Relation electric output and warm water temperature

The electric output depends on the needed temperature of the warm water. The lower the temperature the more electricity can be produced, due to the fact that the steam pressure out of the turbine can be decreased. The lower the outlet pressure, the more expansion of the steam, the more effective the turbine can function.

On the next page an overview is given of the effect on the electric output when heat in the form of hot water becomes available at different temperatures with the same amount of steam. The decrease in electric output makes the case with heat at low temperatures the most interesting for implementing a CHP unit.

Temperature °C warm water	Electric output (kWe)
45 °C	700
90 °C	500
110 °C	450

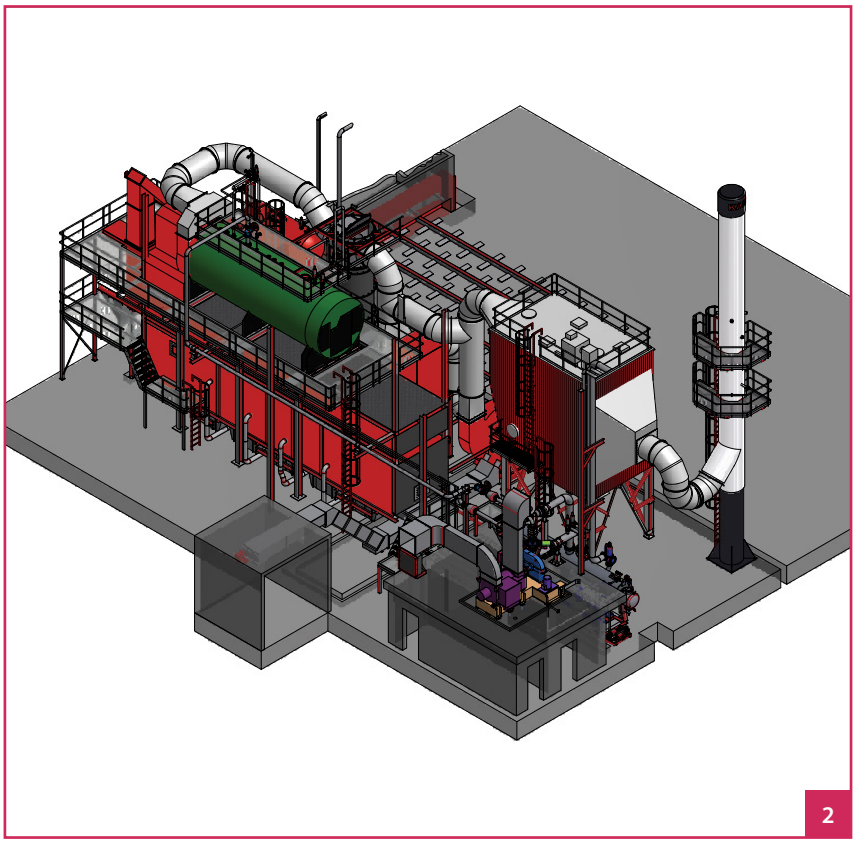
Superheated or saturated steam

A choice can be made for an installation operated with superheated steam or saturated steam, based on the following factors:

- The warm water temperature
- Size of the installation
- If the installation is operated based on heat or power demand

By superheated steam, the saturated steam coming out of the boiler is further heated up in a super heater, thereby going to temperatures above the 400 °C.

The advantage of superheated steam is that the volume of the steam flow increases and no condensate problems arise when the steam is going through a steam turbine. This way low outlet pressure can be achieved and turbine with multiple wheels instead of one can be used. These systems are the preferred option for installations running at low water temperatures.



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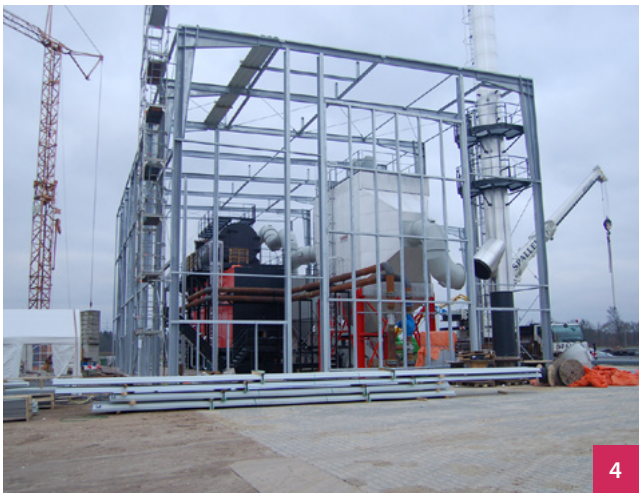
3

4

THE SOLUTION

2 - Lay out CHP plant
3-4 - Inside the furnace
5 - Turbine

5



CUSTOM WORK

1-2-3-4-5 - **Cogeneration plant under construction**

For whom?

Companies that should think about CHP units are:

- Sawmills that have drying kilns and a lot of rest wood available.
- Furniture producers that have large amounts of waste wood available from their production, and have a heat demand e.g. heating factory.
- Companies with high heat demand at low temperatures throughout the year, e.g. green-houses.
- Etc.

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