Biomass

In a DH context, biomass is generally used to feed CHP plants, either as a dedicated source or replacing a percentage of the original fuel. Because biomass is an energy carrier and can therefore be stored, biofuel CHP plants have the potential to be used as a renewable peak plant, during times of low supply or high demand. When combined with a thermal store, revenue can furthermore be increased by making it possible to control output based on electricity prices, rather than thermal demand.

Facilities

Conversion to biogas requires an intermediate step, usually an anaerobic digester. Although this facility can be scaled up and placed more centrally, it depends on the energy content per amount of feedstock mass (frequently related to the percentage of water content) if this is economically feasible. If central collection takes place anyway for other reasons (for example green household waste collection or tapping into an existing landfill), this will be less of an issue and centralised larger scale installations will then be feasible.

Depending on the biofuel available and the installation present, existing CHP plants may be able to accept partial or full replacement of their existing fuel source, sometimes right away, sometimes requiring a degree of conversion. CHP plant size is also highly variable, from the relatively small Vertical City biodiesel engine which partially serves a single building to a large wood chip CHP plant (converted from coal) as part of the Gothenburg DH network. The presence of a combustion process does require some attention to emissions, but assuming the energy content of the biomass or biofuel is high enough, transport cost should not be an issue and CHP plant location will then mostly depend on where the heat is needed. In case of wood and other solids, storage facilities should be covered to reduce rain absorption, as a wet condition may significantly reduce the energetic output per ton.

Sources

Considering the complete supply chain involved is important. Importing significant amounts of biomass over larger distances incurs an additional CO2 exhaust related to fossil fuel use in its transport and may additionally introduce the same political and economic vulnerabilities in security of supply that fossil fuels themselves bring. Local and regional sources therefore should have priority.

Many sources of biomass can be considered. These are generally divided into several categories: wastes, residues and feedstocks. Wastes and residues generally require a step in between to convert the biomass into a fuel, for example through an anaerobic digester. These usually have a low energy content per amount of biomass, but rarely negatively influence other processes and streams like food production or the higher density fuel demand for transport and may therefore both be desirable and available.

Solid biofuel sources commonly considered are:

- Production forests (wood chips or pellets)
- Public park clippings (usually collected centrally)

Examples of biogas sources:

- Agricultural and horticultural residues (may be suitable for direct combustion if dried, or low enough on water content)
- green household waste (if collected separately)
- manure (liquid faction digested on site, solid faction can be collected for central digestion)
- sewage sludge (collected and usually processed/digested locally at sewage treatment facilities)
- landfills (may produce biogas on site)

How to gauge the potentially available amount of local biomass strongly depends on the type of biomass considered. Some residues, like sewage sludge and manure may already be collected and disposed of, and their quantities will therefore be registered by the collection agency. This usually applies to green waste and clippings from parks services as well. In case of production forests, the annual yield per hectare needs to be considered. The only additional figure required is the expected average energy output per ton, taking into account conversion processes like digestion. For a more detailed analysis the fluctuation over time in yield will have to be considered, although the ability to store most biofuels means weekly or monthly yield figures should provide sufficient detail.

Implementation

The installation of a biomass fired CHP plant aimed at producing electricity and at feeding a district heating network will be feasible in most places, provided that some prerequisites are satisfied:

- a sufficient amount of biomass is available within a reasonable distance from the city and at a reasonable cost
- the available biomass is truly renewable, thus reducing the environmental impact of the wood cut process and guaranteeing the biomass supply for the whole duration of the plant's life
- the space required for the installation of a CHP plant is available in a location that minimizes the length of the required pipelines
- the economic barriers connected to the high installation costs of a district heating network and a cogeneration plant are overcome
- a sufficient level of public acceptance is reached, and the inhabitants are convinced about the environmental and economic benefits induced by this solution

Read more

Case Studies

- A biomass CHP plant is part of the Gothenburg DH network.
- The Vertical City building in Rotterdam includes a backup biodiesel CHP.