

The possible roles of the different parts of the power and heat production chain in sustainable system

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The idea is to maximise the value of biomass as a flexible component in the sustainable energy system. In other words, the aim is to minimise system level emissions and costs.

Wood terminal

- Enables matching of wood fuel production and consumption
- Communion place
- Transfer from trucks to larger trucks, trains and vessels
- Wood drying, natural, or artificial with excess heat
- Wood chip screening

Heat pump

- Utilises cheap electricity, when there is more production than consumption
- Most feasible when upgrading e.g. heat from waste waters
- Reduces the need for heat-only boilers
- Reduces up-down ramps of CHP plants
- Quick regulation possible

Wind and solar power

- Can produce a significant share of total electricity production, if...
- ...flexible CHP plants and HPs, heat storages and DSM are used, wisely.

Hydropower

- Regulating power
- Limited, especially when Norwegian hydro power will be exported more

Heat storage tank

- Enables matching of heat production and consumption
- For CHP, HPs, electrical resistances, geothermal energy...
- The larger, the smaller the relative losses
- For large units, investment cost is round 3 euros/kWh (vs. 300-3000 euros/kWh for electricity storage)

Combined heat and power plant

- Produces power when wind and solar is not enough, and heat as an easily storable by-product
- Quick ramping is needed in the future
- High power-to-heat is needed, since there may well be a surplus of heat in system level

Borehole heat storage

- Seasonal
- The larger, the smaller the relative losses

Forest fertilisation

- The more the forest grows, the more fossil fuels can be sustainably replaced by biomass
- Wood ash is suitable for peatlands, nitrogen for mineral soils

Wood fuel supply, Fast Track

- Moist biomass should be used or dried quickly, to avoid biomass degradation
- The fellings are now made more in wintertime than in summertime, good from energy point of view
- With high wind share even better match of biomass production and fuel needs seems probable
- Moist fuel can be dried efficiently, see "Wood chip dryer"



Snow melting from walking and cycling lanes

- Makes walking and cycling more popular, which...
- ...decreases energy needs in traffic and has significant positive health effects.
- Utilises excess heat and/or electricity

Demand side management

- A part of system balancing
- The consumer must have some advantage (e.g. in price) when participating in the flexibility measures
- Participation must be voluntary, not dictated

Electricity&district heating networks

- Enablers of balancing: the one who has surplus, sells to one who has deficit
- The wider the network, the better the balancing possibilities
- Openness in management and use possibilities are crucial

Wood chip dryer

- Water in biomass can be evaporised prior to boiler, by excess heat or even electricity...
- ...instead of using prime energy from combustion itself, in boiler
- Low-temp heat for drying can also be recovered from flue gas scrubber

Biomass gasifier /liquidification

- Produces fuel mainly for diesel buses, trucks, trains, vessels and aviation
- Better alternative for cars may be electricity with flexible charging, or preferably walking, cycling and public transport, due to the limitations in biomass amount

Gas engine

- Regulating power
- Some models can utilise biomass-derived oil or gas
- Conversion process from biomass to oil or gas has a energy loss of roughly 20-50%
- Loss, i.e. excess heat, can be used for district heating, if network and storages exist
- Advantage compared to steam power plant, in addition to fast ramping, is better electricity production efficiency, which counteracts the conversion loss issue