TT5: QM system basics and extension
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Integration of alternative renewable heat sources and extension of the QM system

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FUTURE RENEWABLE DISTRICT HEATING

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- Transition to renewable (district) heating is inevitable!
  - "Rivalry" between renewables is useless and dispensable
  - We need ALL RENEWABLES to make the change

District heating is a valuable infrastructure to collect and utilise **every locally available** renewable heat source!

- Existing biomass DH networks are a perfect starting point
- New projects should consider all potential sources

SELECTION OF SUITABLE HEAT SOURCES

- Higher priority of …
  … location-bound sources
  … non-resource consuming
  … non-emissive sources
  … sources with high temperature levels
- Does location of the source allow effective integration?
- Does thermal capacity, load profile and availability fit?
- Controllability, transport and/or storage ability?
- Positive/negative interactions with other heat sources?
- Insurmountable obstacles?

SYSTEM COMPLEXITY AND PLANNING

- System complexity increase significantly !!
  - Multiple heat sources and characteristics
  - Distributed heat sources, prosumers
  - New DH concepts, reduced system temperatures
  - Sector coupling
  - Short and long term storage
  - Intelligent control strategies
- Comprehensive and detailed planning even more important!
  - Clearly structured planning procedure
  - Strictly defined tasks and responsibilities
  - QM includes all of that!

QM Biomass DH Plants

- Further info: ENTRAIN planning guidelines "Flexible DH Solutions"

BEYOND HEAT …

- Local renewable district heating have great potential
- Some experiences and ideas …
  - Trigger for additional energy + energy efficiency projects in the area
  - Internet provider (shared infrastructure with pipe network!)
  - Power production (PV, CHP,…), local power grid
  - Citizen participation models (PV, thermal solar, DH Plant,…)
  - Energy communities
  - Biomass fuel trading
  - Car sharing
  - …

TO KEEP IN MIND…

QM Holzheizwerke is a quality management system for hot water heating systems based on woody fuels and biomass in the output range from about 100 kW for the heat supply of individual properties or local and district heating networks.

GENERAL REMARK

- QM does not forbid any other heat source!
  - Each heat source has its characteristics and requirements
- Basic idea of QM
  - The plant configuration and dimensioning of boilers must ensure a suitable and controlled operation.
  - When adding other heat production units this has to be assured
    - for the biomass boilers
    - for other heat sources
- General requirements do not change for
  - the general planning process (heat demand assessment, system selection,…)
  - the DH network
  - Monitoring and optimization
  - General considerations regarding biomass DH plants and biomass boilers
  - Use QM "likewise"

ALTERNATIVE HEAT SOURCES AND INTEGRATION IN QM - WHERE TO FIND WHAT

- Annexes to the Planning guidelines
  - Basic information for mayors, other project initiators, share holders, …

- QM Planning Handbook 3rd edition
  - Basic and more detailed technical information (e.g. hydraulic integration)
  - Chapter 13.7 Complementary heat sources and heat generation systems
    - Heat recovery from exhaust gas
    - Heat pumps
    - Solar energy
    - Waste heat utilisation
    - Multi boiler plants

EXAMPLE HYDRAULIC SCHEME FOR HEAT PUMP INTEGRATION

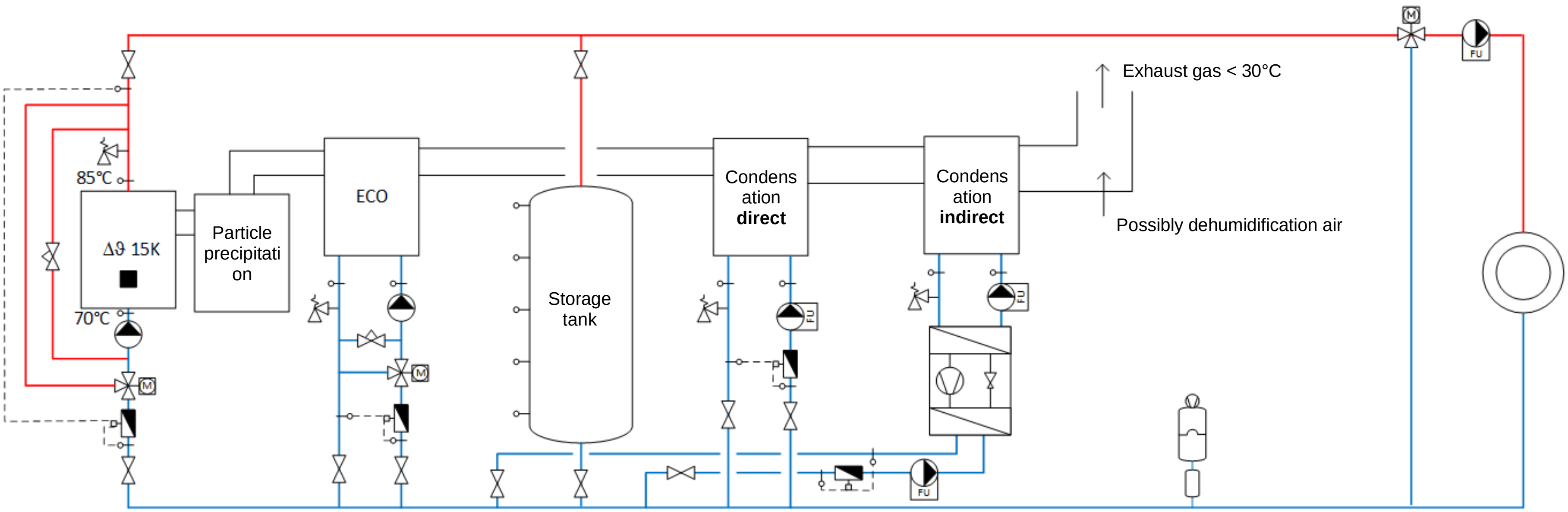


Figure 13.25 of the new QM Planning Handbook

COP OF HEAT PUMPS

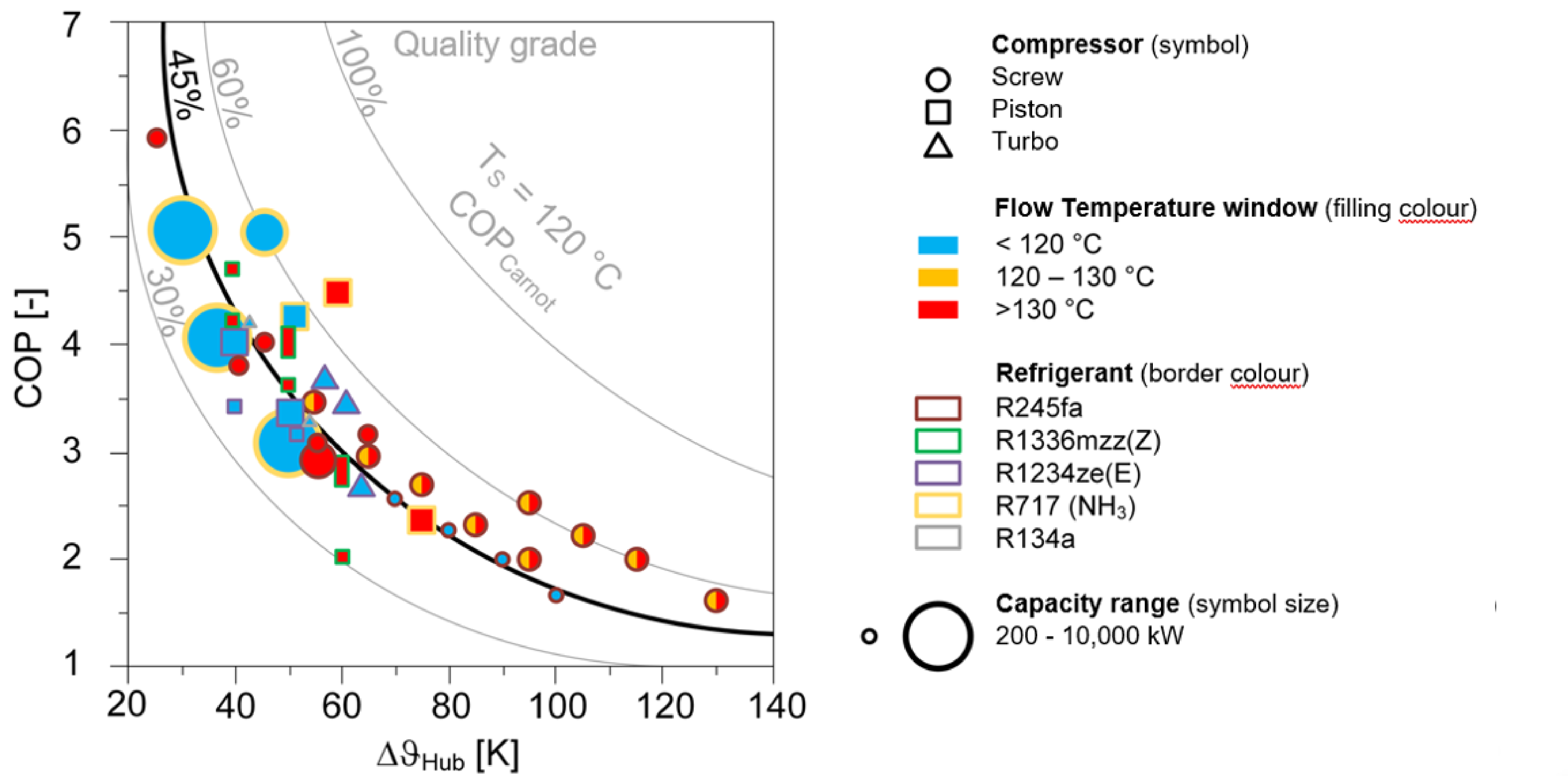
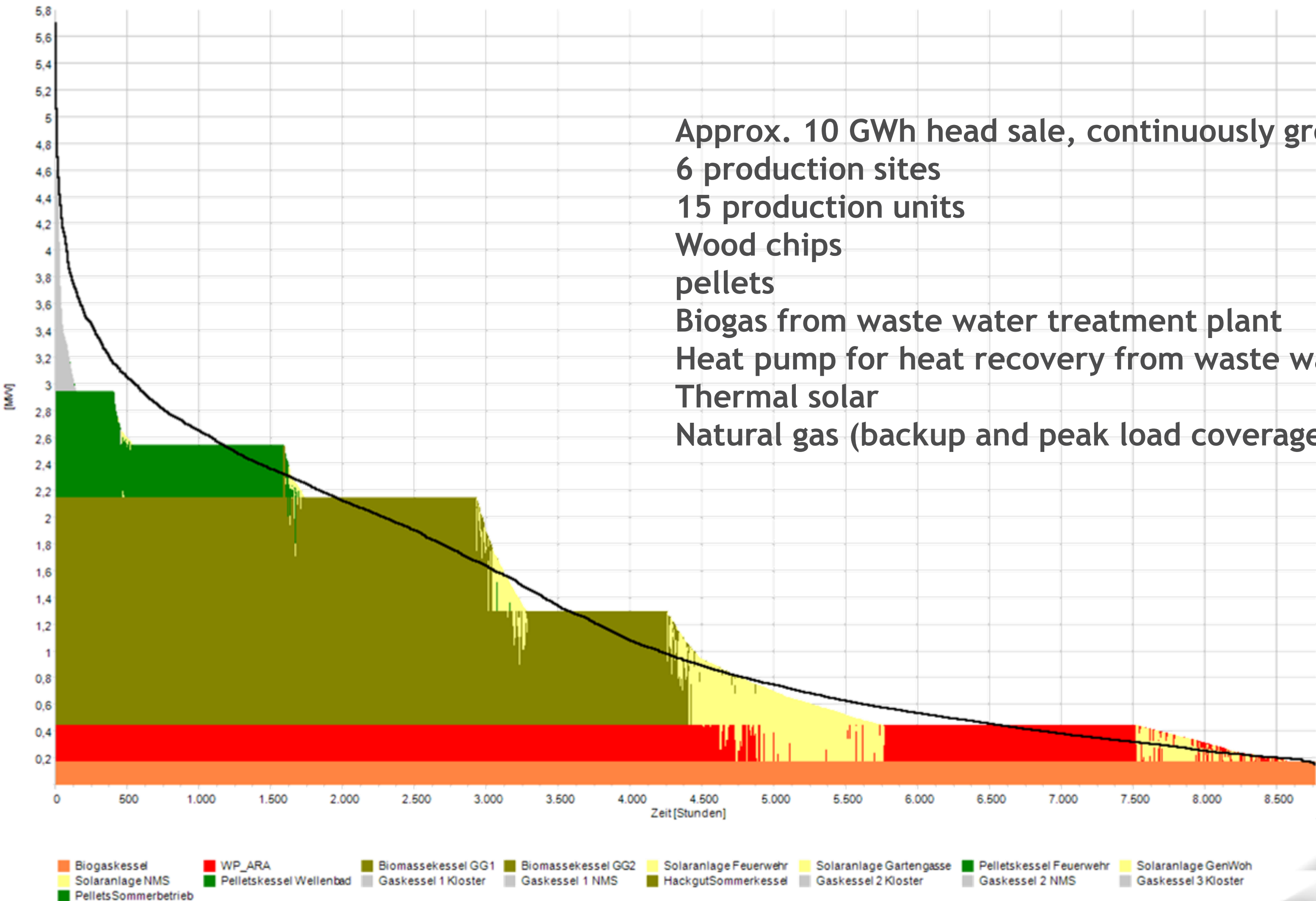


Figure 13.23 of the new QM Planning Handbook

QM AND OTHER HEAT SOURCES

- Each heat source has its own characteristics
  - To be known and considered!
- To be considered in system design and dimensioning
  - General operation strategy
  - Load management + prioritisation of heat sources during operation (merit order)
  - Min-load restrictions of biomass boilers
  - Start/stop restrictions of biomass boilers
  - Consider load change gradients of biomass boilers
- Currently no specific Q requirements for other heat sources
  - Standardisation is difficult due to complexity and diversity
  - General benchmarks for heat pumps (COP>4) and thermal solar are known!
- See ENTRAIN planning guideline annexes!

EXAMPLE OF A COMPLEX DH SYSTEM



Approx. 10 GWh head sale, continuously growing
6 production sites
15 production units
Wood chips
pellets
Biogas from waste water treatment plant
Heat pump for heat recovery from waste water
Thermal solar
Natural gas (backup and peak load coverage)

EXAMPLES FOR WASTE HEAT SOURCES AND INTEGRATION OPTIONS

Sector / industry	Waste heat source (process)	Implementation examples
Automotive industry	Various processes Waste heat from air compressors	
Food industry	Afterburning of exhaust gases from production processes Waste heat from cooling or drying processes	Installation of flue gas/water heat exchangers in the flue gas lines of the individual processes Utilisation of waste heat from refrigeration machines for DH with heat pumps
Detergent production	Waste heat from steam drying for powder production	Direct utilisation with heat exchanger (exhaust steam condensation)
Textile industry/laundries	Steam condensates from washing processes Residual heat in washing waste water	Waste water heat exchanger
Waste water treatment plants	Residual heat in waste water	Installation of special sewer/heat exchanger and heat pump
Steel production, metal processing industry, foundry	Waste heat from melting and process furnaces	Direct utilisation with exhaust gas heat exchanger
Paint shops	Thermal afterburning of solvent vapours from the paint shop or drying rooms	Direct utilisation with exhaust gas heat exchanger
Cement industry	Waste heat from the clinker cooling plant	
Packaging industry	Various (steam) processes	
Chemical industry	Waste heat from sulphuric acid plants	
Food supermarket	Waste heat from cooling systems	Utilisation of waste heat from refrigeration machines for DH with heat pumps

Source: M. Pehnt, J. Bödeker, M. Arens, E. Jochem and F. Idrissova, “Die Nutzung industrieller Abwärme - technisch-wirtschaftliche Potenziale und energiepolitische Umsetzung,” Heidelberg, Karlsruhe, 2010; translated and modified

CHARACTERISATION OF WASTE HEAT SOURCES (ANNEX WASTE HEAT AND HEAT PUMPS FOR DISTRICT HEATING) - I

- Type of waste heat source
- Location and availability
  - Is it a single or various sources and locations (e.g. within a company/industrial process)?
  - Location and distance in relation to the heating plant
- Temperature level and temperature behaviour
  - Constant temperature level (independent of season / production /...)
  - Fluctuating (seasonal/dependent on process parameters/...)
  - What temperature range and (annual) temperature profile has to be expected? (daily and seasonal fluctuations have to be especially considered for ambient heat sources); dependencies on the industrial process for waste heat sources in industry (especially for non-continuous processes).
  - For heat pumps, the minimum available temperature level during the intended period of use (during a year) of the heat source is relevant for the worst case.

CHARACTERISATION OF WASTE HEAT SOURCES (ANNEX WASTE HEAT AND HEAT PUMPS FOR DISTRICT HEATING) - II

- Load characteristic
  - Load profile - daily/weekly/yearly curve of the available heat capacity
  - Constant or (strongly) fluctuating?
    (base load, peak load, ratio of base load and peak load)
    As constant as possible is advantageous - especially for heat pumps.
  - Planned operation interruptions - e.g. holiday shutdowns, weekend brakes, (periodic) service and maintenance shutdowns
  - Rather uncritical for ambient heat sources (as "quasi-inexhaustible")
- Expected future development of the framework conditions
  - Production extension/reduction, possible uncertainties regarding operating site and future development of a company (see chapter 5.3)
- Heat transfer medium (water, air, flue gas, thermal oil, steam, …)
- Space demand and availability – is sufficient space for plant equipment available on site?

QM AND FLUE GAS CONDENSATION

- Flue gas condensation is proven and widely applied
  - No special quality criteria within QM
  - Apply QM "likewise":
    - high efficiency and low operating costs required
    - Requirements: low return temperature, low excess air content, high moisture content in fuel
    - Only economic, if significant contribution to overall energy production
- To be considered for plant dimensioning
  - System selection, boiler sizing, operation at low load
  - "Active" flue gas condensation using compression or absorption heat pumps
- Still treated as standard hydraulic scheme
  - but different implementation concepts possible

QM AND CHP

- Clear suggestion*:
  - only heat driven application without cooling
  - Dimensioning of CHP according to base load to ensure high number of operating hours
- To be considered as heat source for plant dimensioning
  - eventually with special characteristic (base load, high priority,...)
  - System selection, boiler sizing, operation at low load
  - Implementation with standard hydraulic scheme possible
- No specific quality criteria for the power production
  - e.g. ORC or steam turbine plants
- Q-requirements can be used likewise
- Increases complexity and required skills of operators!

* This is no official statement from QM Holzheizwerke, but from QM in AT

QM AND THERMAL SOLAR

- **Challenge:** solar plant must not force boiler being operated in start/stop or low load conditions
- **Suggestion**: Dimensioning to fully cover summer operation without needing a biomass boiler
  - eventually supported by oil/gas boiler or small biomass boiler with automatic ignition
- **In reality**: dimensioning according to available space (on roof)
- Take care:
  - Excellent load and storage management required!
  - Enlarged storage volume?
  - Hydraulic integration into system!
  - Low supply and return temperatures required!
  - Significantly different specific solar yields monitored!

SPECIAL PLANT CONFIGURATIONS

- Distributed heat sources
  - To be considered for system design and dimensioning
  - For the basic dimensioning it does not matter where the heat source is
  - Differences in DH network control strategy if operated at the same time!
- Different ownership of plant and network
  - Try to coordinate as good as possible
  - Cooperation should allow optimization!
- Large urban DH systems
  - Not primarily addressed by QM – they are experts and should know what they do!
  - However, they should have a closer look to some standards!!
  - Use it likewise for the biomass boiler plant

SPECIAL PLANT CONFIGURATIONS

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- Biomass boiler feeding into a large urban DH system
  - Depends on proportion of boiler compared to network capacity (e.g.Small additional heat source with5 MW for DH network of Graz)
  - Different objectives and operating strategies
  - Limited but likewise applicability of QM possible!
  - Apply basic idea of “Appropriate system design” for a biomass boiler
- Industrial or “non-space-heating” processes
  - Limited but likewise applicability of QM possible!
  - Apply basic idea of “Appropriate system design” for a biomass boiler

SUMMARY

- Standardisation of multi fuel/technology systems is limited
- Basic QM-process and planning procedure can always be applied
- Quality criteria are always applicable for DH network and biomass boilers
- QM is not always fully applicable - use QM "likewise"

THANK YOU!

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