QM

Biomass DH Plants

Q-Guidelines

Ruedi Bühler
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Andres Jenni

Based on the third, extended edition

Translated with support from
CE-INTERREG-Project ENTRAIN

Working group QM Biomass DH Plants

Switzerland: Holzenergie Schweiz

Austria: AEE - Institute for Sustainable Technologies

Baden-Württemberg: University of Applied Forest Sciences Rottenburg

Bayern: C.A.R.M.E.N. e.V.

Italy: APE FVG - Agenzia per l'Energia del Friuli Venezia Giulia

QM Holzheizwerke® (Quality Management (QM) for Biomass District Heating (DH) Plants) refers to the quality standards for biomass heating plants jointly developed by partners from Switzerland, Baden-Württemberg, Bavaria, Rhineland-Palatinate and Austria. The main aspects of the quality standards include professional design, planning and implementation of the heating plant and the heating grid. Important quality criteria encompass high operational reliability, precise control, low emissions and economical fuel logistics. The aim is to achieve an energy-efficient, environmentally friendly and economical operation of the entire plant.

QM for Biomass DH Plants is designed for hot water systems which are used to generate heat. Systems for generating electricity are not taken into account.

This Q-guidelines describe the process of the standard procedure of the **QMstandard** and defines the current quality requirements that must be met for the construction of a wood-fired district heating plant. These quality requirements are defined with a Q-plan at the beginning of the project (in the appendix of this Q-guide). The milestones given in the Q-plan are used to check any quality deviations. In case of deviations corrective measures are applied. Great emphasis is given to the accurate operational optimisation. After one year of plant operation, it has to be proven that the plant meets the quality requirements specified in the Q-plan.

In addition, QM for Biomass DH Plants has also defined the **QMmini** process for smaller monovalent systems in its own Q-guidelines (not the subject of this Q-guidelines).

The collected knowledge is published in **German as series of publications "QM-Holzheizwerke". English versions of selected volumes are available.**

Band 1: Q-Leitfaden (mit Q-Plan)
ISBN 978-3-937441-91-7

Band 2: Standard-Schaltungen – Teil I
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Band 3: Muster-Ausschreibung Holzkessel
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Band 4: Planungshandbuch
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Band 5: Standard-Schaltungen – Teil II
ISBN 978-3-937441-95-5

Band 6: Ratgeber zur Biomassekesselausschreibung
(Version Österreich)
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English versions:

Volume 1: Q-Guidelines

Volume 2 and Volume 5: Standard hydraulic schemes
(worksheet templates only)

Volume 4: Planning Guidelines

The publications of Quality Management for Biomass District Heating Plants can be downloaded or requested *www.qmholzheizwerke.ch*

QM
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Publication series QM for Biomass DH Plants
Volume 1

developed by the working group
Quality Management for Biomass District Heating Plants

Q-Guidelines

QMstandard

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Working group Quality Management for Biomass District Heating Plants in different countries

Switzerland:
Holzenergie Schweiz with the financial support of the Swiss Federal Office of Energy
www.qmholzheizwerke.ch
www.holzenergie.ch

Austria:
AEE - Institute for Sustainable Technologies
www.klimaaktiv.at/qmheizwerke

Germany:
Baden-Württemberg: University of Applied Forest Sciences Rottenburg
Bayern: C.A.R.M.E.N. e.V.
www.qmholzheizwerke.de

Italy:
APE FVG - Agenzia per l'Energia del Friuli Venezia Giulia
www.ape.fvg.it

These websites contain information and publications on the subject of biomass energy. From there you can also download further documents and software tools.

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Table of contents

Preface to the international version

The international version of the Q-guidelines is based on the documents of **QM Holzheizwerke® - Quality Management (QM) for Biomass District Heating (DH) Plants** published by the working group QM Holzheizwerke (Quality Management for Biomass District Heating Plants) consisting of experts from Switzerland, Germany and Austria. The Q-guidelines are the basis for the implementation of a quality management system for biomass district heating plants and networks. The document was translated and adapted within the CE INTERREG project ENTRAIN.

■ The terms used in these guidelines may vary from country to country. Important terms are explained in the **glossary**

■ As **regulations** and **standards** may differ from country to country, we advise to apply the corresponding regulations and standards used for the specific country.

■ Ensure that the individual requirements listed in the Q-plan comply with the corresponding national standards and regulations and the current state of the art.

■ The **classification of fuels**, see **Table 10,** is based on the international fuel standard ISO 17225 with slight deviations in order to meet the higher quality criteria of QM for Biomass DH Plants. The abbreviation used in the table are derived from the German expressions.

■ The QM procedure described in this Q-guidelines (including the simplified version) is called **QMstandard** in the following. In addition, QM for Biomass DH Plants has defined the new **QMmini** process for smaller monovalent systems in a separate Q-guidelines [7]

The ENTRAIN project aims at improving the capacities of public authorities to develop and implement local strategies and action plans for enhancing the use of endogenous renewable energy sources in small district heating grids, whether it is solar, biomass, waste heat, heat pumps or geothermal energy. Implementation of these action plans will lead to a CO2 emission reduction, to an improvement of local air quality and to socio-economic benefits for local communities through the growths of technical expertise, the start-up of investments and innovative financial tools. The project is funded by INTERREG CENTRAL EUROPE.

Brief introduction to Quality Management for Biomass District Heating Plants

Quality Management (QM) for Biomass District Heating (DH) Plants **(QM Holzheizwerke®)** is a project-related quality management system. It ensures that within a project with a time limit and involving several companies the required quality is defined and verified. QM for Biomass DH Plants must not be confused with company-related quality management (e.g. certification according to ISO 9000) and the testing of product samples (type testing). QM for Biomass DH Plants can, of course, be applied by companies involved in the project within their framework of company-related certified QM systems.

QM for Biomass DH Plants is the result of a cross-border cooperation. The team of developers of the QM for Biomass DH Plants (ARGE QM Holzheizwerke) consists of experts from Germany, Austria and Switzerland who are continuously involved in the improvement of the QM system. The broad experience of this team is bundled and flows into the realisation of new projects. The most important quality objectives of QM for Biomass DH Plants are

- reliable, low-maintenance operation
- high utilisation ratios and low distribution losses
- low emissions in all operating conditions
- precise and stable control systems
- ecological and economic sustainability

QM for Biomass DH Plants and networks pays off

Most wood-fired heating plants are barely economically viable due to high investments and long payback periods. The complexity of the investment entails numerous risks. QM for Biomass DH Plants helps the investor to reduce these risks.

Typical problems are oversized boilers and heating plants, or overestimated heat sales, i.e. the heat actually sold to the heat consumers is less than planned. Besides various technical problems, this leads to low utilisation of the plant and a slower return of investment. Design errors (e.g. oversized biomass boilers) often cannot be corrected afterwards. It could occur that the operator suffers the consequences of this error for 20 years or more. However, if shortcomings of the planning are detected and corrected early on, investors and operators save money and time.

The investment in QM is worthwhile. For 1 - 2 % of the investment costs, it is ensured that the required quality of a plant is unequivocally defined at the beginning and that plant owners actually receive the quality they ordered. The additional costs for QM are negligible compared to the potential savings in investments and operating costs - an important prerequisite for the economically successful operation of the plants in the long term.

Learning from the mistakes of others

The aim when planning a biomass district heating plant is to reach a technically and economically feasible and ecologically sensible heat supply. In recent years, a large number of successful biomass district heating projects have been implemented in Germany, Austria and Switzerland. In addition to a number of positive examples, however, there are always plants that have clear shortcomings such as oversized heating plants and / or district heating grids, excessively large and incorrectly designed wood fuel stores, faulty hydraulic and control solutions, imprecise and unstable control systems. Such and similar other planning errors can cause expensive adjustments and retrofits, increased maintenance costs and sometimes serious economic problems. Last but not least, they also have a negative impact on the public opinion of bioenergy.

The evaluation of various projects showed that most errors could have been avoided, if more care had been taken in planning and execution and the experiences gained in building similar installations had been used. Quality-oriented planning combined with the transfer of know-how and experience foster technically and economically optimized solutions leading to low emissions and an efficient utilisation of biomass fuels.

The quality managers (Q-manager)

In addition to the authorized representative of the plant owner and the main planner of the plant, QM for Biomass DH Plants introduces another project participant: The Q-manager. Q-managers are assigned by the plant owner and supervise the project from the very beginning. In coordination with the plant owner and the main planner, they define quality requirements in a Q-plan document. During the planning and realisation of the biomass district heating plant, they check whether these are fulfilled. If deviations are detected, the Q-manager recommends corrective measures and their implementation to the plant owner. Furthermore, as an expert with broad experience from many other projects, the Q-manager also provides neutral second opinions during the different project phases.

Q-managers are trained and approved by the QM for Biomass DH Plants and their national representatives and can be found on the corresponding websites (e.g. www.qmholzheizwerke.ch).

The milestones

Figure 1 gives a general overview of the quality management process. The plant owner appoints an authorized representative, the Q-manager, who is responsible for the implementation of QM, and the main planner, who is responsible for the overall planning of the plant. Together they keep record of the quality requirements in the Q-plan. Milestone 1 and thus the QM process will be established as early as possible so that Q-planning can be started before the design planning begins. Milestone 2, 3 and 4 are then used for Q-checks and Q-control during the course of the project. This ensures that quality deviations are detected and corrected in time. QM is completed after the evaluation and optimisation of the plant operation in Milestone 5.

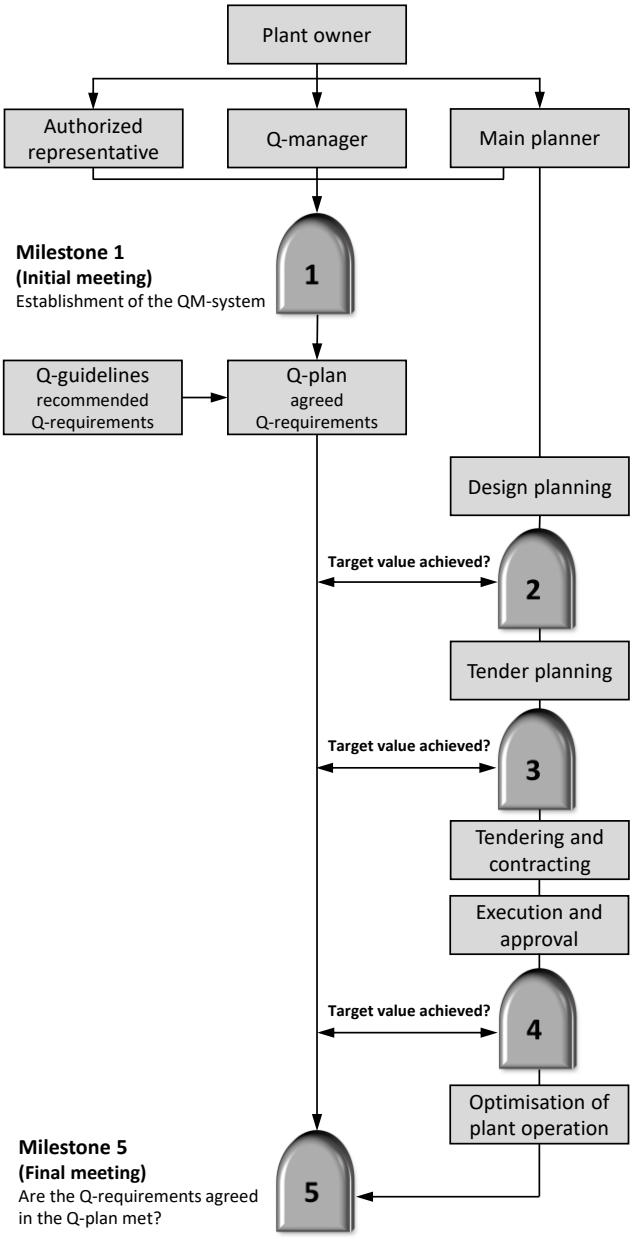


Figure 1

The Q-requirements

The Q-requirements are generally defined in the following Q-guidelines. They are then project-specifically defined at the beginning of the project in a kick-off meeting (Milestone 1) and documented in the Q-plan.

Important Q-requirements refer to heat demand inquiry and determination of basic design data, the therewith related plant configuration, hydraulic concept, control strategy and the heating grid. Furthermore, requirements regarding applicable fuels, documentation and optimisation are also defined. Thus, the quality requirements cover essential areas of the project - from the determination of basic design data to the commissioning of the plant and its optimisation which should occur no later than at the end of the second year of operation.

The optimisation of plant operation

After the commissioning of the plant it is absolutely necessary to perform a systematic optimisation of the technical operation. Therefore, the most important operating data must be continuously recorded and evaluated. The main planner has to evaluate and interpret the results during at least three different weeks of the year (winter, summer, spring/autumn).

The records within the scope of the operational optimisation provide useful information to evaluate and optimise the operation of the heating plant. Furthermore, the records provide the evidence that the plant is actually functioning according to the quality requirements agreed at the beginning. The aim of the evaluation is to prove that the plant follows the Q-requirements defined at the beginning of the project.

The Q-plan

QM should be managed with as little paper documentation as possible. Therefore, the central part is the Q-plan, consisting of two documents (to be found in the appendix):
– Q-plan main document, to be prepared during the establishment of the QM process in Milestone 1
– Q-plan add-ons, created in Milestone 2 to 5 of the QM process

The Q-guidelines is an integral part of the Q-plan. It describes the QM process and in detail the quality requirements that should be applied on the planning and construction of biomass district heating plants. The Q-guidelines have the same structure as the Q-plan, so that both documents can be used correspondingly:

A. Project participants
B. Establishment of QM process
C. Project schedule with corresponding milestones
D. Plant owner tasks and responsibilities
E. Main planner tasks, responsibilities and Q-requirements
F. Fuel definition

A Project participants

A.1 Project

The plant name and plant address as well as the owner address must be documented in the Q-plan.

A.2 Responsible persons for QM for Biomass DH Plants

The persons responsible for the establishment and correct execution of QM for Biomass DH Plants should be indicated:

■ The **plant owner's authorised representative** must have the necessary power of attorney to sign all QM-relevant documents.

■ The **Q-manager** ensures that the quality management system QM for Biomass DH Plants is defined, implemented and maintained. The Q-manager expressly bears no responsibility for planning.

A.3 Main planner

For project planning according to Quality Management for Biomass District Heating Plants, a main planner for the biomass heating plant must be assigned in the Q-plan. The main planner is responsible to the plant owner for the quality of the entire plant within the scope of the planning services specified in the engineering contract.

Companies other than the main planner, who are responsible for the planning and implementation of the plant, are not listed in the Q-plan. The plant owner is solely responsible for contractual agreements with these companies.

A.4 Funding authority

If public funding is requested, the funding authority must be specified.

B Establishment of QM for Biomass DH Plants

B.1 Tasks and duties of the Q-manager

B.1.1 The Q-manager ensures that the quality management system QM for Biomass DH Plants is defined, implemented and maintained. This includes the following activities:

- All administrative work related to Quality Management for Biomass District Heating Plants: establishment of the QM system in cooperation with the plant owner and main planner, organisation of the necessary meetings, preparation of the documents required by Quality Management for Biomass District Heating Plants
- Quality planning: Infallible definition of the quality requirements in the quality plan in cooperation with the plant owner and the main planner; guarantee that the quality requirements listed in the quality plan comply with recognised technical rules and that the quality standards required by funding authorities are met.
- Quality control: ensuring that quality deviations are detected and corrected in a timely manner; if quality deviations are detected, the Q-manager, together with the plant owner and the main planner, must look for solutions.
- Quality check: Check of each milestone whether all documents and data are available and whether the quality requirements agreed in the Q-plan are within the agreed tolerance.

B.1.2 The Q-manager expressly bears no responsibility for planning and is only responsible for QM for Biomass DH Plants according to B.1.1. The Q-manager can only determine whether Q-requirements do not correspond to the recognised technical rules, quality standards required by funding agencies are not met, or whether there are quality deviations and if so, he or she can make appropriate recommendations to the plant owner. Only the plant owner can then demand changes to the project, make claims for damages, etc.

B.1.3 The Q-manager may (in consultation with the main planner) recommend changes and modifications of the Q-plan to the plant owner. Approved changes and modifications must be recorded in the Q-plan annex for the respective milestone.

B.1.4 The Q-manager is entitled to use the title "Q-manager Quality Management for Biomass District Heating Plants" if listed in the register "Q-manager of the Working Group Quality Management for Biomass District Heating Plants", which is published on the internet (http://www.qmholzheizwerke.ch). In order to be included in the register, the Q-manager must meet the following minimum requirements:

- There is currently no longer any economic connection between the Q-manager and the planning or executing companies in the heating, ventilation and air conditioning sector
- Planning experience in the heating, ventilation and air-conditioning sector
- Experience with the realisation of biomass district heating plants

B.1.5 The Q-manager commits to strict confidentiality concerning all documents and knowledge of the plant and its condition. This does not include the forwarding of a copy of the Q-plan (main document and annex) to a documentation centre and / or a funding authority who are also obliged to treat the data confidentially.

B.1.6 The remuneration of the Q-manager is defined in Milestone 1 "Establishment of QM for Biomass DH Plants and Q-planning".

B.2 Tasks and duties of the main planner

B.2.1 The main planner is responsible for the quality of the biomass heating plant within the framework of the planning services specified in the engineering contract. The required quality is defined in the Q-plan (Chapter E "Q-requirements main planner").

B.2.2 The main planner undertakes to accept the Q-plan (main document and annex) as an addition to the engineering contract once it has been approved by the parties involved. In the event of contradictory parts of the contract, the Q-plan shall apply.

B.2.3 The main planner ensures (in cooperation with the plant owner) that sub-planners, executing companies and suppliers also comply with the quality requirements.
Examples:

- *Sub-planner: Capacity and heat demand of potential heat consumers*
- *Biomass boiler supplier: Minimum and nominal heat capacity of the biomass boiler with reference fuel*
- *Fuel supplier: Quality of the fuel assortment*

B.2.4 The main planner is responsible for drawing up and updating a schedule. Changes in the schedule must be immediately reported to the Q-manager.

B.2.5 Unless expressly agreed, a tolerance of 10% towards poor quality applies to quality deviations. In the case of weather-dependent variables, the values that have been corrected to an average year using the number of heating degree days are decisive in cases of doubt.

B.2.6 The main planner shall without restriction provide the Q-manager with the required plans, calculation documents, data sheets etc.

B.3 Tasks and duties of the plant owner

B.3.1 The plant owner shall appoint an authorised representative. The plant owner gives the authorised representative the necessary power of attorney to be able to sign all QM-relevant documents.

B.3.2 The services to be provided by the plant owner are defined in the quality plan (Chapter D "Services to be provided by the plant owner").

B.3.3 The plant owner shall appoint the Q-manager.

B.3.4 The plant owner designates a main planner who is responsible for the overall plant quality according to the framework of the services specified in the engineering contract.
Examples:

- *In the case of a contractual relationship with a planning team (individual contracts between the planners and the plant owner), the main planner is usually the HVAC planner for heat production plant.*
- *In the case of a contractual relationship with a planning consortium (a single engineering contract with the planning consortium), the main planner is the project manager of the planning consortium.*
- *In the case of a contractual relationship with a general planner, the main planner is the project manager of the general planner.*

B.3.5 The plant owner draws up the engineering contract with the main planner taking into account Quality Management for Biomass District Heating Plants.

B.3.6 Companies other than the main planner (sub-planner, executing companies or suppliers) responsible for the planning and implementation of the plant are not named in the Q-plan. The plant owner is solely responsible for contractual agreements with these companies.

B.3.7 Sanctions for non-compliance with the quality which go beyond the usual legal remedies (rectification, price reduction, conversion) (e.g. contractual penalty, bonus-malus agreement) are to be recorded in the corresponding contracts.

B.3.8 If changes and modifications to the Q-plan in the Q-plan annex for the respective milestone were approved, the plant owner is responsible for necessary adjustments to the engineering and work contracts.

B.4 Recommendations for funding agencies

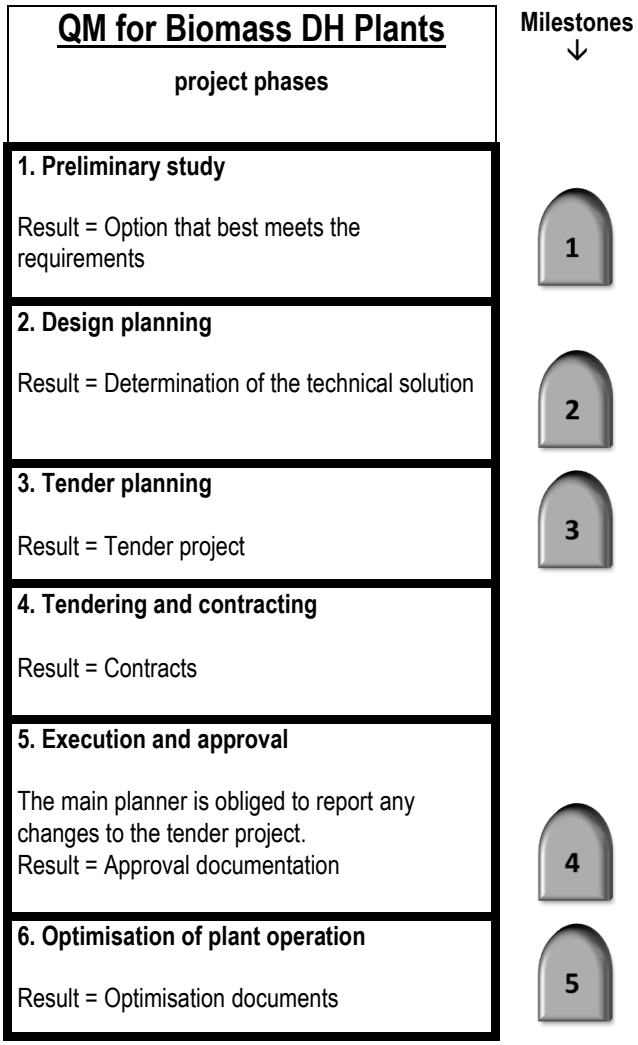
In principle, funding agencies are free to formulate technical specifications, conditions and procedures. Based on previous experience, however, the following recommendations should be observed for funding accompanied by **QMstandard** (see Chapter C):

B.4.1 In general the following should be demanded: the complete Q-plan, the main document for Milestone 1, the Q-plan annexes for Milestone 2 to 5. The construction of the plant should not begin before Milestone 3 (in the simplified version Milestone 2) was completed.

B.4.2 When disbursing the public funding, it should be noted that the main disbursement rate will only be paid if the Q-plan of Milestone 3 (in the simplified version Milestone 2) signed by the Q-manager has been submitted and the Q-manager has confirmed that the demand assessment and appropriate system selection correspond to the Q-requirements of QM for Biomass DH Plants. The final payment should not be made until Milestone 5 of the Q-plan has been submitted and the Q-manager confirms that an operational optimisation has been carried out.

C Project flow with milestones

The rules and regulations valid in different countries may use different terms and planning processes. An optimal project sequence is defined according to the milestones of the Quality Management for Biomass District Heating Plants. **Table 1** gives an overview of the QM for Biomass DH Plants project sequence in line with the milestones.



milestones at the end of each project phase

1 Establishment of QM for Biomass District Heating Plants and Q-planning

2 Q-checks and Q-control at design planning stage

3 Q-checks and Q-control at tender planning level*

4 Q-checks and Q-control at Contracting

5 Q- checks and conclusion of QM for Biomass DH Plants after one year of operation at the earliest

*Not applicable for the simplified version (see section C. 2)

Table 1

C.1 QMstandard

This QM system **QMstandard** used by default is described in the Q-guidelines. **Table 1** shows where the individual milestones in the project are completed. The checklists in the appendix describe in detail which documents for the individual milestones must be delivered by the main planner to the Q-manager. The main planner is responsible for obtaining the necessary documents from the plant owner.

The important thing is:

- A prerequisite for the guidance according to the QM for Biomass DH Plants is to conduct a kick-off meeting at Milestone 1 with all required participants (authorised representative of the plant owner, main planner and Q-manager); the final meeting at Milestone 5 is important and should only be dispensed in exceptional cases.
- A milestone can only be verified once all the necessary documents have been received.
- Milestones are completed when the Q-plan (the main document in Milestone 1 or the respective annex in Milestone 2 to 5) has been signed.
- In principle, it is assumed that the realised project corresponds to the planning during tendering. If this is not the case, the main planner is obliged to report changes immediately to the Q-manager. The latter then decides whether Milestone 3 must be repeated (additional remuneration).

C.2 Simplified version of QMstandard with only 3 milestones

Normally QM for Biomass DH Plants includes 5 milestones. In the simplified version, Milestone 3 and 4 can be omitted. This is possible only under the following conditions:

- A standard hydraulic scheme is selected for Milestone 2 (this condition can only be omitted if the hydraulic and control solution selected by the planner is described in the same level of detail as the standard control and this solution is complete for Milestone 2),
- Performance, flow rates and temperatures are already defined in Milestone 2,
- The demand assessment and appropriate system selection in Milestone 2 already fulfils all Q-requirements of Milestone 3 (to be ensured by the main planner).

Although Milestone 3 and 4 are not verified by the Q-manager, they must still be fulfilled by the main planner. Missing documents must be submitted to the Q-manager in Milestone 5.

The simplified procedure is used for monovalent or bivalent, single boiler or multi-boiler systems

- without district heating grid up to a maximum of 500 kW, or
- with heating grids and connected capacity up to a maximum of 200 kW.

C.3 QMmini

In addition to **QMstandard,** which is described in the Q-guidelines, QM for Biomass DH Plants has defined the **QMmini** process for smaller monovalent systems in its own Q-guidelines [7] available in German. **QMmini** is not further discussed in the Q-guidelines presented here.

D Services plant owner

The plant owner shall appoint an authorised representative. The plant owner gives the authorised representative the necessary powers of attorney to be able to sign all QM-relevant documents. The services to be provided by the plant owner or the authorised representative for each milestone are listed in **Table 2**.

No.	Designation	Services to be provided by the plant owner
D.1	Services to be performed in Milestone 1	■ Assignment of the main planner. ■ The following questions should be clarified internally: - Who should be the owner? - What should be the legal form of the responsible body - How should the ownership be founded? - Who is responsible for the finances? - Who will later be responsible for the operation? - How are the responsible people involved in the planning process? - Has the competitive situation in the heating market of the supply area been clarified? - Who is responsible for competent market development and subsequent customer care? - Where should the heating plant be located (including legal security)? - What are the framework conditions for the subsequent building permit? - What is the procedure regarding building permits and easements for pipes? - What are the terms and conditions for tendering (procurement)? - How should the heat supply contracts be designed? - How is the financing of the further project phases secured? ■ Decision that it makes sense to carry out a design planning for a biomass heating plant.
D.2	Services to be performed in Milestone 2	■ Evaluation of the organisation and legal form of the responsible body ■ Evaluation whether and under which conditions the planned biomass heating plant will receive a building permit. ■ Evaluation whether and under which conditions land owners are willing to grant easements / transit rights for the heating grid. ■ Evaluation of possible heat consumers, accepting the commercial connection conditions (e.g. heat prices) resulting from the preliminary study: - Who has made a reliable declaration of intent and is ready to start contract negotiations? - Who is interested in connecting under certain conditions, what are the conditions (time, economic viability, etc.)? - What are the future intentions concerning further interesting properties located in the area to be assessed? ■ List of heat consumers with indication of connection time and status ("contract signed", "open", etc.). **At least 70% of the annual heat requirement must be secured by written documents** (contract or letter of intent). ■ Evaluation regarding fuel: - Which fuel types are an option? - How is the fuel procurement organised? - Which fuel price should be used in the profitability calculation? ■ Obtaining an indicative offer for fuel delivery. ■ Evaluation regarding financing: - What subsidies can be expected? - How and under what conditions can further financing take place? ■ Proof of profitability according to the annuity method; a business plan is already recommended for systems with a heating grid. ■ Decision for the implementation planning.

Table 2

No.	Designation	Services to be provided by the plant owner
D.3	Services to be performed in Milestone 3	■ Final regulation of the organisation and legal form of the responsible body. ■ Obtaining the building permit. ■ Securing easements/rights of transit. ■ Clarification of insurance issues for construction and operation. ■ Ensuring that there is an offer for the fuel delivery that is adapted to the planned plant (size of the fuel store, delivery interval, access, etc.). ■ Evaluation of possible heat consumers as planning basis (continuation of Milestone 2); especially concerning the following questions: - Which heat consumers have signed a heat supply contract in the meantime? - Which heat consumers can be expected to sign a contract before commissioning? - Which areas can be connected in which time? - For which heat consumers is the plant owner willing to bear the risk that they might not connect after all? ■ List of heat consumers with indication of connection time and status ("contract signed", "open", etc.). At the start of construction, at least 60% of the annual heat demand must be secured by signed heat supply contracts. ■ Preparation of the heat supply contract with technical and general terms and conditions. ■ Revised proof of profitability according to the annuity method; for systems with a heating grid, a business plan with budgeted balance sheet and budgeted income statement for 20 years is mandatory. ■ Proof that the financing is secured. ■ Coordination of the tender planning with involved and affected parties. ■ Decision for execution.
D.4	Services to be performed in Milestone 4	■ Approval of the business optimisation concept (incl. contract for implementation). ■ List of persons responsible for the operation. ■ Takeover and acceptance of the plant and implementation of the operational organisation.
D.5	Services to be performed in Milestone 5	■ Preparation of a cost summary and comparison with the planned figures. ■ Preparation of an annual balance sheet and income statement for the first year of operation and comparison with the target figures.

Table 2 (continued)

E Services and Q-requirements main planner

E.1 Achievements in the individual milestones

For the individual milestones, the main planner must perform the services according to the **Table 3** and meet the associated Q-requirements. The description refers to the following sections E.2 to E.7. The degree of accuracy and detail in the individual project phases - in particular for the areas "demand assessment and appropriate system selection", "heating grid" and "heat production" - are subject to the remuneration agreement of the country concerned (e.g. [30], [32], [33]).

No.	Designation	Services and associated quality requirements that the main planner must provide in the individual milestones
E.1.1	Services to be performed in Milestone 1	■ Answer to the question: Are the contractual prerequisites fulfilled so that the main planner, as contractor of the plant owner, can sign the agreements on QM for Biomass DH Plants in the Q-plan? ■ Determine target values together with the plant owner and the Q-manager: - Heat loss of district heating grid → **Figure 2** - Minimum linear heat density • Full-year operation 2.0 MWh/(a.Trm) • Heating period without domestic hot water production 1.0 MWh/(a.Trm) - Specific investment costs of district heating grid → **Figure 3** - Specific investment costs of heat production → **Figure 4**
E.1.2	Services to be performed in Milestone 2	**E.2 Demand assessment and appropriate system selection** ■ The situation was documented in accordance with E.2.1 - E.2.6. **E.3 Heating grid** ■ The quality requirements E.3.1 - E.3.6 are to be fulfilled. **E.4 Heat production** ■ The quality requirements E.4.1 - E.4.8 and E.4.11 are to be fulfilled. **F. Fuel types** ■ The type of fuel was defined in Milestone 1 during the establishment of Quality Management for Biomass District Heating Plants. As part of the design planning, it was checked together with the plant owner, - whether the intended range of fuels in the region can be obtained in sufficient quantity at the price provided in the economic profitability calculation, - whether sufficient security of supply can be assumed to dimension the fuel storage in accordance with the requirements of E.4.5. ■ The fuel type may have to be adjusted. **Profitability calculation** ■ The main planner shall provide the plant owner with the necessary planning data for the preparation of the economic profitability calculation and shall participate in the cost calculation and cost estimation in accordance with the specifications in the remuneration agreement of the country concerned. If the main planner should provide a detailed proof of cost-effectiveness, this must be agreed in the engineering contract. ***Simplified version of QMstandard with only 3 milestones*** ■ To be able to skip Milestone 3 and 4, the following prerequisites must be fulfilled: - A standard circuit was selected or the selected circuit was documented in the same level of detail as a standard circuit and suitably declared by the Q-manager. - Capacities, flow rates and temperatures are already specified - The demand assessment and appropriate system selection already meets all Q-requirements of Milestone 3 - Milestone 3 and 4 are not verified by the Q-manager, but they still must be fulfilled by the main planner
E.1.3	Services that have to be performed in Milestone 3 (continued)	**Profitability calculation** ■ The main planner shall provide the plant owner with the necessary planning data for the preparation of the economic profitability calculation and shall participate in the cost calculation and cost estimation in accordance with the specifications in the remuneration agreement of the country concerned. If the main planner is to provide a detailed proof of economic efficiency, this must be agreed in the engineering contract. **Note:** It is also recommended to carry out a calculation of costs and economic efficiency in the case of self-supply. **Subsequent delivery of tender for heat production plant** ■ The tender for the heat production plant usually is not yet available for Milestone 3, but it is possible to agree on its subsequent delivery to the Q-manager. A content check by the Q-manager is additionally to be remunerated on a time and material basis.

Table 3

No.	Designation	Services and associated quality requirements that the main planner must provide in the individual milestones
E.1.3	Services that have to be performed in Milestone 3	**E.2 Demand assessment and appropriate system selection** ■ The situation was documented in accordance with E.2.1 - E.2.6. **E.3 District heating grid** ■ The quality requirements E.3.1 - E.3.6 are to be fulfilled. **E.4 Heat production** ■ The quality requirements E.4.1 - E.4.11 are to be fulfilled. **F. Fuel types** ■ The types of fuel must be verified together with the plant owner. As a result of this verification, an offer is available for the range of fuels envisaged in the tender project. With this offer it is possible to meet the conditions regarding the delivery rhythm (determining size for silo dimensioning). The fuel price assumed in the profitability calculation is based on the offer.
E.1.4	Services to be performed in Milestone 4	**E.2 Demand assessment and appropriate system selection** ■ The demand assessment and appropriate system selection was carried out. **E.6 Approval and concept for operational optimisation** ■ The approval was carried out in accordance with E.6.1 and E.6.2. ■ The optimisation of operations was agreed in the engineering contract. ■ Operational optimisation must be designed in accordance with E.6.3. **F. Fuel types** ■ The fuel supply contract has been signed. With this contract, the conditions regarding the delivery intervals (determining size for storage dimensioning) can be fulfilled. The fuel price of the economic profitability calculation corresponds to the specifications in the supply contract.
E.1.5	Services to be performed in Milestone 5	**E.2 Demand assessment and appropriate system selection** ■ Current situation of the heat consumers was verified according to E.2.1 - E.2.6. **E.5 System documentation** ■ The plant documentation was prepared in accordance with E.5.1 - E.5.3. The Q-manager must be provided with the table of contents of the system documentation, with a signature to confirm it is complete and has been updated. If a final meeting is held, the complete investment documentation must be provided for this meeting. **E.7 Implementation of operational optimisation** ■ Operation optimisation was carried out in accordance with E.7.1 - E.7.3. ***Simplified version of QMstandard with only 3 milestones*** ■ *The missing documents of the omitted milestones are to be submitted to the Q-manager, especially those from Milestone 4:* *- Fuel supply contract (in case of external fuel supplier)* *- Heat supply contract (in case of heat sale)* *- Contract biomass boiler* *- Approval report* *- Concept for optimizing operations*

Table 3 (continued)

E.2 Q-requirements demand assessment and appropriate system selection

The main planner must submit a situation report that meets the Q-requirements in **Table 4**. For E.2.1 to E.2.6, an EXCEL table "demand assessment and appropriate system selection" is available for entering the required information and for plausibility checks. The EXCEL table "demand assessment and appropriate system selection" and the corresponding manual [8] are available for free download (www.qmholzheizwerke.ch).

Important note: Although the table is not a planning instrument for determining the heat capacity and the heat demand of the individual heat consumer, the EXCEL table can be used as a planning instrument for determining the heat capacity of the overall system (load characteristic) and the design of the biomass boiler in a bivalent system. The calculation of the main planner is always decisive.

No.	Designation	Q-requirements
E.2.1	Annual heat requirement for each heat consumer	**New buildings** Calculation of the annual heating demand according to valid national regulations (e.g. corresponding to ISO 52016-1 [26]). Deviations from the standard use are possible in consultation with the plant owner. **Existing buildings** On-site surveys are used to determine the current final energy consumption over several years and to estimate the degree of utilisation of previous heat production. From this, the future heat demand is determined, taking into account future renovations, extensions and changes in use. The determination should be comprehensible and plausible. If there is no reliable data available on previous consumption or if a reliable distribution of heating demand, heat demand for domestic hot water production and process heat is not possible, detailed measurements over a sufficiently long period of time are required (in particular large consumers and process heat). **New housing development areas** Calculation from the estimated energy reference area and specific heat requirements of the locally applicable regulations (e.g. [27], [28], [29]). Include specific heating requirements 10- 20% below the prescribed value in the calculation, specific heating requirements for domestic hot water according to standard usage. **Required data** ■ Heat demand [kWh/a] ■ Annual heat demand for domestic hot water production [kWh/a] ■ Annual heat demand for process heat [kWh/a] ■ Energy reference area [m²] (see glossary)
E.2.2	Heat capacity for each heat consumer	**New buildings** Calculation of the heat capacity according to valid national regulations (e.g. corresponding to EN 12831-1 [25]) **Existing buildings** The most accurate method is to determine the load characteristics using measurements (particularly recommended for large consumers and process heat). Approximation method by estimation from E.2.1: - Maximum heat capacity for space heating: Division of the heat demand by a suitable number of full load operating hours (depending on the annual load duration curve at the location, the heating limit and the size of the non-weather-dependent component). - Average heat capacity for domestic hot water: Division of heating demand by the number of heating hours (seasonal operation) or 8760 hours (year-round operation). - Average heat capacity for process heat: Division of heat demand by the number of operating hours per year (estimated or according to measured operating hours). **New housing development areas** Estimate from E.2.1 analogous to the procedure for existing buildings. **Required data** ■ Max. heat capacity for space heating [kW] ■ Max. heat capacity for domestic hot water [kW] ■ Max. heat capacity for process heat [kW]
E.2.4	Plausibility check for each heat consumer (the EXCEL table "Status-quo analysis" is available as a help)	**Required key figures** The main planner calculates the following key figures from E.2.1 and E.2.2 for each heat consumer (automatically with EXCEL table "Status quo analysis"): ■ Number of full load operating hours for space heating [h/a] ■ Number of full load operating hours for domestic hot water [h/a] ■ Number of full load operating hours for process heat [h/a] ■ Specific heat demand [kWh/(m²a)] ■ Specific heat capacity for space heating [W/m²] ■ Specific energy demand for domestic hot water production [kWh/(m²a)] The key figures are compared by the Q-manager with information from literature (e.g. from the planning handbook [4]) and own empirical values.

Table 4

No.	Designation	Q-requirements
E.2.3	Temperature requirement for each heat consumer	**New buildings** According to design of heat output, domestic hot water production, etc. **Existing buildings** Estimation based on existing heat output, water heating, etc. Unclear cases: Measurement over a sufficiently long period of time. **Construction area** Estimation based on the expected heat consumers. **Required data** ■ Max. supply temperature [°C] (with heat exchanger: primary and secondary temperatures) ■ Max. return temperature [°C] (with heat exchanger: primary and secondary temperatures) With heat exchanger: in the EXCEL table "Situation detection" the primary temperatures should be used (decisive for supply flow and return flow temperature).
E.2.5	Overall system	**Required data** ■ Climate station ■ Room temperature [°C] ■ Heating limit [°C] ■ Standard outside temperature [°C] ■ Non-weather-dependent part of heat capacity for space heating [%] ■ Power loss of the district heating grid [kW] (power loss through transmission) ■ Annual heat loss of the district heating grid [kWh/a] (annual heat loss through transmission) ■ Max. supply temperature [°C]
E.2.6	Plausibility check of the overall system (the EXCEL table "Demand assessment and appropriate system selection" is available as a help)	**Required key figures and characteristic curves** The main planner calculates the following key figures and characteristic curves for the entire system from E.2.1 to E.2.3 and E.2.5 (automatically with EXCEL table "Demand assessment and appropriate system selection"): ■ Max. supply flow temperature for the heat consumer [°C] (highest value occurring) ■ Max. return flow temperature [°C] (highest average value of return flow) ■ Number of full load operating hours of space heating for the entire system [h/a] ■ Number of full load operating hours of domestic hot water for the entire system [h/a] ■ Number of full load operating hours of process heat for the entire system [h/a] ■ Specific heating demand for the entire system [kWh/(m²a)] ■ Specific heat capacity of the space heating for the entire system [W/m²] ■ Specific heat demand of domestic hot water for the entire system [kWh/(m².a) ■ **Load characteristics** as a function of the outside temperature are shown as a sum of: - Heat capacity requirement for space heating depending on weather conditions [kW] - Heat capacity requirement for space heating not depending on the weather conditions [kW] - Heat capacity requirement for domestic hot water [kW] - Heat capacity for process heat [kW] - Power loss through transmission in the grid [kW] ■ **Annual duration curve of the heat capacity requirement** calculated from the load characteristic curves ■ **Independent calculation of the total heat demand** using the annual duration curve of the heat capacity for comparison with the sum of the heat demand indicated by the main planner. The key figures and characteristic curves are compared by the Q-manager with information from literature (e.g. from the planning handbook [4]) and own empirical values.

Table 4 (continued)

E.3 Q-requirements of district heating grid

The Q-requirements of E.3 only apply to projects with a district heating grid.

This means that at least one heat consumer is supplied with district heating grid (and corresponding district heating grid pump). (A system without a district heating grid is characterized by the fact that all heat consumers are connected directly to the main manifold of the heating plant.)

The following requirements are met:

- The demand assessment and appropriate system selection was made in accordance with E.2 and the plant owner has determined which heat consumers are to be taken into account in the planning and where the heating plant is located.

- The location of the heating plant and the pipe routing was chosen (iterative process) so that the Q-requirements can be met best possible.

When designing the heating grid, the quality criteria listed in **Table 5** must be met.

No.	Designation	Q-requirements
E.3.1	State of the art technology	■ The district heating grid must be planned and constructed in accordance with state of the art technology. Particular attention must be paid to: - QM Planning Handbook
E.3.2	Design of the heating grid	■ The following design principles expressly assume that the annual heat requirement and heat capacity have been calculated in accordance with the Q-requirements in Chapter E.2 "demand assessment and appropriate system selection" and that the calculated key figures are plausible. ■ The maximum return flow temperature should be as low as possible (see E.3.6). ■ The temperature difference between supply and return should be as large as technically feasible and should be at least 30 K in the final configuration. ■ A reliable pressure loss calculation must be prepared. Recommendations: - Flow calculation based on heat capacity without safety surcharges - Hydraulic pipe roughness according to [22] max. 0.01 mm - Average pressure drop in the relevant pipe (see glossary "District heating grid") 150...200 Pa/m - The resulting flow velocities should be within the range of the values given in **Table 13** and **Table 14 (**see annex). ■ For each individual heat consumer, the maximum heat capacity and the maximum permissible return flow temperature shall be contractually specified.
E.3.3	Determination of key figures for the heating grid	■ Losses of the heating grid: - Target value 10% (related to the heat supplied to the heating grid) - Limit value according to agreement Under certain circumstances, a higher limit value than the target value may be useful. The limit value applicable to the project must be recorded in Milestone 1 of the Q-plan. If this is above the target value, this must be justified in the Q-plan. ■ Linear heat density and specific investment costs of heating grid: - Based on the agreed limit value for the district heating grid losses, the corresponding value for the minimum linear heat density can be determined from **Figure 2** in the Annex (depending on the mode of operation of the network). - **Figure 3** in the Annex shows the target values of the specific investment costs of the district heating grid; they should not be exceeded by more than 25%. The values of the specific investment costs, heat losses and linear heat density applicable to the project are to be recorded in Milestone 1 of the Q-plan. If a value is agreed for the specific investment costs that is more than 25% above the target value, this must be justified in the Q-plan.
E.3.4	Hydraulic design and measurement, control and regulation (MCR) solution for heating grid	■ The hydraulic design and MCR solution must comply with the specifications of the standard hydraulic schemes [2][5].
E.3.5	Interface heat supplier - heat consumer	■ The heat supplier - heat consumer interface must be defined in the heat supply contract or in the associated General Terms and Conditions and Technical Connection Regulations. Check for templates of heat supply contracts in your country.
E.3.6	Hydraulic design and MCR solution for heat consumers	■ The hydraulic circuits of the heat consumers shall be designed in accordance with the standard hydraulic schemes [2][5]. ■ The heat consumers must not have any equipment that heats the return flow with hot supply water. The following facilities are to be avoided: - Injection and deflection circuits with three-way valves - Four-way mixing valve - Hydraulic switches - By-passes of all kinds - Excess flow valves - Manifold with large heat-transferring connecting surface (pipe in pipe, square)

Table 5

E.4 Q-requirements for heat production

The following **prerequisites** are fulfilled:

- The demand assessment and appropriate system selection is in accordance with E.2 and the district heating grid (if available) is designed in accordance with E.3.
- The energy demand and heat capacity for the time of commissioning and for the final expansion are known.
- The supply and return flow temperatures of the district heating grid as a function of the outside temperature are known, the maximum permissible return flow temperature is specified.
- The fuels or fuel types to be considered in the design are defined.

For the project planning and the construction of the heat production the quality criteria according to **Table 6** must be fulfilled.

No.	Designation	Q-requirements
E.4.1	State of the art technology	■ Heat production must be planned and carried out in accordance with state of the art technology. In particular, the information in the Planning Handbook [4] must be observed. ■ The installation plan (boiler house, fuel storage) must be discussed with possible fuel and boiler suppliers.
E.4.2	Expansion options for heat production	■ It must be shown to the plant owner how the consideration of the various expansion stages of the district heating grid affects the design of the heat production. ■ Together with the plant owner, it must be determined which heat consumers are to be taken into account for the dimensioning of the heat production: - Heat consumers connected during commissioning - Heat consumers connected in the final stage The requirements of possible funding programmes must be taken into account.
E.4.3	Heat capacity and temperature requirements relevant for project planning	■ Based on the results of the status-quo analysis, it must be determined which thermal power, heat and temperature demands are decisive for the planning of the heat production: - At the time of commissioning - In the final stage These basic data for dimensioning and design shall be submitted to the plant owner for approval.
E.4.4	System selection for heat production	■ The thermal power demand of the heat production is decisive for the system selection. One of the systems listed in the Annex shall be selected in accordance with **Table 15**. The specified conditions must be fulfilled. In the case of bivalent systems, the distribution of heat production between biomass boilers and fossil heat production shall be shown by means of the annual duration curve. ■ If a system other than those in the tables is selected, the reasons for this must be given. This must be discussed and approved by the plant owner. ■ Minimum average daily heating load for low load operation is defined according to **Table 16.** ■ Choice of furnace system. The decisive criteria are: Fuel type, boiler output, mode of operation (base load, frequent low load operation, etc.). ■ If particle filters are used, they must be selected and designed according to the state of the art technology (number, design, mode of operation, functional description with measurement and control concept).
E.4.5	Dimensioning of the fuel storage system	**Wood chip storage** ■ Dimensioning: - Net volume for demand of 5 to 7 days at nominal heat output + 1 container filling (depending on number of full load operating hours and output of the biomass boiler, this corresponds to approx. 5...10% of the annual heat demand) - Net filling degree > 70 % - Underground silos: ratio of height to width between 1 and 1.5 This dimensioning requires a contract guaranteeing a fuel supply in the long term. In exceptional cases (delivery bottlenecks due to shortage of wood, snowy region, no delivery over Christmas / New Year etc.) larger storage capacities may be necessary.

Table 6

No.	Designation	Q-requirements
E.4.5	Dimensioning of the fuel storage system (continued)	■ Design and dimensioning of the fuel storage with potential wood fuel suppliers (size of delivery container, tipping height of delivery vehicle, etc.). ■ Attention to the maximum dumping height in order to reliably prevent spontaneous ignition. ■ Ventilation of the fuel storage and therewith related rooms: Avoid accumulation of fermentation gases; ensure removal of moisture. **Pellet storage** ■ Dimensioning: The storage volume should not fall below the transport volume of the silo truck and the maximum consumption volume between pellet order and delivery. ■ Observe the latest regulations and recommendations regarding the prevention of injury to persons through carbon monoxide (CO).
E.4.6	Hydraulic design and MCR solution for heat production	■ The standard hydraulic schemes [2][5] corresponding to the system selection must be used. ■ If no standard solution is available for the selected system of heat production, the following documents shall be provided: - Hydraulic scheme of heat production - Control scheme of heat production - Functional description - Interpretation - Additions to the approval report These documents must be formatted in accordance with standard hydraulic schemes [2][5]
E.4.7	Logistics of ash disposal	■ Selection of the suitable transport and container system. Criteria to be applied: Spatial situation, ash quality, quantity, disposal option. ■ The recovery and disposal of wood ash must comply with the legal framework
E.4.8	Ensuring heat supply for monovalent systems	■ The maximum permissible downtime must be determined by the plant owner and recorded in the operator's concept. ■ Connection pipes (flange) for emergency heating must be provided.
E.4.9	Tender wood boiler	■ The tendering guidelines for biomass boilers [3] can be used. ■ The requirements for the measurement equipment including the data export interface shall be specified in the invitation to tender.
E. 4.10	Choice of boiler supplier	■ A systematic, neutral comparison of the services offered and the references obtained must be made. ■ Before placing the order with the boiler supplier, it must be ensured that they accept the built-in heat meter (part of the standard hydraulic scheme) for checking the boiler performance.
E.4.11	Specific investment costs	■ **Figure 4** in the Annex shows the specific investment costs of heat production as a function of output. The target values specified there should not be exceeded by more than 25%. ■ The value applicable to the project for the specific investment costs of heat production must be recorded in the Q-plan when establishing Quality Management for Biomass District Heating Plants.
E.4.12	Supervision of execution	■ The main planner has to ensure that the contractors carry out the work according to recognised technical rules, especially points not described in detail in the planning documents: - Complete thermal insulation - Sound insulation: The system must be designed in such a way that its operation does not cause considerable inconvenience to other people; the applicable noise emission regulations must be observed. - De-aeration, drain - Identification labels - Accessibility for revision - Accident prevention

Table 6 (continued)

E.5 Q-requirements investment documentation

The following **prerequisites** are fulfilled:
- District Heating grid and heat production meet the Q-requirements of chapters E.3 and E.4.
- The approval meets the Q-requirements of E.6

The system documentation must meet the quality criteria listed in **Table 7**.

No.	Designation	Q-requirements
E.5.1	Plant documentation for heat production	■ The plant documentation for heat production must contain the following documents with the corresponding chapters: **1. Operator documentation** - List of addresses, telephone, e-mail addresses of planners, contractors and suppliers - General investment description - Operating instructions and maintenance concept with general operating instructions - Procedure for troubleshooting - Organisation remote alarm system - Locking system (assigns keys to locking cylinders, including electronic systems) **2. Technical documentation** - Hydraulic scheme of heat production with capacities, temperatures, flow rates according to standard hydraulic scheme [2][5] - Control scheme for heat production - Functional description of the hydraulic and control solution according to standard hydraulic scheme [2][5] - Addition to the approval report according to standard hydraulic scheme [2][5] - Recordings of operational optimisation according to the standard hydraulic scheme [2][5] - Documentation for biomass heating system with fuel transport system according to tendering guidelines for biomass boilers [3] - Software documentation with instruction list, data point list, t remote alarm system, etc. - Electrical diagrams - Data sheets of all important system components - Commissioning protocols - Approval reports - Other test reports (emission measurement reports, etc.) - Installation plans ■ All documents must be updated to the current status.
E.5.2	Investment documentation for heating grid (Only for systems with heating grid)	■ The system documentation for the district heating grid must contain the following documents: - Documentation of the district heating pump and pressure difference control according to standard hydraulic scheme [2][5] - Documentation of the district heating pipes used - Documentation of the leak monitoring system - Electrical diagrams - Approval reports - Plans - Piping plan with fittings (shut-off valves, de-aeration, drains) - Longitudinal profile - Detailed plans (shafts, fixed points, weld seam plans, isometrics of the house connections) - Grid monitoring plan - Data sheets of all important system components ■ All documents must be updated to the current status.
E.5.3	System documentation for heat consumers	■ The system documentation for heat consumers shall contain the following documents: - List of heat consumers with address and technical connection data - Overview plan with heating plant, pipeline and heat consumers - Standard schematics of all transfer stations used - Approval report - Data sheets of all important system components (especially pumps, heat meters, differential pressure controllers and control valves) ■ All documents must be kept up to date.

Table 7

E.6 Q-requirements approval and concept for operational optimisation

The **prerequisite** is that the system components have been commissioned in accordance with the contract.

The approval shall meet the quality criteria set out in the **Table 8**.

No.	Designation	Q-requirements
E.6.1	Approval of heat production, district hea-ting grid and heat consumers	■ Partial approval should only take place under the condition that these plant components remain in the care of the contractor until the entire plant is accepted ■ The approval test of the entire system is carried out in accordance with national standards and regulations. After approval, the plant becomes the property of the plant owner (e.g. [31]) ■ To assess the nominal biomass boiler output(s) with reference fuel, there should be a performance measurement for over 1 hour in stationary operation (if necessary with temporary heat exchanger for heat dissipation).
E.6.2	Addition to approval report	■ As an additional document, the table "Addition to approval report" must be drawn up and signed by the boiler supplier, the main planner and the plant owner (this table is listed in each standard hydraulic scheme [2][5].
E.6.3	Operational optimisation concept	■ With the approval and handover of the plant to the plant owner, the operational optimisation concept is to be delivered containing the following elements: - Contractor for operational optimisation - Adjusted list of measuring points according to standard hydraulic scheme [2][5] - Indication of which operating states are measured - Information on the planned evaluations - Information on existing optimisation possibilities and potentials - Appointments

Table 8

E.7 Q-requirements implementation of operational optimisation

The **prerequisite** is that the Q-requirements of E.6 are fulfilled.

The operation optimisation must meet the quality criteria listed in **Table 9**.

No.	Designation	Q-requirements
E.7.1	Check the functionality	■ During at least one heating period, the functioning of the system shall be checked by evaluating the operating data, in particular in the agreed operating states. ■ If faults occur, these must be reported immediately to the responsible persons and measures must be taken for a quick solution. ■ To assess the nominal biomass boiler output(s) with reference fuel, a performance measurement for 1 hour in stationary operation mode should be available (if necessary with temporary heat exchanger for heat dissipation). ■ For the assessment of the emissions from the biomass boiler(s), an appropriate measurement report must be available.
E.7.2	Optimisation of operation	■ Optimisation measures result from the review of the functionality. The first things to optimize are: - Hydraulic balancing - Set points, controller parameters - Time programs
E.7.3	Completion of operational optimisation	■ At the end of the operational optimisation, the main planner shall submit a written assessment of the data records and make statements on them, - whether the system is working as intended, - where there are still deficiencies or open questions, if any, and - when and how possible deficiencies can be fixed and when and how open questions can be answered.

Table 9

F Fuel definition

The reference fuel must be agreed on in accordance with the requirements in **Table 10**. The main planner must then ensure that the agreed reference fuel is included in the contract for the biomass boiler delivery. The fuel supply contract must guarantee that the fuel quality to be supplied is at least of the same quality as the reference fuel.

No.	Designation	Q-requirements
F.1	Fuel declaration	In the tendering guidelines for wood fired boilers [3] and in the fuel supply contract, it must be stated how the selected fuel assortments are applied: - Combustion of individual fuels mixed according to the overall mixing ratio of the annual fuel assortment - Single combustion of the fuels - Combinations of individual fuels ■ Mixed fuels are to be listed in detail as well as the assortments assigned for the low load operation.
F.2	Classification	■ **Table 12** is decisive for the classification of fuels.
F.3	Water content	■ Depending on the combustion technology used (grate / underfeed furnace), certain water contents in the fuel must not be exceeded (see [3] and [4]). ■ The quantity of fuel in a fuel sample used to determine the water content shall be at least 1 kg. ■ The water content condition of a fuel (e.g. W50) is fulfilled if the water content of each fuel sample drawn does not fall below or exceed the specified range (e.g. 20-50%). ■ Remoistening (e.g. through rain, snow, condensation) which results in a water content that is considerably higher than that achieved during the drying process is not permitted. A remoistening can be recognized by an optical assessment of the cross section of the fuel parts. The outer layer of the fuel parts is then usually much darker than the core. ■ In order to avoid remoistening, especially for systems up to 500 kW, care must be taken to ensure proper temporary storage under shelters and proper transport in covered containers (to be agreed in the fuel supply contract). ■ The water content in the fuel must have a homogeneous distribution, both over the cross section of the individual fuel parts and over the entire fuel supply. The deviation must not exceed 15%. ■ If individual fuels with different water contents are processed into a mixed fuel, the mixed fuel shall have a uniform, homogeneous distribution of the water content. The water content of different fuel samples taken may show the following deviations from the mean value: - For plants with a boiler output of up to 2 MW maximum ±10%. - For plants with a boiler output greater than 2 MW maximum ±15%.
F.4	Fuel processing	■ Fuel preparation can be carried out using the following methods: - Cutting process with sharp tools (drum or disc chopper) for the production of wood chips (good flow properties, homogeneous fuel) - Breaking process with blunt tools (slow-running chippers with fangs, hammer mills, screw chippers etc.) for the production of shredded fuel (wedging easily, poor flow behaviour, inhomogeneous) ■ The fuel preparation procedure shall be agreed in the fuel definition of the biomass boiler tendering [3] and in the fuel supply contract.
F.5	Wood defects	■ The range and qualities of fuels should contain healthy wood. Minor rotting spots and red rot in coniferous wood and slight asphyxiation in hardwood are tolerated. However, rotten, brittle, splintered and suffocated wood and wood with white rot should be treated as a special category.

Table 10

Mixed fuels

A mixed fuel is produced by mixing individual fuels. Mixed fuels may also contain fuels with unfavourable properties. Bark with high water content can, for example, be mixed with dry residual wood, while pruning with a tendency to slagging can be mixed with low-ash wood chips.

In order to ensure smooth operation, the rated boiler output corresponding to each fuel or fuel mixture must be agreed with the boiler manufacturer. An example is shown in **Table 11.**

Fuel mixtures as a function of the rated boiler output (example)				
Power range	Range share			
	Forest and sawmill waste wood w = 40–50 %	Bark w = 40–60 %	Old wood w = 10–20 %	Sawdust w = 40–50 %
30–100%	100 %	–	–	–
30–100%	50 %	–	50 %	–
30–100%	80%	–	–	20 %
30–100%	–	60 %	40 %	–
50–70%	–	100 %	–	–
30–70%	–	–	100 %	–
Low load operation	100%	–	–	–
	–	–	100%	–

Table 11

Special wood chips

Besides standard fuel classifications, some countries use additional names and definitions for special wood chip types such as high quality or premium wood chips with low water and dust content.

Classification of fuels and their energy content

Fuel	Abbreviated designation	P Particle size mm (see below)	W Water content [3] Weight% moist fuel as-supplied condition	N Nitrogen content Weight % dry basis	F Fines share < 3.15 mm Weight% as-supplied condition	A Ash content with impurities Weight % dry basis	Energy content referring to $LHV_{wet\ basis}$ Variation range [6] kWh/LCM
Wood chips from forest residues (WS) [1] [9] and industrial residues (IS) [1] [9]	fine WS-P16S-M20 / IS-P16S-M20	16S	15-20	N0.5	F05	A1.0	WH: 700-900 HH: 1000-1200
	coarse WS-P31S-M20 / IS-P31S-M20	31S	15-20	N0.5	F05	A1.0	WH: 630-850 HH: 950-1150
Wood chips from forest residues (WS) [1] and industrial residues (IS) [1] [2]	WS-P31S-M35 / IS-P31S-M35	31S	20-35	N0.5	F10	A3.0	WH: 600-800 HH: 900-1100
	WS-P31S-M50 / IS-P31S-M50	31S	30-50	N0.5	F10	A3.0	WH: 550-750 HH: 850-1050
	WS-P31S-M55+ / IS-P31S-M55+	31S	30-60	N0.5	F10	A3.0	WH: 550-700 HH: 800-1000
	WS-P45S-M35 / IS-P45S-M35	45S	20-35	N0.5	F10	A3.0	WH: 550-750 HH: 850-1050
	WS-P45S-M50 / IS-P45S-M50	45S	30-50	N0.5	F10	A3.0	WH: 500-700 HH: 800-1000
	WS-P45S-M55+ / IS-P45S-M55+	45S	30-60	N0.5	F10	A3.0	WH: 450-650 HH: 750-950
	WS-P63-M50 / IS-P63-M50	63	30-50	N0.5	F10	A3.0	WH: 450-650 HH: 750-950
	WS-P63-M55+ / IS-P63-M55+	63	30-60	N0.5	F10	A3.0	WH: 400-600 HH: 700-900
Poplars and willows from pruning	PWW	31S 45S 63	30-60	N0.5	F10 F10 F10	A5.0	450-700 400-650 350-600
Poplars and willows from short rotation forestry	PWK	31 45 63	30-60	N3.0	F25 [7]	A10.0	400-650 350-575 300-500
Pruning	LH [1]	31 45 63	30-60	N3.0	F25 [7]	A10.0	400-800 350-750 300-700
Thinning residues of softwood and wood Ø <80 mm and crown wood	DH	31 31 45 45 63 63	30-60	N3.0	F25 [7]	A10.0	WH: 400-650 HH: 650-900 WH: 350-600 HH: 600-850 WH: 300-550 HH: 550-800
Sawdust	SP	<4	35-50	N0.5	-	A3.0	WH: 450-550 HH: 650-750
Crushed bark	Rz	45 45 63 63	30-65+	N3.0	F05 F05 F05 F05	A10.0	WH: 700-850 HH: 950-1150 WH: 650-800 HH: 900-1100
Bark uncrushed [8] max. coarseshare 5%	Ruz	n.V.	30-65+	N3.0	F05	A10.0	-
Residual wood from wood processing [10]	RHH	n.V.	n.V.	n.V.	n.V.	n.V.	-
Waste wood [4] [10]	AH	45 63	<30	N3.0	F10 F10	A10.0	550-750 500-700
Pellets [5]	PEL	n.V.	-	-	-	-	-

The classification is based as far as possible on the fuel standard ISO 17225 [36], deviations are mentioned.

1) Unless contractually agreed, may not contain poplars and willows; bark content adhering to the wood chips maximum 20 % by weight dry basis
2) According to CEN/TS 14588 [39]. Wood chips produced as a by-product of the wood-working industry, with or without bark. In Switzerland, only natural wood chips from sawmill residues are considered as wood chips from industrial residues (IS). Notice that CEN/TS 14588 [39] has been replaced by ISO 16559 [40].
3) Water content classification does not correspond to fuel standard ISO 17225 [36].
4) DE: Waste wood category A I and A II
AT: Waste wood according to "Branchenkonzept Holz" Q3 and Q4
CH: Waste wood is not considered as wood fuel (Air Pollution Control Ordinance: Annex 5, point 3, paragraph 2, letter a)
5) Pellet standard according to ISO 17225-2 [38].
6) Range of variation is determined by different bulk density:
- Chopping trunk wood from stacks results in a higher bulk density than chopping of whole trees with branches
- The size distribution of the wood chips in the main share of 60% influences the bulk density (a higher share of fine wood chips increases the bulk density)
- Chipping or shredding has a large influence on the bulk density (shredded fuel has a lower bulk density than chopped fuel)
7) with needles leaves and twigs
8) - The numerical values (P class) of the mass refer to the particle sizes (mass fraction at least 95%) that fit through the specified sieve opening size of round openings (ISO 17827-1 [35]). If a sample meets the criteria of more than one class, it shall be assigned to the lowest possible class.
- The coarse portion is ≤ 5 m-% in the as-supplied condition.
9) For quality wood chips (coarse and fine), additionally stricter requirements of country-specific standards must be observed.
10) For residuals from wood processing RHH and waste wood AH, the chemical composition is to be determined on the basis of fuel analyses in accordance with EN ISO 17225-1 [37] Table 5b, page 24 and Annex B, Table B.1, page 43. For waste wood, the maximum impurities content (m-% dry basis) of sand, stones and glass is to be determined for the maximum ash content.

n.V. By agreement, to be determined on a case-by-case basis
softwood WH coniferous wood : spruce, fir, pine, douglas fir, larch
Softwood: maple, cherry, alder
Hardwood HH Hardwood: oak, beech, elm, chestnut, ash, robinia,
hornbeam, hazel, birch, nut, fruit trees (except cherry)
For all fuels applies: Hu > 1.5 $kWh/kg_{w.b.}$

Classification of particle sizes of wood chips and coarse shredder wood

Particle size	Main share: * min. 60 % / 95 % [1]	Fines share *: < 3.15 mm	Coarse share *:	Maximum length of the particles:	Cross section of the oversized particles
P16S	3.15 mm to 16 mm	F15	>31.5 mm, ≤ 6%	≤ 45 mm	< 2 cm^2
P31S	3.15 mm to 31.5 mm	F10	>45 mm, ≤ 6%	≤ 150 mm	< 4 cm^2
P31	3.15 mm to 31.5 mm	F25 [2]	>45 mm, ≤ 6%	≤ 200 mm	< 4 cm^2 [4]
P45S	3.15 mm to 45 mm	F10	>63 mm, ≤ 6%	≤ 200 mm	< 6 cm^2
P45	3.15 mm to 45 mm	F25 [2]	>63 mm, ≤ 6%	≤ 350 mm	< 6 cm^2 [4]
P63	3.15 mm to 63 mm	[3]	>100 mm, ≤ 6%	≤ 350 mm	< 8 cm^2 [4]
P100	3.15 mm to 100 mm	[3]	>150 mm, ≤ 6%	≤ 350 mm	< 12 cm^2 [4]

1) The numerical values of the mass are related to the particle sizes (mass fraction at least 60%) that fit through the specified sieve opening size of round openings (ISO 17827-1 [35]). For bark and crushed bark, the main share including fines must have a mass fraction of 95%. For wood chips and coarse shredded wood for use in domestic and small commercial fireplaces, S-classes shall be used. The lowest possible property
2) class shall be indicated.
3) with needles, leaves and twigs
4) Fines share vary according to fuel
* Recommendation in deviation from the standard: For fuel transport and fuel feeding systems with screw conveyors
Particle size in mass-%, m-% in as-delivered condition

Table 12

Glossary

Important preliminary remark: The descriptions basically follow the definition of Quality Management for Biomass District Heating Plants. The terms used may vary from country to country.

Annual heat demand (annual energy demand) [kWh/a] or [MWh/a]: Annual heat demand of a heat consumer, a district heating grid etc. for space heating, domestic hot water and process heat.

Annual outdoor temperature duration curve: Sum of the daily average value of the outdoor temperature, shown as a function of one year. The area below the annual duration line (cumulative frequency of the difference between room temperature and outside temperature) corresponds to the heating degree days. These can be determined for different heating limits and room temperatures.

Annual heat capacity duration curve: Sum of the heat output requirement, displayed as a function of one year. The area below the annual duration line corresponds to the annual heat demand. This area can be divided into different heat consumers, types of heat consumers or heat producers.

Annuity method: The annuity method described in the VDI Guideline 2067 Part 1 [34] allows single payments and investments as well as current payments to be combined by means of an annuity factor during a certain observation period.

Approval: a) Classification in the course of the project: The approval takes place after completion and commissioning of the plant, i.e. towards the end of the project phase "realisation and approval".
b) Legal meaning: If the contractor reports the completion of the system, the plant owner must carry out the approval within a certain (first) deadline. If the plant owner makes use of the system, a different second deadline may apply. If these time periods are missed, the installation is deemed to have been tacitly accepted. The warranty period begins with the approval of the plant and the responsibility for the plant is transferred from the contractor to the plant owner. Approval may be refused due to defects until remedied.

Bivalent heat production: Heat production with two heat carriers, e.g. wood and oil.

Bulk volume [LCM]: Bulk volume of wood chips in loose cubic meters.

Business plan: Basic document for assessing a company's chances of success (here the construction of a biomass heating plant). The business plan serves as a decision-making basis for individuals and companies who want to participate in the company. It provides information about the structure of the company, the market situation, financial requirements, profit prospects, risks, etc.

District Heating grid: This is composed of:
- Primary pipeline
- Branch pipelines
- Household connection pipelines

The trench length of the heating grid results from the sum of all route sections of these lines. For the calculation of the mean specific pressure drop, the pipe length (supply + return) of the most unfavourable section is decisive, i.e. this is usually the route to the heat consumer furthest away

District heating grid plan: shows the location of the central heating plant and the route of the district heating grid.

Domestic hot water production: Heating of domestic hot water.

Domestic hot water production unit: Device for heating domestic hot water. This can be a domestic hot water boiler or tankless heaters (flow heater).

Draft planning: Project phase in which the technical solution of the project is determined

Energy reference area: Sum of all above-ground and underground floor areas that require heating or air conditioning for their use. The energy reference area is calculated as gross area, i.e. from the external dimensions including bounding walls and parapets. Approximately, the heated gross floor area can be assumed as the energy reference area.

Execution project: Project which forms the basis for the realisation of the plant.

Heat capacity (heating load) [kW]: Heat capacity of a heat consumer, a district heating grid etc. for space heating, domestic hot water and process heat.

Limit value: Value that must not be exceeded or fallen below (see also "Target value").

Linear heat density [MWh/(a.Trm)]: Sum of the annual heat demand of the heat consumers connected to the grid [MWh/a] divided by trench length [Trm].

Load characteristic: Heat capacity of the heat consumers, shown as a function of the outside temperature. Different heat consumers or types of heat consumption can be presented.

Main planner: Planner, who is responsible to the plant owner for the quality of the overall system. For project planning according to Quality Management for Biomass District Heating Plants, a main planner must always be designated in the Q-plan.

Milestones: QM for Biomass DH Plants sets 5 milestones for quality assurance at the end of the most important project phases:

1. Establishment of QM for Biomass DH Plants and Q-plan as conclusion of project phase 1
2. Q-check and Q-control at the level of "design planning" as conclusion of project phase 2
3. Q-check and Q-control at the level of "tender planning" as conclusion of project phase 3
4. Q-check and Q-control at "approval" level as conclusion of project phase 5
5. Q-check and conclusion of QM for Biomass DH Plants after at least one operating year as conclusion of project phase 6

Monovalent heat production: Heat production with a single heat carrier, e.g. wood.

Nominal output (nominal heat output): For Quality Management for Biomass District Heating Plants, "nominal output" (rated output) is generally understood as the maximum continuous output of the biomass boiler with the agreed reference fuel.

Number of full load operating hours for biomass boiler: Indicator calculated from heat production [kWh/a] (according to heat meter) divided by nominal output of the biomass boiler [kW] with reference fuel.

Number of full load operating hours for the heat consumers: Indicator calculated from the annual heat demand of the heat consumers [kWh/a] divided by the maximum heat capacity of the heat consumers [kW] (both design data). This index can also be determined for individual heat consumers or for different types of heat consumption (space heating, domestic hot water, process heat, etc.).

Operational optimisation: After the plant has been handed over to the plant owner, operational optimisation systematically checks and optimises the functioning of the plant. In the course of the Quality Management for Biomass District Heating Plants, the optimisation of operations is within the responsibility of the executing companies, under the direction of the main planner.

Preliminary study: Project phase in which the project variant that best meets the requirements is determined.

Project phases: QM for Biomass DH Plants divides the project sequence into the following 6 project phases:

1. Preliminary study
2. Design planning
3. Tender planning
4. Tendering and contracting
5. Execution and approval
6. Optimisation of plant operation

Project-related quality management (PQM): Ensures that the required quality is defined and checked in a temporary project in which several companies are involved. A PQM must not be confused with company-related quality management (certification according to ISO 9000) and the inspection of samples (type testing). However, a PQM can of course be used within the framework of certified QM systems of companies involved in the project. (QM for Biomass DH Plants is a PQM.)

QMmini: Process developed in addition to QMstandard for smaller monovalent plants, which is described in separate Q-guidelines [7]. It is available in German language.

QMstandard: Procedure used as standard, which is described in this Q-guidelines. Normally QMstandard includes all 5 milestones. In the simplified version of QMstandard, Milestone 3 and 4 can be omitted under certain conditions (see Section C.2).

Quality: Ratio of the material or immaterial object (here: the biomass heating plant) to the quality requirement (usually consisting of a sum of individual requirements). Here, good quality means that the biomass heating plant implemented fulfils all the quality requirements agreed in the Q-plan within the agreed tolerances.

Quality control (Q-control): Definition of measures in the course of the project to ensure that quality deviations are detected and corrected in appropriate time.

Quality guidelines (Q-guidelines) [1]: Integrating part of the Q-plan with detailed description of the quality requirements according to standard QM for Biomass DH Plants including process and work instructions.

Quality inspection (Q-inspection): Ongoing inspection during the course of the project and in particular at completion (final inspection) to determine whether the quality requirements agreed in the Q-plan are within the agreed tolerance.

Quality manager (Q-manager): Ensures that the quality management system "Quality Management for Biomass District Heating Plants" is defined, implemented and maintained. The Q-manager´s activities are: quality planning, quality control and quality inspection.

Quality management (QM): All activities that define the quality requirements and responsibilities and implement them through quality planning, quality control and quality inspection.

Quality Management for Biomass District Heating Plants: Project-related quality management system for biomass heating plants, developed by Switzerland, Baden-Württemberg, Bavaria, Rhineland-Palatinate and Austria as part of a cross-border project. The focus is on the professional conception, planning and implementation of the heat production plant and the heating grid. Important quality criteria are high operational reliability, precise control, low emissions and economical fuel logistics. The goal is an energy-efficient, environmentally friendly and economical operation of the entire plant.

Quality plan (Q-plan): Document in which the quality requirements (including instrumentation, measurement method and tolerance) and responsibilities are defined before the implementation of the plant. This is the main document of the quality management system, which is created during the establishment of the QM process in Milestone 1. The quality control and the quality inspection then take place in the consecutive milestones. During each further milestone of the QM process annexes to the Q-plan are created (maximum 4).

Quality planning (Q-planning): Unambiguous definition of quality requirements including responsibility, instrumentation, measurement method and tolerance in a Q-plan. Ensure that the individual requirements listed in the Q-plan comply with the corresponding national standards and regulations and the current state of the art.

Quality requirements (Q-requirements): In Quality Management for Biomass District Heating Plants, these are the individual requirements that are placed on the quality of a biomass heating plant. The quality requirements for a biomass heating plant are formulated in detail in the Q-guidelines, and they are defined for the biomass heating plant to be realised in the Q-plan.

Simplified version of QMstandard: Normally, QMstandard includes all 5 milestones. In the simplified version of QMstandard, Milestone 3 and 4 can be omitted under certain conditions (see Section C.2).

Standard hydraulic scheme [2][5]: Proven solutions for monovalent or bivalent heat production systems for one or two biomass boilers, with or without storage. Numerous solutions for space heating and domestic hot water production are also described for the heat consumer side. If a standard hydraulic scheme is selected, the design and functional description of the system is particularly simple: calculations are carried out in prepared tables and questions about the system concept can be answered by simply ticking the boxes.

Target value: Value demonstrated in comparable successful projects. If a target value is specified for a Q-requirement, this means that this value should be aimed for. However, there may be good reasons to deviate from this target value, but the reasons for deviation should be given. (In contrast, it is not allowed to exceed or fall below a limit value.)

Tendering and contracting: Project phase in which the tender project is tendered and awarded (contracted).

Tendering guidelines for biomass boiler [3]: Guidelines and templates for tender documents according to standard Quality Management for Biomass District Heating Plants.

Tender planning: Project phase in which the tender project is created (possibly over several planning stages).

Tender project: Project which forms the basis for the preparation of the tender.

Trench length [Trm]: Sum of the length of all route sections of the district heating grid, including routes to the consumers (house connection pipes) (see also "Heating grid").

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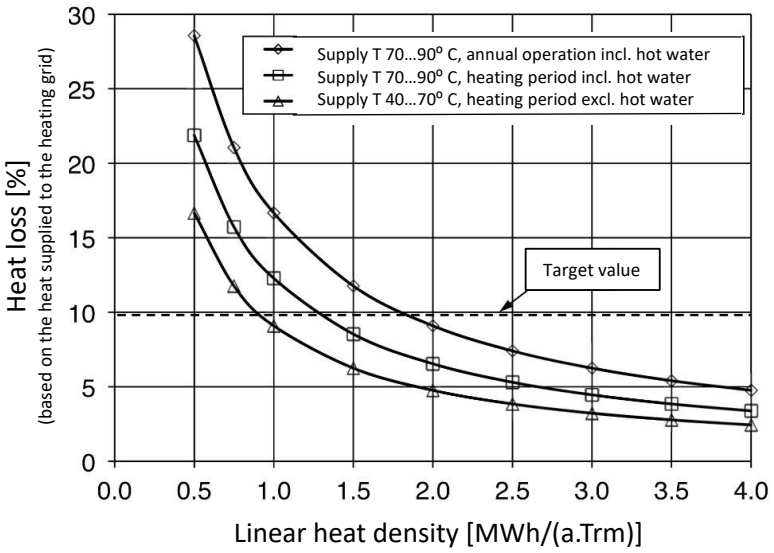
Annex

Heat losses of district heating grid



Source: Curves determined on the basis of data from installations carried out in Switzerland (as of 2004)

Figure 2

Flow velocities according to ÖKL data sheet no. 67 [23]

Main and branch pipelines

Nominal diameter	Inner pipe diameter	Flow velocity	Volume flow rate	Heat transport capacity ΔT=30K
DN	Di	v	Vs	P
[-]	[mm]	[m/s]	[m³/h]	[kW]
20	22.3	0.6	0.8	29
25	28.5	1.0	2.3	80
32	37.2	1.1	4.3	150
40	43.1	1.2	6.3	220
50	54.5	1.4	11.8	410
65	70.3	1.6	22.4	780
80	82.5	1.8	34.6	1,200
100	107.1	1.9	61.6	2,150
125	132.5	2.0	99.3	3,400
150	160.3	2.5	181.6	6,300
200	210.1	3.3	411.9	14,000
250	263,0	3.9	762.7	26,000
300	312.7	4.3	1,188.8	40,000
350	344.4	4.6	1,542.7	50,000
400	393.8	5.0	2,192.4	76,000

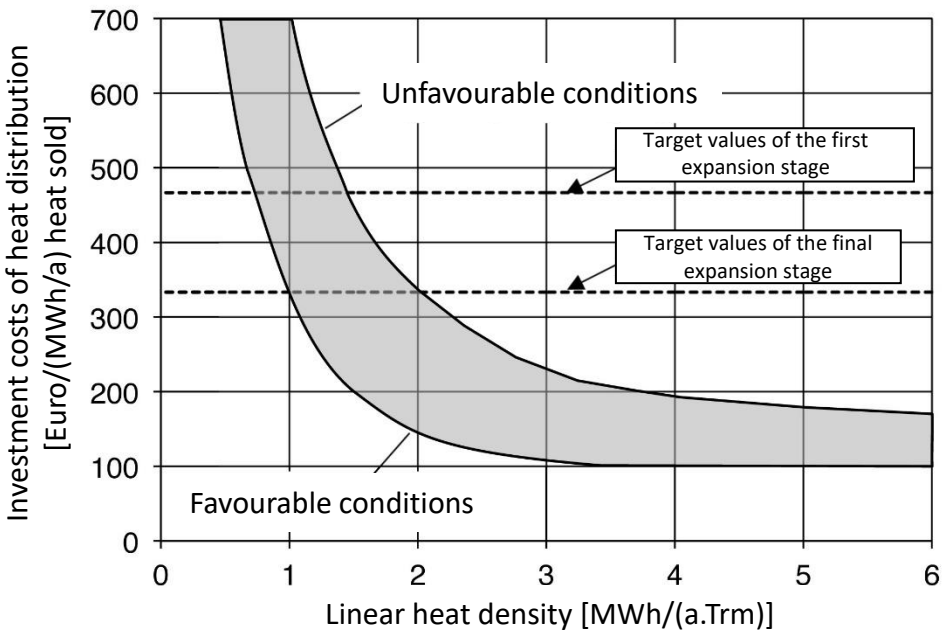
Table 13

House connection pipelines

Nominal diameter	Inner pipe diameter	Flow velocity	Volume flow rate	Heat transport capacity ΔT=30K
DN	Di	v	Vs	P
[-]	[mm]	[m/s]	[m³/h]	[kW]
20	22.3	0.5	0.7	24
25	28.5	0.6	1.4	48
32	37.2	0.8	3.1	110
40	43.1	1.0	5.3	180
50	54.5	1.4	11.8	410
65	70.3	1.6	22.4	780
80	82.5	1.8	34.6	1,200
100	107.1	1.9	61.6	2,150

Table 14

Specific investment costs of heat distribution

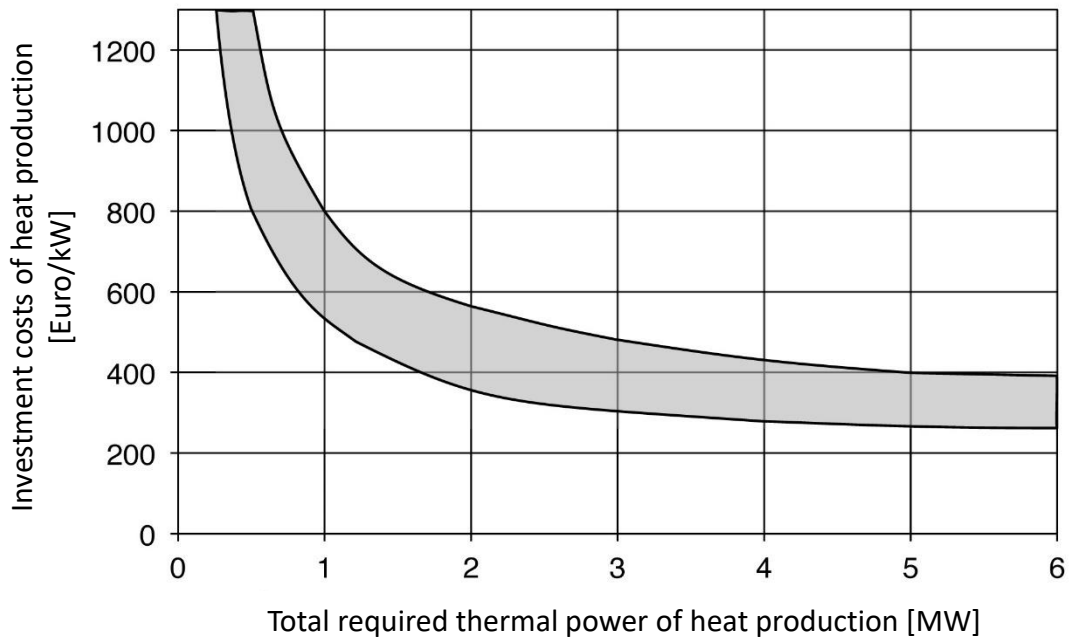


Included are: Transmission pipelines in the heating plant, pipeline grid up to and including heating substation (without consumer's installations)

Source: Curves determined on the basis of data from completed plants in Switzerland (as of 2004) and Austria (as of 2010)

Figure 3

Specific investment costs of heat production



Included are: Heat production units, particle filters (from 500 kW), boiler house, chimney, hydraulic system, control system and fuel storage with discharge for mono- or bivalent wood heating with or without storage tank. The dimensioning meets the Q-requirement E.4.

Important note: The curve is based on empirical values of realised plants in Switzerland (as of 2004) and Austria (as of 2010). It should be noted that no general heating peaks are taken into account for space heating; the full load operating hours for space heating are therefore approx. 2000 h/a. If the heating peaks are taken into account, the number of full load operating hours is lower and the total heat output requirement is higher. If in bivalent systems the biomass boiler is designed for the same number of full load operating hours (e.g. 3000 h/a) in both options (with or without consideration of the heating peaks), the investment costs are approximately the same. However, the specific investment costs are lower if the heating peaks are considered. This must be taken into account when determining the target value for the specific costs (in the Q-plan in Milestone 1).

Figure 4

Q-requirements heat production

Set-up	Description	Total heat capacity		
		100...500 kW	501...1000 kW	> 1000 kW
1 biomass boiler without storage WE1 (WE11)	Annual heat production with biomass	100%		
	Design of biomass boiler capacity	100% with peak loads		
	Number of full load operating hours of biomass boiler	> 1500 h/a		
	Low load operation	Summer operation possible if sufficient summer load exists according to **Table 16**		
	Automatic ignition?	Yes		
	Fuel	Max. P45; with automatic ignition W ≤ 45%		
	Expansion reserve	Only possible in exceptional cases due to low load problems		
1 biomass boiler with storage WE2 (WE12)	Annual heat production with biomass	100%		
	Design of wood boiler capacity	100% without load peaks		
	Number of full load operating hours of biomass boiler	> 2000 h/a		
	Low load operation	Summer operation possible if sufficient summer load exists according to **Table 16**		
	Automatic ignition?	Yes		
	Fuel	Max. P45; with automatic ignition W ≤ 45%		
	Expansion reserve	Only possible in exceptional cases due to low load problems		
	Storage capacity	≥ 1 h related to the rated output of the biomass boiler		
1 biomass boiler + 1 oil/gas boiler without storage WE3 (WE13/15 with 1 biomass boiler)	Annual heat production with biomass	80...90%		
	Design of biomass boiler capacity	60...70%*		
	Design of oil/gas boiler capacity	Min. 70%, max. 100%		
	Number of full load operating hours of wood boiler	> 2500 h/a Target 4000 h/a		
	Low load operation	If **Table 16** not fulfilled by oil/gas boiler		
	Automatic ignition?	Yes		
	Fuel	Max. P45; with automatic ignition W ≤ 45%	No restriction; for automatic ignition W ≤ 45%	
	Expansion reserve	Possible through oil/gas boilers (with corresponding reduction of the biomass coverage ratio)		
1 biomass boiler + 1 oil/gas boiler with storage WE4 (WE14/16 with 1 biomass boiler)	Annual heat production with biomass	80...90%		→ For systems without summer operation, it is possible that only 1 biomass boiler + 1 oil/gas boiler can be useful for systems above 1000 kW.
	Design of wood boiler capacity	50...60%*		
	Design of oil/gas boiler capacity	Min. 70%, max. 100%		
	Number of full load operating hours of wood boiler	> 3500 h/a Target 4000 h/a		
	Low load operation	If **Table 16** not fulfilled by oil/gas boiler		
	Automatic ignition?	Yes		
	Fuel	Max. P45; with automatic ignition W ≤ 45%	No restriction; for automatic ignition W ≤ 45%	
	Expansion reserve	Possible through oil/gas boilers (with corresponding reduction of the biomass coverage ratio)		
	Storage capacity	≥ 1 h related to the rated output of the biomass boiler		
*Guiding value for systems with predominantly space heating				

Table 15

Set-up	Description	Total heat capacity		
		100...500 kW	501...1000 kW	> 1000 kW
2 biomass boilers without storage WE5	Annual heat production with biomass	→ Realisation of monovalent summer operation may only be possible with two biomass boilers	100%	
	Design of biomass boiler capacity 1		33% with peak loads	
	Design of biomass boiler capacity 2		67% with peak loads	
	Number of full load operating hours biomass boiler 1+2		> 1500 h/a	
	Low load operation		Compliance with **Table 16** with the small biomass boiler usually possible	
	Automatic ignition?		For the small biomass boiler	
	Fuel		Max. P45; with automatic ignition W ≤45%	No restriction; for automatic ignition W ≤45%
	Expansion reserve		Possible with correspondingly high investment costs (expensive biomass boilers)	
2 biomass boilers with storage WE6	Annual heat production with biomass	→ Realisation of monovalent summer operation may only be possible with two biomass boilers	100%	
	Design of biomass boiler capacity 1		33% without load peaks	
	Design of biomass boiler capacity 2		67% without load peaks	
	Number of full load operating hours biomass boiler 1+2		> 2000 h/a	
	Low load operation		Compliance with **Table 16** with the small biomass boiler usually possible	
	Automatic ignition?		For the small biomass boiler	
	Fuel		Max. P45; with automatic ignition W ≤45%	No restriction; for automatic ignition W ≤45%
	Expansion reserve		Possible with correspondingly high investment costs (expensive biomass boilers)	
	Storage capacity		≥ 1 h related to rated output of large biomass boiler	
2 biomass boilers + 1 oil/gas boiler without storage WE7 (WE13/15 with 2 biomass boilers)	Annual heat production with biomass			80...90%
	Design of biomass boiler capacity 1			20...23%*
	Design of biomass boiler capacity 2			40...47%*
	Design of oil/gas boiler capacity			Min. 100% - small biomass boiler, max. 100%
	Number of full load operating hours biomass boiler 1+2			> 2500 h/a Target 4000 h/a
	Low load operation			Compliance with the **Table 16** with the small biomass boiler or oil/gas boilers
	Automatic ignition?			For the small biomass boiler
	Fuel			No restriction; for automatic ignition W ≤45%
	Expansion reserve			Possible through oil/gas boilers (with reduction of the biomass coverage ratio)
2 biomass boilers + 1 oil/gas boiler with storage WE8 (WE14/16 with 2 biomass boilers)	Annual heat production with biomass			80...90%
	Design of biomass boiler capacity 1			17...20%*
	Design of biomass boiler capacity 2			33...40%*
	Design of oil/gas boiler capacity			Min. 100% - small biomass boiler, max. 100%
	Number of full load operating hours biomass boiler 1+2			> 3000 h/a Target 4000 h/a
	Low load operation			Compliance with the **Table 16** with the small biomass boiler or oil/gas boilers
	Automatic ignition?			For the small biomass boiler
	Fuel			No restriction; for automatic ignition W ≤45%
	Expansion reserve			Possible through oil/gas boilers (with reduction of the biomass coverage ratio)
	Storage capacity			≥ 1 h related to rated output of large biomass boiler
Guiding value for systems with predominantly space heating				

Table 15 (continued)

Minimum average daily heating load with low load operation

Furnace type→	Grate furnace					Underfeed furnace		
	With automatic ignition		with stand-by (fire bed maintenance)			with automatic ignition		with stand-by (fire bed maintenance)
With/without storage recommendations ↓	w ≤ 35%	w ≤ 35% w ≤ 45%	w ≤35%	w > 35% w ≤ 50%	w > 50%	w ≤ 35%	w > 35% w ≤ 45%	w ≤ 50%
Without storage	20%	25%	20%	25%	40%	15%	20%	20%
With storage	15%	20%	15%	20%	30%	10%	15%	15%
Important note: The values may vary slightly depending on the biomass boiler manufacturer. The values and recommendations of the biomass boiler manufacturer are always decisive.								

Table 16

Example: Biomass boiler maximum output = 1000 kW; heat requirement in summer operation = 1500 kWh per day; storage and transmission losses in summer operation = 1000 kWh per day.

minimum load = (1500 kWh + 1000 kWh) / (24 h x 1000 kW) = 0.10 = 10%

When using good quality dry wood chips (w ≤ 35%), summer operation with underfeed furnace should be possible with this system if automatic ignition and a storage are available.

For systems without summer operation, operation must meet the same requirements during the spring/autumn period. It is therefore often necessary to first use the oil/gas boiler (if available) or the small biomass boiler (for monovalent systems) for low load operation.

Checklist procedure Milestone 1 (kick-off meeting)

Prerequisite: Project phase 1 "Preliminary study" completed

Purpose: Establishment of QM for Biomass DH Plants and Q-planning

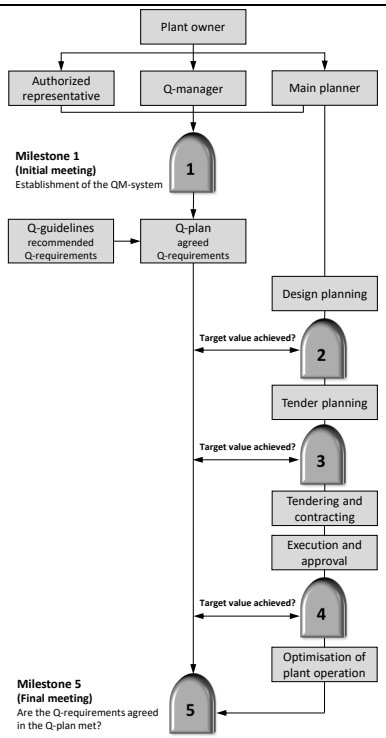
Form: Kick-off meeting is absolutely necessary, signatures are required immediately or possibly later by mail

Documents: The Q-manager receives the most important project documents available at this moment and organizes the kick-off meeting with the plant owner and the main planner.

Q-plan main document: It is decided how QM for Biomass DH Plants will be integrated into the project and which quality standard will be used; in principle, the plant owner decides, but the Q-manager ensures that the rules of technology and the quality standards required by the funding agency are taken into account.

Aim: Q-plan main document signed by plant owner, main planner and Q-manager

Note: This checklist supports the Q-manager for conducting the kick-off meeting; the only legally binding document is the main document.

Chapters	Description	Comments
	Short introduction 	☐ The basic procedure of QM for Biomass DH Plants is established
A	**Project participants** ☐ The plant owner has decided to have the project accompanied by a Q-manager of Quality Management for Biomass District Heating Plants. ☐ The authorized representative of the plant owner is designated and present at the starting meeting; he is entitled to sign QM documents. ☐ The main planner is designated and present at the kick-off meeting; he is entitled to sign QM documents. ☐ The project was discussed with regard to possible subsidies and the associated subsidy criteria.	☐ All participants and their contact details are known ☐ Authorisations for signing have been clarified? ☐ Yes ☐ No If so, which ones?
B	**Establishment of Quality Management for Biomass District Heating Plants** ☐ Presentation of QM tools → Bibliography ☐ Basic information about Quality Management for Biomass District Heating Plants:	☐ Tools presented ☐ Basics known

	Quality requirements for biomass district heating plants are defined in the Q-guidelines in accordance with the current state o -the art technology. – In Milestone 1, the quality plan specifies which quality requirements must be met for the present project. – The plant owner alone decides which quality requirements according to the Q-guidelines must be complied with in this project. – If state laws and regulations or a funding agency impose special quality requirements, these must be complied with (Note: funding schemes may prescribe stricter quality requirements than this Q-guidelines). – Milestone 2 to 5 check whether the quality requirements defined in Milestone 1 are met; if deviations occur, intervention action is taken. ☐ Tasks and duties of the Q-manager according to the Q-guidelines: – The Q-manager, together with the plant owner and the main planner, determines which quality requirements must be met in accordance with the Q-guidelines. – The Q-manager expressly has no planning responsibility – If quality deviations are found in Milestone 2 to 5, the Q-manager makes recommendations to the plant owner; whether these are implemented or not is then decided solely by the plant owner. – Documents and findings are treated confidentially ☐ Remuneration of the Q-manager. ☐ Tasks and duties of the main planner according to the Q-guidelines: – The main planner accepts the quality requirements defined in the Q-plan and is solely responsible to the plant owner for compliance with these requirements. – The main planner makes all necessary documents available to the Q-manager ☐ Tasks and duties of the plant owner in accordance with the Q-guidelines, in particular: – The plant owner ensures that QM for Biomass DH Plants is included in the engineering contract with the main planner and in the contracts with the suppliers. – If quality deviations are found in Milestone 2 to 5, the plant owner decides whether or not the recommendations of the quality representative are implemented.	☐ Tasks and duties of the Q-manager in accordance with Q-guidelines ☐ Offer of Q-manager available ☐ Exceptions: ☐ Tasks and duties of the main planner in accordance with Q-guidelines ☐ Exceptions: ☐ Tasks and duties of the plant owner in accordance with Q-guidelines ☐ Exceptions:
C	**Project process with milestones** ☐ QMstandard with 5 milestones. ☐ Simplified version of QMstandard with milestones MS1 MS2 and MS5. ☐ The checklists for Milestone 2 to 5 describe in detail which documents for the individual milestones must be delivered to the Q-manager by the main planner. The main planner is responsible for obtaining the necessary documents from the plant owner.	☐ QMstandard ☐ Simplified version of QMstandard Planned milestones: ☑ MS1 ☐ MS2 ☐ MS3 ☐ MS4 ☑ MS5
D.1	**Services provided by plant owner within Milestone 1** The following points should be internally sufficiently clarified: ☐ Funding (foundation, legal form, financing) ☐ Responsibilities for operation (incl. inclusion in planning process) ☐ Responsibilities for market development and customer service (taking into account the competitive situation in the heating market of the supply area) ☐ Location of heating central/heating plant (incl. legal security) ☐ Framework conditions for building permits and transit rights ☐ General conditions for the invitation to tender ☐ Clarification of funding contributions	☐ All points are internally sufficiently clarified ☐ Exceptions:
D.2	**Services provided by plant owner within Milestone 2** ☐ List of heat consumers with indication of connection time and status ("contract signed", "open", etc.). At least 70% of the annual heat requirement must be secured by written documents	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:

	☐ Target quotation for the fuel supply. ☐ Proof of profitability according to the annuity method; a business plan is already recommended at this stage for systems with a district heating grid.	
D.3	**Services provided by plant owner within Milestone 3** ☐ Final offer for the for the fuel supply, adapted to the planned system (size of the fuel store, delivery frequency, access, etc.). ☐ List of heat consumers with indication of connection time and status ("contract signed", "open", etc.). At the start of construction, at least 60% of the annual heat demand must be secured by signed heat supply contracts ☐ Heat supply contract with technical connection regulations and general terms and conditions. ☐ Revised proof of profitability according to the annuity method; for plants with district heating grid a business plan with budgeted balance sheet and budgeted income statement for 20 years is required at this stage.	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:
D.4	**Services provided by plant owner within Milestone 4** ☐ Approval of the business optimisation concept (incl. contract for implementation). ☐ List of persons responsible for the plant. ☐ Takeover of the plant and implementation of the company organisation.	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:
D.5	**Services provided by plant owner within Milestone 5** ☐ Cost breakdown and comparison with target figures. ☐ Annual balance sheet and income statement for the first year of operation and comparison with budget figures.	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:
E.1.1	**Services of the main planner within Milestone 1** ☐ Determine target values together with the plant owner and the Q-manager: - Standard hydraulic scheme yes/no (possibly not yet known) - Heat losses of district heating grid → Figure 2 - Minimum linear heat density • Annual operation 2.0 MWh/(a.Trm) • Heating period without domestic hot water production 1.0 MWh/(a.Trm) - Specific investment costs of district heating grid →Figure 3 - Specific investment costs of heat production → Figure 4 If national laws and regulations or a funding body have special quality requirements, these must be complied with (Note: Funding programmes may prescribe stricter quality requirements than this Q-guidelines).	Standard hydraulic scheme? ☐ yes ☐ no ☐ not yet known Agreed key figures: Heat losses of district heating grid % Minimum linear heat density MWh/(a.Trm) Spec. investment heating grid EUR/(MWh/a) Specific investment EUR/kW
E.1.2 **E.1.3**	**Services of main planner within Milestone 2 and Milestone 3** Milestones 2 and 3 are similar. The progress of the project and thus the level of knowledge is different. Therefore, Milestone 2 may refer to Milestone 3 if something is not yet sufficiently known (e.g. the detailed control solution). **E.2 Demand assessment and appropriate system selection** ☐ Execution of the demand assessment and appropriate system selection and transfer of the data to the Q-manager in the form of the EXCEL table "demand assessment and appropriate system selection": – Annual heat demand for each heat consumer divided into space heating, domestic hot water and process heat – Heat capacity of each heat consumer divided according to space heating, domestic hot water and process heat – Temperature requirement for each heat consumer – Energy reference area for each heat consumer – Connection time ("in the first expansion stage", "in the final expansion stage") **E.3 District heating grid** ☐ Compliance with quality requirements: – Temperature difference between supply and return at least 30 K – Heat losses of heating grid→ see E.1.1 – Linear heat density→ see E.1.1	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:

	– Specific investment costs for district heating grid → see E.1.1 **E.4 Heat production** ☐ Compliance with quality requirements: - If possible, choose a standard hydraulic scheme - System selection according to heat capacity → **Table 15** - Minimum average daily heating load for low load operation → **Table 16** - If particle filters are used: Clarify requirements - Specific investment costs of heat production→ see E.1.1 **F. Fuel assortment** ☐ It has to be checked together with the plant owner, - whether the fuel assortment defined in Milestone 1 can be obtained in the region in sufficient quantity at the price specified in the calculation of the profitability, - whether a sufficient supply can be guaranteed to dimension the storage according to the Q-guidelines. The fuel assortment may have to be adjusted. **Profitability calculation** ☐ The main planner has to provide the plant owner with the necessary planning data for the preparation of the economic profitability calculation and to participate in the cost calculation and cost estimation. **Subsequent delivery of tender for heating plant** ☐ The tender for the heating plant is normally not yet available for Milestone 3, but it is possible to agree on its subsequent delivery to the Q-manager. An examination of the content of the invitation to tender by the Q-manager shall be additionally remunerated on a time and material basis. **Note:** If the simplified version of QMstandard was selected, all requirements of Milestone 3 must already be fulfilled for Milestone 2.	☐ Subsequent delivery of tender for heat production agreed ☐ No content check ☐ Content check according to effort
E.1.4	**Services of the main planner within Milestone 4** **E.2 Demand assessment and appropriate system selection** ☐ Checking and, if necessary, updating the demand assessment and appropriate system selection **E.6 Approval and concept for operational optimisation** ☐ Approval (incl. power measurement of biomass boiler). ☐ Preparation of the operational optimisation concept, in particular: - Responsibilities - Adjusted measuring point list according to selected standard hydraulic scheme - Definition of the presentation of measurement data (trends) - Definition of the operating conditions to be measured and analysed **F. Fuel assortment** ☐ Verification that the conditions specified in the fuel supply contract are met and that the fuel price assumed in the profitability calculation is correct.	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:
E.1.5	**Services of the main planner within Milestone 5** **E.2 Demand assessment and appropriate system selection** ☐ Updating the demand assessment and appropriate system selection. **E.5 System documentation** ☐ Preparation of the plant documentation. **E.7 Implementation of operational optimisation** ☐ Implementation of operational optimisation, in particular to be observed: - Automatic data recording mandatory - Measuring points according to measuring equipment list in standard hydraulic scheme **Simplified version of QMstandard:** Missing documents of omitted milestones must be submitted to the Q-manager	☐ Unchanged in accordance with Q-guidelines ☐ Exceptions:
F	**Fuel definition** ☐ Determination of the reference fuel according to the available information in Milestone 1.	Reference fuel:

Checklist documents Milestone 2

Prerequisite: Project phase 2 "Design planning" completed

Purpose: Q-checks/Q-control at the "design planning" level

Form: Written, meeting only when needed
→ A meeting with the Q-manager is to be additionally remunerated according to time and effort.

Documents: The plant owner hands over the necessary documents to the main planner so that he can prepare the required documents for the attention of the Q-manager.

Q-plan annex: The Q-manager creates the document for MS2 based on the information and documents submitted to him by the main planner:
- Possible deviations in the course of the project
- Result of the Q-checks
- Recommendations to the plant owner

Aim: Q-plan annex document MS2 with the plant owner's decision as to which recommendations of the Q-manager are to be implemented, signed by the plant owner, main planner and Q-manager

Note: This checklist is used by the main planner to compile the necessary documents and deliver them to the Q-manager; it must be filled and attached to the documents.

Selected procedure:
☐ **QMstandard** with all 5 milestones
☐ **QMstandard** with MS1, MS3, MS4 and MS5 (MS2 no longer possible)
☐ Simplified version of **QMstandard** with milestones MS1, MS2 and MS5
→ Prerequisite: For MS2, all requirements of MS3 must be fulfilled.

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
201	**General system description** It should give the outsider a quick overview regarding: – Purpose of the plant – Operating times (year-round, heating season only, etc.) – Heat production capacity, individual boiler capacity		☐ As requested here
202	**List of heat consumers** For each heat consumer must be specified: – Date of connection to the grid – Status ("contract signed", "open", etc.) – Annual heat demand At least 70% of the annual heat demand must be secured by written documents → In the simplified version of QMstandard, the requirement of MS3 applies: At the start of construction, at least 60% of the annual heat demand must be secured by signed heat supply contracts Minimum linear heat density for customers secured by written documents (MS3: heat supply contracts): – Full-year operation 2.0 MWh/(a.Trm) – Heating period without water heating 1.0 MWh/(a.Trm)	D.2 Evaluation of possible heat consumers E.1.1 Arrangements MS1	☐ Document of plant owner available ☐ Document of main planner available
203	**District heating grid (if available)** – District heating grid plan with location of the central heating plant and heating grid route – Heat loss calculation for district heating grid	E.3 District heating grid	☐ No heating grid ☐ As requested here
204	**Demand assessment and appropriate system selection** Use the EXCEL table [8]. The situation must be recorded according to the state of knowledge of Milestone 2. At Milestone 3 at the latest, all	E.2 Status-quo analysis	☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	details are required (for the simplified version, all details are already required here). – Annual heat demand for each heat consumer divided into space heating, domestic hot water and process heat – Heat capacity for each heat consumer divided into space heating, domestic hot water and process heat – Temperature requirement for each heat consumer – Energy reference area for each heat consumer – Date of connection ("in the first expansion stage", "in the final expansion stage") For the main heat consumers, indicate how the data was obtained (fuel consumption to date, calculation according to a given standard, measurement over a given period, estimation based on energy reference area, etc.).		
205	**System selection for heat production** The system selection made must be explained. The following main elements of heat production shall be described: – Monovalent or bivalent system: – Number of biomass boilers and their minimum and nominal thermal output with reference fuel (incl. flue gas condensation) – Selected furnace system for the biomass boiler (underfeed furnace, grate furnace, pellet furnace) – Number of other heat production units and their minimum and nominal heat output (incl. flue gas condensation) – With or without heat storage tank (if necessary, with storage volume) – Winter operation or all-year operation (low load operation) – If particle filters are used, they must be selected and designed according to the state-of-the-art technology (number, design, mode of operation, functional description with measurement and control concept).	E.4.1 State of the art E.4.2 Expansion options E.4.3 Heat, power and temperature requirements E.4.4 System selection **Table 15**	☐ As requested here
206	**Hydraulic scheme of heat production** The individual components and configurations should be specified: – thermal capacity – temperatures – flow rates	E.4.6 Hydraulics and MSR solution	☐ As requested here
207	**Hydraulic and control solution** In Milestone 2 an incomplete description of the standard hydraulic and control scheme can be accepted, but in Milestone 3 at the latest the definitive solution has to be presented. If possible, use a standard hydraulic scheme [2][5] following description: – Title page signed by the main planner – Chapter of the selected heat production – Chapter 9 for the description of the district heating grid (if applicable) If no standard hydraulic scheme is used, the description of the hydraulic and control scheme shall correspond to the description of the standard hydraulic scheme [2][5] terms of content and level of detail. In particular, the following is required: – Title page with the most important information signed by the main planner – Design of heat production – Hydraulic scheme with capacities, flows and temperatures – Control diagram (can be integrated in the hydraulic diagram) – Functional description of heat production – Description of data recording for operational optimisation	E.4.6 Hydraulics and MSR solution	☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	– Description of the district heating grid (if available) ☐ The hydraulic and control scheme is only available in Milestone 3→ The simplified version of QMstandard is not possible		
208	**Offer for fuel delivery (if there is an external fuel supplier)** With defined fuel and specifications of the delivery interval.	D.2 Obtaining a reference offer E.1.2 Check offer F Fuel definition	☐ No external fuel supplier ☐ Temporary plant owner document ☐ Document of main planner is available
209	**Installation plan of heating system** Including fuel storage and equipment for ash transport from the heating plant.	E.4.5 Fuel storage E.4.7 Ash disposal E.4.12 Execution	☐ As requested here
210	**Layout plan of fuel storage** The fuel storage system should be at least be included in "209 Installation plan of heating system". ☐ The drawing of the fuel storage is only available in Milestone 3→ The simplified version of QMstandard is not possible	E.4.5 Fuel storage	☐ As requested here
211	**Draft of heat supply contract (if heat is sold)** If a draft of the heat supply contract already exists, it should be enclosed. ☐ The draft of the heat supply contract is only available in Milestone 3. → Not possible with the simplified version of QMstandard	E.3.5 Interface heat supplier - heat consumer	☐ Heat is not being sold ☐ Temporary plant owner document ☐ Document of main planner is available
212	**EXCEL table for Q-plan** The completed EXCEL table for the Q-plan [9] must be submitted.	**Table 17** E.4.5 Fuel storage E.4.11 Specific investment costs	☐ As requested here
213	**Proof of economic profitability** The main planner shall provide the plant owner with the necessary planning data for the preparation of the economic profitability calculation and shall participate in the cost calculation and cost estimation in accordance with the specifications in the remuneration agreement of the country concerned. If the main planner is assigned to provide a detailed proof of economic profitability, this must be agreed in the engineering contract. Milestone 2 applies: – Proof of economic profitability according to the annuity method is required in all cases – For systems with a district heating grid, the preparation of a business plan is already recommended at that stage.	D.2 Services provided by the plant owner E.1.2 Main planner services	☐ Document of plant owner is available ☐ Document of main planner is available
214	**Time schedule** The schedule should include at least the following information: – Completion of tender planning (Milestone 3) – Start of execution – Commissioning and approval of the plant (Milestone 4)		☐ As requested here

Checklist documents Milestone 3

Prerequisite: Project phase 3 "Tender planning" completed

Purpose: Q-checks/Q-guidelines at "tender planning" level

Form: Written, meeting only when needed
→ A meeting with the Q-manager is to be additionally remunerated according to time and effort.

Documents: The plant owner hands over the necessary documents to the main planner so that he can prepare the required documents for the Q-manager.

Q-plan annex: The Q-manager creates the document for MS3 based on the information and documents submitted to him by the main planner:
– Possible deviations in the course of the project
– Result of the Q-checks
– Recommendations to the plant owner
→ A review of the content of the tender for the heat production plant by the Q–manager shall also be remunerated on a time and material basis.

Aim: Q-plan additional document MS3 with decision of the plant owner, which recommendations of the Q-manager are to be implemented, signed by plant owner, main planner and Q-manager

Note: This checklist is used by the main planner to compile the necessary documents and deliver them to the Q-manager; it must be marked and attached to the documents.

Selected procedure:
☐ **QMstandard** with all 5 milestones
☐ **QMstandard** with MS1, MS3, MS4 and MS5 (MS2 no longer possible)
☐ Simplified version of **QMstandard** with MS3 instead of MS2

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
301	**General system description** It is intended to give the outsider a quick overview of: – Purpose of the plant – Operating times (year-round, heating season only, etc.) – Heat production capacity , individual boiler capacity ☐ Document 201 meets the requirements and remains valid ☐ New document 301, because changes have occurred		☐ As requested here
302	**List of heat consumers** For each heat consumer must be specified: – Date of connection – Status ("contract signed", "open", etc.) – Annual heat requirement – At the start of construction, at least 70% of the annual heat requirement must be secured by signed heat supply contracts. – Minimum linear heat density for customers with "heat supply contract signed" and "heat supply contract probably signed upon commissioning": – Full-year operation 2.0 MWh/a per line metre – Heating period without water heating 1.0 MWh/a per route metre ☐ Document 202 meets the requirements and is still valid. ☐ New document 302, because changes have occurred	D.3 Contracts, declarations of intent E.1.1 Arrangements MS1	☐ Document of plant owner available ☐ Document of main planner available
303	**District heating grid (if available)** – Heating grid plan with location of the heating plant and routing of the heating grid – Net loss calculation	E.3 District heating grid	☐ No heating grid ☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	☐ Document 203 meets the requirements and is still valid. ☐ New document 303 because changes have occurred		
304	**Demand assessment and appropriate system selection** Use the EXCEL table [8]. Now is the latest opportunity to supply the following mandatory information unless otherwise agreed in Milestone 1: – Annual heat demand for each heat consumer including room heating, domestic hot water and process heat – Heat capacity for each heat consumer including space heating, domestic hot water and process heat – Temperature demand for each heat consumer – Energy reference area for each heat consumer – Date of connection ("in the first expansion stage", "in the final expansion stage") For the main heat consumers, indicate how the data have been obtained (fuel consumption to date, calculation according to a given standard, measurement over a given period, estimation based on energy reference area, etc.). ☐ Document 204 meets the requirements and is still valid. ☐ New document 304, because changes have occurred	E.2 Status-quo analysis	☐ As requested here
305	**System selection for heat production** The system selection must be explained. The following main elements of heat production shall be described: – Monovalent or bivalent system – Number of biomass boilers and their minimum thermal output and nominal thermal output with reference fuel (incl. flue gas condensation) – Selected furnace system for the biomass boiler (underfeed furnace, grate furnace, pellet furnace) – Number of other heat generators and their minimum heat output and nominal heat output (incl. flue gas condensation) – With or without heat storage tank (if necessary, with storage volume) – Winter operation or all-year operation (low load operation) – If particle filters are used, they must be selected and designed according to the state of the art (number, design, mode of operation, functional description with measurement and control concept). ☐ Document 205 meets the requirements and remains valid ☐ New document 305, because changes have occurred	E.4.1 State of the art E.4.2 Expansion options E.4.3 Heat, power and temperature demand E.4.4 System selection **Table 15**	☐ As requested here
306	Hydraulic scheme of heat production The individual components and configurations should be specified: – thermal capacity – temperatures – flow rates ☐ Document 206 meets the requirements and remains valid ☐ New document 306, because changes have occurred	E.4.6 Hydraulics and MCR solution	☐ As requested here
307	**Standard hydraulic scheme** The definitive solution must be submitted by Milestone 3 at the latest. If possible, use a standard hydraulic scheme [2][5] with the following description: -title page signed by the main planner -chapter of the selected heat production -Chapter 9 for the description of the district heating grid (if available) If no standard scheme is used, the description of the hydraulic and control scheme shall correspond to the description of the standard	E.3.2 Design of heating grid E.3.3 Key figures for heating grid E.4.6 Hydraulics and MCR solution	☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	hydraulic scheme [2][5] terms of content and level of detail. In particular, the following is required: – Title page with the most important information signed by the main planner – Design of heat production – Hydraulic scheme with capacities, flows and temperatures – Control scheme (can be integrated in the hydraulic scheme) – Functional description of heat production – Description of data recording for operational optimisation – Description of the district heating grid (if available) ☐ Document 207 meets the requirements and remains valid ☐ New document 307, because changes have occurred		
308	**Offer for fuel delivery (in the case of external fuel supplier)** With defined fuel and indication of the delivery interval. ☐ Document 208 meets the requirements and is still valid. ☐ New document 308, because changes have occurred	D.3 Offer E.1.3 Review offer F Fuel definition	☐ No external fuel supplier ☐ Temporary plant owner document ☐ Document of main planner available
309	**Installation plan of heating system** Including fuel storage and equipment for ash transport from the heating plant. ☐ Document 209 meets the requirements and remains valid ☐ New document 309, because changes have occurred	E.4.5 Fuel storage E.4.7 Ash disposal E.4.12 Execution	☐ As requested here
310	**Layout plan fuel storage** In Milestone 3 at the latest, the definitive disposition of the fuel storage facility with the following information must be submitted: - Delivery system - Storage roof / silo cover - Distribution system - Gross volume - Filling degree ☐ Document 210 meets the requirements and is still valid. ☐ New document 310, because there have been changes or the disposition of the fuel storage at Milestone 2 was not yet available.	E.4.5 Fuel storage	☐ As requested here
311	**Draft heat supply contract (in case of heat sale)** At Milestone 3 at the latest, the draft heat supply contract with the following additional components must be submitted: - General terms and conditions - Technical connection regulations ☐ Document 211 meets the requirements and remains valid ☐ New document 311, because changes have occurred, or the draft of the heat supply contract was not yet available at Milestone 2.	D.3 Preparation of heat supply contract E.3.5 Interface heat supplier - heat consumer	☐ No heat sales ☐ Document of plant owner available ☐ Document of main planner available
312	**EXCEL table for Q-plan** The EXCEL table for the Q-plan [9] must be submitted fully completed. ☐ Document 212 is up to date and still valid. ☐ New document 312, because changes have occurred	**Table 17** E.4.5 Fuel storage E.4.11 Specific investment costs	☐ As requested here
313	**Proof of economic profitability** The main planner shall provide the plant owner with the necessary planning data for the preparation of the economic profitability calculation and shall participate in the cost calculation and cost estimation in accordance with the specifications in the remuneration agreement of the country concerned. If the main planner is to provide a detailed proof of economic profitability, this must be agreed in the engineering contract. This applies to Milestone 3:	D.3 Services provided by the plant owner E.1.3 Main planner services	☐ Document of plant owner available ☐ Document of main planner available

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	- For systems without a district heating grid, at least a proof of economic profitability according to the annuity method is required. - For systems with a district heating grid, the preparation of a business plan with budgeted balance sheet and budgeted income statement is mandatory. ☐ Document 213 meets the requirements and remains valid ☐ New document 313, because changes have occurred		
314	**Time schedule** The schedule should include at least the following information: - Start of execution - Commissioning and approval of the plant (Milestone 4) ☐ Document 214 is up to date and still valid. ☐ New document 314, because changes have occurred		☐ As requested here
315	**Subsequent delivery of tender for heat production plant** The tender for the heat production plant is normally not yet available for Milestone 3, but it is possible to agree on its subsequent delivery to the Q-manager (see Q-plan main document). A review of the content of the tender for the heat production plant by the Q-manager shall also be remunerated on a time and material basis.	E.1.3 Main planner services	☐ No subsequent delivery was agreed ☐ The subsequent delivery takes place on:

Checklist documents Milestone 4

Prerequisite: Project phase 4 "Tendering and Contracting" completed

Project phase 5 "Execution and approval" completed

Purpose: Q-checks/Q-control at the level of "approval"

Form: Written, meeting only when needed
→ A meeting with the Q-manager is to be additionally remunerated according to time and effort.

Documents: The plant owner hands over the necessary documents to the main planner so that he can prepare the required documents for the Q-manager.

Q-plan annex: The Q-manager creates the document for MS4 based on the information and documents submitted to him by the main planner:
– Possible deviations in the course of the project
– Result of the Q-checks
– Recommendations to the plant owner

Aim: Q-plan annex MS4 with decision of the plant owner, which recommendations of the Q-manager are to be implemented, signed by plant owner, main planner and Q-manager

Note: This checklist is used by the main planner to compile the necessary documents and deliver them to the Q-manager; it must be marked and attached to the documents.

Selected procedure: ☐ **QMstandard** with all 5 milestones
☐ **QMstandard** with MS1, MS3, MS4 and MS5 (MS2 no longer possible)

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
404	**Demand assessment and appropriate system selection** The EXCEL table (document 204 or 304) must be updated to the time of commissioning and approval of the plant. In particular, the time of connection ("connected", "connection to... ") must be specified for each heat consumer. ☐ Document 204 meets the requirements and is still valid. ☐ Document 304 meets the requirements and is still valid. ☐ New document 404, because changes have occurred	E.2 Demand assessment and appropriate system selection	☐ As requested here
408	**Fuel supply contract (in case of the existence of external fuel supplier)** The final fuel supply contract valid at the time of commissioning and approval must be submitted. ☐ Document 208 meets the requirements and is still valid. ☐ Document 308 meets the requirements and remains valid ☐ New document 408, because changes have occurred	E.1.4 Review offer F Fuel definition	☐ No external fuel supply ☐ Temporary plant owner document ☐ Document of main planner available
411	**Heat supply contract (in case of heat sale)** The signed heat supply contract of one affiliated heat consumer with the General Terms and Conditions, the Technical Connection Regulations and the Tariff List must be submitted. ☐ Document 211 meets the requirements and remains valid ☐ Document 311 meets the requirements and remains valid ☐ New document 411, because changes have occurred	E.3.5 Interface heat supplier - heat consumer	☐ No heat sales ☐ Document of plant owner available ☐ Document of main planner available
412	**EXCEL table for the Q-plan**	**Table 17**	☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	As a rule, no changes should have occurred in the "planning" column since Milestone 3. If this is the case, it must be reported to the Q-manager. ☐ No changes ☐ New document 412, because changes have occurred		
421	**Contract for biomass boiler** Copy of the contract with the supplier(s) of the biomass boiler(s). Comparable documents can also be submitted, e.g. the corresponding extract from the tender documents. For each biomass boiler, this should indicate the range of fuels with which the biomass boiler, including fuel transport system, works reliably and which nominal output is achieved with the agreed reference fuel.	E.4.9 Invitation to tender E.4.10 Choice of supplier	☐ As requested here
422	**Approval certificates** Copies of the inspection reports of the biomass boiler(s), the heating installation and the heating grid. For the assessment of the biomass boiler nominal output(s) with reference fuel, a power measurement over 1 hour in stationary operation should be available (if necessary, with temporary heat exchanger for heat dissipation).	E.6.1 Approval	☐ As requested here
423	**Addition to approval report** Important settings of the heat production system must be recorded in an "Annex to the approval report". If the hydraulic and control scheme for the heat production were implemented using a standard hydraulic scheme, the corresponding "Addition to the approval report" must be used for the approval test. If no standard hydraulic scheme is used, an addition to the approval protocol must be created which is structured analogously to the addition of a standard hydraulic scheme.	E.6.2 Addition to the approval report	☐ As requested here
424	**Concept for operational optimisation** It must be clear from the concept when, by whom and which operating data are recorded and evaluated. In addition, it shall be evident that the operation optimisation is carried out as required below. The concept for operational optimisation (incl. contract for implementation) must be signed by the plant owner and the main planner. Requirements for operational optimisation: At the end of the first year of operation, the recorded data must be used to show whether the plant could be operated optimally in the various operating conditions for one week each. Optimum operation means that the functions of the system are carried out in accordance with the functional description and that the control parameters of the individual control loops are optimally set and matched to each other. Evidence shall be provided in the form of weekly and daily diagrams of selected days for the load conditions described below. In addition, the document "Addition to the approval report" must be updated. Minimum operating states to be recorded: Monovalent single boiler: - Period with low load operation - Main heating period, outside temperature on average 0...10°C - Cold heating period, average -5...-10°C Bivalent two-boiler system: - Biomass boiler operation in medium / low load period (autumn / spring) - Main heating period, outside temperature on average 0...10°C - Cold heating period, on average -5...-10°C with cascade operation of the oil / gas boilers. - Possible summer operation with biomass boiler Monovalent two-boiler systems:		☐ As requested here

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
	- Biomass boiler operation in medium / low load period - Main heating period, outside temperature on average 0...10°C with cascade operation of biomass boilers - Cold heating period, on average -5...-10°C with cascade operation of biomass boilers - Possible summer operation with the small biomass boiler Bivalent multi-boiler systems: - Biomass boiler operation in medium / low load period - Main heating period, outside temperature on average 0...10°C with cascade operation of biomass boilers - Cold average heating period -5...-10°C with cascade operation of biomass and oil / gas boilers - Possible summer operation with the small biomass boiler The selection of the operating states for systems with process heat demand is to be carried out analogously to the criteria listed above. This means that the following operating states must be verified: - Low load operation - Main operating mode - Cascade operation - Operation at maximum heat capacity - Extraordinary operating conditions (e.g. summer operation, start-up phase on Monday mornings, etc.)		
425	**Company organisation concept** Description of the company organisation with a list of the persons involved and definition of responsibilities.	D.4	☐ As requested here

Checklist documents Milestone 5 (final meeting)

Prerequisite: Project phase 6 "Operation optimisation" completed

Purpose: Q-checks and conclusion of QM biomass heating plants after at least one year of operation (final inspection)

Form: If possible, a final meeting should be held.

Documents: The plant owner hands over the necessary documents to the main planner so that he can prepare the required documents for the Q-manager.

Q-plan annex: The Q-manager creates the document for MS5 based on the information and documents submitted to him by the main planner. This is the final document of the quality management process:
- Possible deviations in the course of the project
- Result of the Q-checks (in particular the success of the operational optimisation)
- Recommendations to the plant owner on how to proceed (especially if the quality requirements agreed in the Q-plan have not been met in essential parts)

→ An examination of the contents of the plant documentation and/or further support by the Q-manager must be additionally remunerated on a time and material basis.

Goal: Q-plan additional document MS5 as final document with decision of the plant owner, which recommendations of the Q-manager are to be implemented, signed by plant owner, main planner and Q-manager

Note: This checklist is used by the main planner to compile the necessary documents and deliver them to the Q-manager; it must be marked and attached to the documents.

Selected procedure:
- ☐ **QMstandard** with all 5 milestones
- ☐ **QMstandard** with MS1, MS3, MS4 and MS5 (MS2 no longer possible)
- ☐ Simplified version of **QMstandard** with milestones MS1, MS2 and MS5
  → Missing documents of the omitted milestones must be submitted later.
- ☐ Simplified version of **QMstandard** with MS1, MS3 (instead of MS2) and MS5
  → Missing documents of the omitted milestones must be submitted later.

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
504	**Demand assessment and appropriate system selection** The EXCEL table (document 404) must be updated to the time of the final inspection after at least one year of operation and shall in any case be submitted again. It must be clear which heat consumers are currently connected to the heat production system. In the case of heat consumers not yet connected, it must be stated whether and when a connection is planned and whether this is contractually agreed.	E.2 Status-quo analysis	☐ As requested here
512	**EXCEL table for Q-plan** No more changes may be made in the "Planning" column in comparison to the entries at Milestone 4. For Milestone 5, the results of the first year of operation must be entered in the grey input fields of the "Actual, MS5" column. Assessment by the main planner: The main planner must compare the data "Planning" and "Actual, MS5". Any deviations must be commented. This also applies to the key figures calculated from the input data.	**Table 17**	☐ As requested here
513	**Cost compilation and proof of economic profitability** A cost summary and an economic profitability calculation for the first year of operation must be submitted.	D.5 Services provided by the plant owner E.1.5 Main planner services	☐ Temporary plant owner document ☐ Main planner document available

No. additional document	Description of documents	Requirements Chapters A to F	☑ Comments
523	**Addition to approval report** The updated "Addition to the approval report" corresponding to the actual condition must be submitted.	E.6.2 Addition to the approval report	☐ As requested here
531	**Plant documentation** The Q-manager must be provided with the table of contents of the system documentation, signed and completed, and updated. If a final meeting is held, the complete investment documentation must be brought to this meeting. Only the completeness of the system documentation is checked; for a content check, the Q-manager is additionally remunerated on a time and material basis.	E.1.5 System documentation E.5 System documentation	☐ As requested here
532	**Report on operational optimisation** The main planner has made statements about – whether the system functions as intended, - if there are still shortcomings or open questions, and - when and how any shortcomings can be remedied, and open questions answered. The main planner must answer the following questions in particular: – Is it proven that the biomass boiler achieves the contractually agreed minimum and maximum output? – Does the biomass system work in discontinuous operation (transition period, summer) without unpleasant smell? – Is the combustion capacity adjusted according to the demand without causing fluctuations of the thermal power output? – Does the output control work in such a way that the biomass boiler is always operated at the lowest possible output level? – For bivalent systems: If the oil / gas boiler is turned on, will it shut down again as soon as there is no further demand? – Do the measured temperatures correspond to the planning values and show a stable behaviour? Data acquisition: In order to interpret and assess the data collected in accordance with the operational optimisation concept (document 424), it is essential to present the data graphically. The following requirements should be met: – Representation of a weekly trend – Representation of a daily trend for selected days – It must be possible to present the most important data together on a single diagram. – The time axis and y-axis are divided and labelled so that numerical values can be easily read (e.g. for the time 14.00, 16.00 etc.; for the power 500, 550, 600 kW etc.; for the temperatures 40, 60, 80°C etc.). Nominal biomass boiler output(s) with reference fuel: For the evaluation a power measurement over 1 hour in stationary operation should be available (if necessary, with temporary heat exchanger for heat dissipation).	E.7 Implementation of operational optimisation	☐ As requested here
533	**Emission measurement of biomass boiler** An appropriate measurement protocol must be available.	E.7.1	☐ As requested here
Submission of missing documents	If the simplified version of QMstandard has been implemented, the missing documents of the omitted milestones must be submitted, in particular those of Milestone 4: ☐ 408 Fuel supply contracts (in case of an existence of external fuel supplier) ☐ 411 Heat supply contracts (in case of heat sale) ☐ 421 Work contracts for biomass boiler ☐ 422 Approval reports ☐ 424 Concept for operational optimisation		☐ Not applicable ☐ Checked documents as required

Q-plan (Main Document and Annex)

Note: The EXCEL table for the Q-plan, which is required in the Q-plan annex, can be downloaded from the Internet (www.qmholzheizwerke.ch). **Table 17** shows the EXCEL table with a numerical example.

Project short name or project number	TEMPLATE EUR			
			Plan	Is, MS5
Heat demand of all heat consumers		MWh/a	398	
of which via the heating grid		MWh/a	306	
District heating grid losses		MWh/a	30	
Total heat demand (incl. district heating grid losses)		MWh/a	428	
Heat capacity of all heat consumers		kW	209	
of which via the heating grid		kW	143	
Heat losses district heating grid		kW	13	
Total heat capacity		kW	222	
Length of district heating grid (incl. house connections)		Trm	224	
Nominal power of the biomass boiler(s) with reference fuel		kW	239	
Nominal power of the heat production with other energy sources: ……		kW	99	
Total nominal power of heat production		kW	338	
Percentage of heat produced from biomass		%	87	
Heat produced from biomass		MWh/a	372	
Net size of the storage silo		m^3	76	
Filling level of the storage silo		%	80	
Gross size of the storage silo		m^3	95	
Energy content per cubic meter		kWh/LCM	750	
Annual fuel consumption of the biomass boiler(s)		LCM	584	
Costs				
Investment costs of heat production		EUR	395,500	
Investment costs of heating grid		EUR	124,500	
Temperature specification in the design point				
Temperature of the main supply flow		ºC	80	
Temperature of the main return flow		ºC	60	
Key figures	**Agreed value**			
E.2.6 Full load operation hours of the heat consumers	-	h/a	1,904	
E.3.3 Linear heat density		MWh/(a.Trm)	1.4	
E.3.3 District heating grid losses (% of the heating demand of the customers)		%	10	
E.3.3 District heating gird losses (% of the delivered heat)		%	9	
Heat distribution cost per Trm		EUR/Trm	556	
E.3.3 Specific investment costs of heating grid		EUR/(MWh/a)	407	
E.4.10 Specific investment costs of heat production		EUR/kW	1,782	
E.4.4 Total full load operating hours of the biomass boiler(s)		h/a	1,558	
E 4.6 Total full load operating hours of other heat production units		h/a	562	
E.4.5 Storage silo size: coverage of full load operation for number of days (+ 30 LCM)		days	5	
The fields with a grey background are input fields				

Table 17

Q-plan: Main Document

Short project name .....
.....
Project number .....

Recommended procedure: 1) Joint preparation of the main document by all parties involved under the direction of the Q-manager at the kick-off meeting "Establishment of QM for Biomass DH Plants and Q-planning" (Milestone 1). 2) Signed by all participants at the meeting.

Integrating component	Q-guide for QM for Biomass DH Plants (same structure as this Q-plan) version: .....

A Project participants

A. 1 Project	Plant name: ..... Plant address: .....
	Plant owner: ..... Address: .....
A.2 Responsible for QM for Biomass DH Plants	Authorized representative of the plant owner: ..... Address: ..... Phone: .....Fax: ..... E-mail: .....
	Q-manager: ..... Address: ..... Phone: .....Fax: ..... E-mail: .....
A.3 Main planner	Company: ..... Address: ..... Person in charge: ..... Phone: .....Fax: ..... E-mail: .....
A.4 Funding agency	Designation: ..... Address: .....

B Establishment of Quality Management for Biomass District Heating Plants

The undersigned agree on the establishment of QM for Biomass DH Plants as follows:

B.1 ☐ Tasks and duties of the Q-manager according to the Q-guidelines

☐ Exceptions: .....

Remuneration of the Q-manager:

☐ Offer: .....☐ Cost ceiling: ..... ☐ Hourly rate: .....

B.2 ☐ Tasks and duties of the main planner according to the Q-guidelines

☐ Exceptions: .....

B.3 ☐ Tasks and duties of the plant owner according to the Q-guidelines

☐ Exceptions: .....

C Project flow with milestones

The undersigned agree the project schedule with milestones as follows:

C. 1 ☐ QMstandard with the milestones (if necessary, without MS2, if this is no longer possible)

☑ MS1 ☐ MS2 ☑ MS3 ☑ MS4 ☑ MS5

C. 2 ☐ Simplified version of QMstandard with the 3 milestones (possibly MS3 instead of MS2)

☑ MS1 ☐ MS2 ☐ MS3 ☑ MS5

D Plant owner Services

The plant owner agrees to provide the following services:

Chapter	Area	According to Q-guidelines	
		Unchanged	With the following exceptions
D.1	Services related to Milestone 1	☐	☐
D.2	Services related to Milestone 2	☐	☐
D.3	Services related to Milestone 3	☐	☐
D.4	Services related to Milestone 4	☐	☐
D.5	Services related to Milestone 5	☐	☐

E Services and Q-requirements of the main planner

The main planner agrees to provide the following services and the associated Q-requirements:

Chapter	Area	According to Q-guidelines		
		Unchanged	with the following exceptions	Appointment documents
E.1.1	Services related to Milestone 1	☐	☐	
	Is a standard hydraulic scheme used? ☐ yes ☐ no ☐ not yet known If so, which ones? Target values: Heat losses of heating grid ..... % spec. invest heating grid ..... EUR/(MWh/a) Min. linear heat density ..... MWh/(a.Trm) invest of heat production ..... EUR/kW			
E.1.2	Services related to Milestone 2	☐	☐	
E.1.3	Services related to Milestone 3	☐	☐ Subsequent delivery tender for heat production agreed ☐ No content check ☐ Content check according to time and effort ☐	
E.1.4	Services related to Milestone 4	☐	☐	

E.1.5	Services relate to Milestone 5	☐	☐	

F Fuel definition

The main planner shall ensure that the following fuel types are included in the biomass boiler supplier's contract and in the fuel supply contract:
Relevant reference fuel for the design of the biomass boiler: .....
.....

Possible additional fuels: .....
.....

QM Holzheizwerke QMstandard

Q-plan: Annex

Short project name: Example for MS2
.....
Project number: .....
Milestone: 2 .....

Recommended procedure: 1) Preparation of the annex by the Q-manager on the occasion of each milestone, if necessary, in consultation with the main planner. 2) Decisions and signature of the plant owner. 3) Acknowledgment and signature of the main planner. 4) Signature of the Q-manager.

G Submitted documents

☐ The planning data (also updated values in MS 5) was submitted as an EXCEL table.
☐ All other required documents have been submitted

☐ The following documents are missing: .....
.....
.....

H Examination of the previous project process

☐ The previous project procedure was carried out according to the main document or previous additional documents.

☐ The previous project procedure deviates (with description of the consequences): .....
.....
.....

J Quality inspection on the basis of the documents submitted

The following statements refer to the submitted documents and are based on the assumption that the project is actually planned or performed according to these documents (no on-site inspection).
☐ No deviations from the agreed quality were found.
☐ Insignificant deviations from the agreed quality were found
☐ Significant deviations from the agreed quality were identified

Deviations from the agreed quality are subsequently recorded and the Q-manager makes recommendations for further action. The plant owner then has to decide whether the recommendations are to be implemented by ticking the appropriate boxes.

The following consent to the above listed agreements

The representative of the plant owner	**The main planner**	**The Q-manager** (documented in the official register of "QM Holzheizwerke")
Place and date: ..... Signature:	Place and date: ..... Signature:	Place and date: ..... Signature: .....

Numbers	Assessment and recommendation of the Q-manager	Plant owner's decision
201 201.1 201.2	**General system description** Documents relevant to the assessment: Example document 1 Example document 2	
	Assessment: sample text	
E201.1	Recommendation 1: sample text	realisation ☐ yes ☐ no
E201.2	Recommendation 2: sample text	realisation ☐ yes ☐ no
202	**List of heat consumers** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
203	**District heating grid** (if available) Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
204	**Demand assessment and appropriate system selection** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
205	**System selection of heat production** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
206	**Hydraulic scheme of heat production** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
207	**Standard hydraulic schemes** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
208	**Target quotation for fuel supply** (in case of external fuel supplier) Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
209	**Heating system installation plan** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
210	**Layout plan fuel storage** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
211	**Draft of heat supply contract** (if heat sale) Documents relevant to the assessment:	
	Assessment:	

Numbers	Assessment and recommendation of the Q-manager	Plant owner's decision
	Recommendation:	
212	**EXCEL table for Q-plan** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
213	**Proof of economic profitability** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	
214	**Time schedule** Documents relevant to the assessment:	
	Assessment:	
	Recommendation:	

K Final assessment by the Q-manager

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The plant owner's authorised representative confirms the implementation of the marked recommendations and accepts the resulting changes from previous agreements. Place and date: ..... Signature:	**The main planner** confirms the acknowledgement of the report and will see to the implementation of the changes listed above. Place and date: ..... Signature:	**The Q-manager** (documented in the official register of "QM Holzheizwerke") confirms the correct execution of the Q-check according to the Q-guidelines. Place and date: ..... Signature: .....


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