Final Report

Raising the efficiency of new heating systems (BOILeff)

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Executive Summary

Space heating is the largest component of energy consumption in households in virtually all member states, accounting for 67 % at the level of the EU 15, followed by water heating and appliances. [1]

Demonstrations based on laboratory analyses show that new condensing boilers achieve efficiencies of more than 100 %, both for gas and oil boilers. This contrasts with results of field studies in real conditions which show that the seasonal efficiencies of boilers are up to 15 – 20 % lower than under optimal conditions in demonstration cases. [2],[4] While new condensing boilers are already highly efficient with little room for improvement, the installations of heating systems still offer broad opportunities for efficiency improvements. This observation could also be verified by the German research project "Optimus" which dealt with the optimization of installed heating systems. [3]

The general objective in the first project phase was to gather and condense information on existing boiler installations with a focus on the actual quality of these installations resp. on failures and mistakes that are commonly made leading to a decrease of the efficiency of these heating systems. The following tasks were performed [6]-[9]:

- Literature analysis of studies and field test reports dealing with boiler efficiencies in practice
- Interviews with market actors
- Analysis of typical weaknesses of boiler installations by performing of 75 audits in Austria, Germany, Hungary, Spain and Greece

The audits revealed the following installation weaknesses:

- Incorrect boiler sizing – no heat load calculation performed (66 % of the analysed heating systems)
- Too high exhaust gas losses, surface losses and/or ventilation losses (72 %)
- Insufficient insulation of armatures and pipes (93 %)
- Missing control systems, e.g. thermostatic valves, etc. (57 %)
- No hydraulic balance performed (95 %)
- …

In total 27 major weaknesses were identified, summarised, published in a list and communicated to the national stakeholder groups (installers, end-consumers, etc.) in order to raise the awareness concerning energy efficient heating systems.

Starting from the observation that there exist serious shortcomings in common heating system installations, the project consortium consisting of the project partners Austrian Energy Agency (Austria), Wuppertal Institute (Germany), Innoterm (Hungary), the Regulatory Authority for Energy RAE (Greece), and the University of Rovira i Virgili (Spain) initiated a project to improve the quality of new boiler installations by developing and testing of two new market approaches.

The first market instrument is called "Declaration of High Quality Installation" (DHQUI). This declaration is included in the contract between installers and end consumers. It provides a checklist of quality criteria for a high quality installation. The second instrument is called "Guaranteed Performance Quality" (GPQU). The installer should be able to pledge a certain seasonal efficiency of his high quality installation.

The following main criteria of the heating system based on a condensing boiler were identified to be essential for the seasonal efficiency of an optimally installed boiler[1]:

1. Is the boiler located inside or outside the heated area?
2. Is the boiler equipped with a bypass valve?
3. Are radiators or panel heating systems used?
4. Is the boiler fuelled by gas or oil?

By the following formula the installer can forecast the seasonal efficiency of an optimally installed gas or oil fuelled condensing boiler in the GPQU.

$$\eta_a = 89\% * (1 - 3\%*O) * (1 + 4\%*I) * (1 - 3\%*V) * (1 - 1{,}5\%*W) \quad (1)$$

The four parameters (O, I, V und W) have to be chosen by the installer according to the specific heating system:

Oil fuelled condensing boiler			**O** =1	Gas fuelled condensing boiler	**O** = 0
Boiler located inside heated area			**I** = 1	Boiler located outside heated area	**I** = 0
Boiler equipped with bypass valve			**V** = 1	Boiler without bypass valve	**V** = 0
Radiators	**W** = 1	Panel heating	**W** = –1	Radiators and panel heating	**W** = 0

Both approaches (DHQUI and GPQU) were tested and evaluated by field tests under real conditions in the heating period 2008/2009. For the field tests, typical residential buildings with heat loads up to 20 to 25 kW have been taken into account.

In total, metering results were achieved in 23 gas heating systems, 3 oil heating systems and 3 biomass heating systems in Austria, Germany and Hungary. In average, the gas heating systems achieved a seasonal efficiency of 87,9% (GCV)[2], the two oil heating systems 85,0% (GCV), the pellets system 90,6% (NCV[3]) and the firewood boiler 74,2% (NCV). BOILeff installations outperform standard systems (stock consideration) by 11,9 (gas), 10,0 (oil), 16,6 (pellets) resp. 7,2 (firewood) percentage points. Due to the low number of heating systems with oil and different biomass technologies (and biomass fuels), for comparison reasons, an in-depth analysis was carried out for gas heating systems.

The 8 Austrian test cases show a maximum deviation of 3 percentage points of the determined seasonal efficiency compared to the calculated value in the GPQU. Due to this fact a security band for the guaranteed seasonal efficiency of 3 percentage points may be considered. Unfortunately two Hungarian test cases show a negative deviation of 5% resp. 5,6%. Accordingly, for Hungarian heating systems a larger security band (up to 6%) must be suggested. Taking into account that a random choice of condensing boilers on a different price and efficiency level installed by different installers took place, it may be further concluded that installers using certain brands and models (of this brand) will outperform GPQU values in either case (based on DHQUI installations)(!)

Although, the validation of both concepts could be achieved within the project a full validation and quantification of effects including the different boiler brands and models and also the different installa-

[1] Optimal installation means that the installation fulfils the criteria of the “Declaration of High Quality Installation”.

[2] GCV is the abbreviation for gross calorific value, also known as higher heating value.

[3] NCV is the abbreviation for net calorific value, also known as lower heating value.

tion qualities would need a large-scale field test. The validation for interested installers – as already mentioned above – knowing best their installed boiler brands and models – may be achieved much easier by using their normal or slightly adapted business models.

The following parameters contribute positively to the seasonal efficiency: (i) boiler is placed in the heated area, (ii) boiler has no bypass valve, (iii) heat dissipation by floor heating system, and (iv) additional solar thermal system. Positive correlations to the seasonal efficiency were analysed for the following parameters: (i) increasing heat and work load, (ii) low overdimensioning, (iii) low domestic hot water demand, and (iv) high energy demand. Problems could be identified in test cases with low heat loads. In these cases boilers are often overdimensioned; sometimes installers did not care to perform heat load calculations or there was no suitable boiler model available.

The field tests revealed also improvement potential of present heating systems, the following recommendations to the boiler manufacturers could be derived:

- Improvement of the hydraulics of small wall-mounted and floor-standing compact boilers
- Installation of measurement devices in heating systems for achieving automated energy balances
- Reduction of the auxiliary electrical energy consumption in small heating systems for detached and semi-detached houses
- Improving the overall efficiency of integrated heating systems, especially heating systems in combination with thermal solar systems and/or other RES systems for hot water generation and space heating

In-depth analysis of 14 gas heating systems showed annual energy savings of 106.708 kWh (Ø 7.789 kWh per test case in average for Austria, Ø 7.400 kWh per test case in Hungary); including the 2 oil and the 2 biomass systems the savings accumulate to 140.206 kWh. The CO_{2eq} emissions of the Hungarian test cases were reduced by 8.441 kg/a (Ø 1.407 kg/a per test case), in Austria the reduction amounts to 15.765 kg/a (Ø 1.971 kg/a per test case). In total, the CO_{2eq} savings amount to 24.206 kg/a (Ø 1.729 kg/a per test case), which is reduction of almost 30% on average.

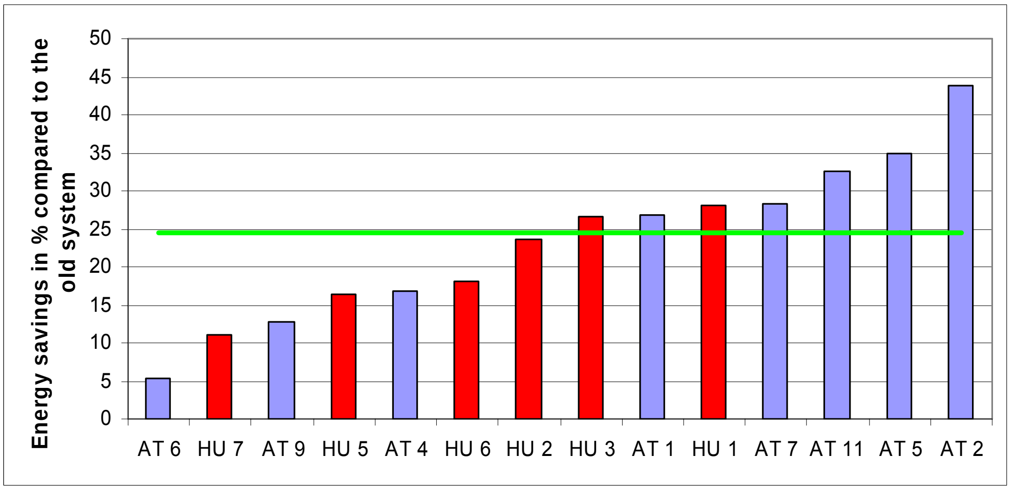

Figure 1 Energy savings in % compared to the old systems; the 6 Hungarian results are coloured red, the 8 Austrian are blue; the energy savings on average are indicated by the green line. AT stands for Austrian test cases, HU for Hungarian ones. The numbers correspond to the consecutive numbers of the field test objects (Source: Austrian Energy Agency)

In Austria, presently approximately 62,545 GWh/a are required for space heating and domestic hot water. The Austrian Energy Agency assumes final energy savings of up to 13.3% by a total exchange of the heating stock by BOILeff installations. This correlates to a possible reduction of greenhouse gas emissions of up to 4.74 Mio. t per year. Final energy savings of 4,300 GWh/a and a reduction of greenhouse gas emissions of 890,000 kg/a can be achieved. Innoterm expects energy savings of 3,200 MWh/year in Hungary. URV Crever estimates annual energy savings of about 350 MWh/year in Spain.

The assessment of the two new proposed market approaches based on a questionnaire exercise including 64 boiler owners and 35 installers came to the following results. The customers as well as the installers regard the DHQUI approach as realistic whereas the GPQU is only partly agreed with at the moment. It seems that too many questions are still open (e.g. the open question regarding an independent arbitrator in case the guaranteed efficiency is not achieved).

Generally the agreement in Austria and Germany is higher than in Hungary, Greece and Spain but the customers' motivation to implement a high quality installation matches the installers' in all participating countries: Customers want a high quality installation to save greenhouse gas emissions and money, installers see the possibility to extend their business activities via a clear differentiation from cheap installations.

Because of the higher installation quality, both the customers and the installers expect fuel savings between 5 % and 30 %. The customers principally accept additional costs, which will result from DHQUI and GPQU, though there are some differences between countries regarding the amount of the additional costs. It is agreed that additional costs could be reduced partly by the general integration of heat and electricity meters into the heating system.

The following problems have to be overcome for the future implementation: Insufficient transparency of the installation quality for customers, more personal and time efforts for acquisition and higher efforts for the initial setup by installers.

These obstacles can partly be overcome by the installation of an independent arbitrator, who can mediate in case of problems. Nearly all customers and installers in the participating countries agree to such an institution, though big differences and uncertainties exist concerning the question which institution or person could execute such a role.

An important measure to overcome insufficient transparency for the customer and to reduce time efforts for acquisition of the installer could be the invention of a “Guaranteed Installation Quality Label” for installers who are certified to carry out high quality installations. All customers in the participating countries agree, the installers generally agree as well but show a different grade of agreement in the different countries: Austria 50 %, Germany, Hungary, Spain 70 % to 80 % and Greece 100 %.

The BOILeff activities could contribute to a new voluntary measure to increase the energy efficiency in heating systems and could build-up on article 8 (inspection of boilers and heating systems) of EPBD and relate to LOT1 & 2 of the Ecodesign Directive.

1 Introduction

Space heating is the largest component of energy consumption in households in virtually all member states, accounting for 67 % at the level of the EU 15, followed by water heating and appliances. [1]

Demonstrations based on laboratory analyses show that new condensing boilers achieve efficiencies of more than 100 %, both for gas and oil boilers. This contrasts with results of field studies in real conditions which show that the seasonal efficiencies of boilers are up to 15 – 20 % lower than under optimal conditions in demonstration cases. [2],[4] While new condensing boilers are already highly efficient with little room for improvement, the installations of heating systems still offer broad opportunities for efficiency improvements. This observation could also be verified by the German research Project “Optimus” which dealt with the optimization of installed heating systems. [3]

Starting from the observation that there exist serious shortcomings in common heating system installations, the project BOILeff was initiated by the consortium consisting of the project partners Austrian Energy Agency (Austria), Wuppertal Institute (Germany), Innoterm (Hungary), the Regulatory Authority for Energy RAE (Greece), and the University of Rovira i Virgili (Spain) in order to improve the quality of boiler installations by developing and testing of two new market approaches.

The first market instrument is called: “Declaration of High Quality Installation” (DHQUI). This declaration is included in the contract between installers and end-consumers. It provides a checklist of quality criteria for a high quality installation. The second instrument is called: “Guaranteed Performance Quality” (GPQU). The installer should be able to pledge a certain seasonal efficiency of his high quality installation. A field test of about 50 installations during the heating period 2008/2009 was foreseen in Austria, Germany, Hungary, Spain and Greece to evaluate the practicality and effectiveness of both new approaches.

2 Typical weaknesses of boiler installations

The general objective in the first project phase was to gather and condense information on existing boiler installations, with a focus on the actual quality of these installations resp. on failures and mistakes that are commonly made leading to a decrease of the efficiency of heating systems. The following tasks were performed: [6]-[9]

- Literature analysis of studies and field test reports dealing with boiler efficiencies in practice
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The audits revealed the following installation weaknesses:

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- No hydraulic balance performed (95 %)
- …

In total 27 major weaknesses were identified, summarised, published in a list and communicated to the national stakeholder groups (installers, end-consumers, etc.) in order to raise the awareness concerning energy efficient heating systems (see next table).

Table 1 List of failures and shortcoming with respect to boiler installations

1.	Oversized boiler
2.	No or insufficient isolation of the boiler
3.	No lock valves at the boiler (at inflow and outflow)
4.	No operating hour counter
5.	Boiler in stand by operation mode during the summer period, even if no hot water production is needed
6.	Oversized circulation pumps
7.	Circulation pumps without control system and adjusted on highest power level
8.	No or insufficient isolation of the circulation pumps
9.	Continuous operation of the circulation pumps (over whole heating season or even over the whole year)
10.	No hot water storage tank installed
11.	Too high temperature in hot water storage tank
12.	Insufficient isolation of hot water storage tank
13.	No thermal layered hot water storage tank used
14.	Size of hot water storage tank not adapted to the actual demand
15.	No control system integrated in the heating system (only on/off operation, no specified heating periods, no night set-back of boiler or circulation pumps)
16.	Wrong adjustment of flow temperature (adjustment of the heating curve usually too high)
17.	No temperature control devices at hot water flow and return flow
18.	No or insufficient isolation of pipes in the heating room

19.	Too long time periods between maintenance services (no maintenance service in the last three years)
20.	No thermostatic valves installed at the radiators
21.	Radiators partly sheeted by furniture
22.	Air in the heating circuit (pipe system)
23.	Indoor temperature sensor placed inadequate (e.g. placed in a room with a second heating system)
24.	Outside temperature sensor placed inadequate (e.g. sensor placed at direct solar radiation)
25.	Control system for summer/winter operation not adjusted
26.	No hydraulic balance of the heating system is/was performed
27.	Heat water circuit connected direct to the public water pipe system (the specific preparation of heat water isn't possible)

A summary of results both of performed audits and typical weaknesses is available in [10] und [11].

These results were also the basis for developing of the Declaration of High Quality Installation (DHQUI; see the following section) and the Performance Guarantee Modules (GPQU; see also the following section).

3 High Quality Declaration (DHQUI) and Performance Guarantee (GPQU)

3.1 General

Due to missing information in "regular" quotations of installers, the end-consumer is not able to evaluate the efficiency of a new heating system. The main selection criteria for the system and the installer is the price. Consequently, most end-consumers choose the cheapest offer which is usually not the most efficient one. In the frame of BOILeff project two instruments were developed in order to visualise how an optimum of efficiency can be achieved. The first one is a **Declaration of High Quality**; the second one is a **Performance Guarantee** for highly efficient installations. These two services are supposed to help to establish energy efficient heating system as a second criterion for the end consumers´ choice beside the investment costs.

The Declaration of High Quality (DHQUI) contains the main quality criteria for an optimal refurbishment or new installation of a heating system. The compliance of these quality criteria should become part of the quotation of the installers to the end-consumers. This is not only beneficial for the customer but also for the installer, who will be able to prove the value of his work which allows to differ from cheap "inefficient" installations.

By the use of the Performance Guarantee the installer has the possibility to guarantee the end-consumer a certain (high) value for the seasonal efficiency of his new efficient heating system.

3.2 High Quality Declaration (DHQUI)

The typical business case of BOILeff installations (residential buildings with a nominal heat load of about 20 to 25 kW) includes the modernisation of old heating systems. When the heating system breaks down and the building owner receives the information from the installer that a repair service is very expensive and doesn't pay off any more, then the developed BOILeff services should take place.

An end-consumer can usually only judge the investment costs for his future heating system. He is not in the position to evaluate the quotation whether the new heating system will perform in an energy efficient way or not. The end-consumer receives in the quotation only information about components, materials and a summary of working hours (in the best case) necessary to install the new heating system or to make changes in the old system.

For this reason, the end-consumer can evaluate the quotations only according to the price, not to the quality. Consequently, installers have difficulties to establish quality-orientated business models. In order to address this issue, a set of quality criteria was developed to assure installations in an energy efficient way.

The declaration of high quality installation includes the following major criteria:

- Implementation of a heat-load calculation
- Installation of a high efficient boiler technology (e.g. condensing boilers)
- Calculation of the hydraulic system for dimensioning of the circulation pump
- Installation of high efficient circulating pump(s)

- Correct dimensioning of the domestic hot water demand and installation of the corresponding storage tank
- Implementation of the hydraulic balance of the heating system
- Implementation of pipe- and armature insulation

The Declaration of High Quality (DHQUI) was developed and specified for the countries Austria, Greece, Germany, Spain and Hungary. The different criteria and the implementation possibilities of this declaration by installers got discussed in several stakeholder meetings in the different countries taking into account their perspectives in developing this new service. The country specific versions are attached **in Annex 9.1**.

In general, the contents is split into a general part and into check lists for the heating system. The general part makes the quality criteria easily accessible and comprehensible for the end-consumer and supplies the installer with arguments for high quality installations and against cheap standard offers. The check lists of the DHQUI provide the quality criteria of a high quality installation and should become a part of the quotation of installers. A detailed discussion showing and(!) explaining the different criteria would be beyond the scope of this report; the documentation is available in [14], [15] & [23].

Installations fulfilling DHQUI quality criteria receive higher prices than conventional ones due to additional services and additional components. These additional costs have to be paid by the end-consumers. For this reason the installer has to provide the end-consumer additional information justifying the higher costs by showing the energy savings in the long run. This additional information is given in form of performance guarantees (GPQU), more details of the performance guarantee is provided in the next chapter.

3.3 Guaranteed Performance Quality (GPQU)

In the “Guaranteed Performance Quality” (GPQU) the installer guarantees a certain quality standard of the new heating system to the end-consumer. This guarantee centres either on the seasonal and the annual energy demand resp. the annual energy savings compared to the old system. Obviously the end-consumer’s user behaviour will have a big influence on the energy demand; but also the seasonal efficiency can be influenced by the user. Accordingly at the beginning of the project three types of a performance guarantee were considered:

1. Optimal case: The seasonal efficiency *and* the energy savings compared to the old system can be forecasted in a small security band and therefore be guaranteed.

2. Second case: The energy savings differ heavily from the forecasted values due to the individual customer behaviour (rebound effects, changes in use etc.), which only allows the installer to mention a non-obligatory number for the energy savings, still the seasonal efficiency of the new system can be estimated and guaranteed.

3. Third case (worst case): Neither efficiency values nor energy savings can be forecasted within an acceptable security band. The installer can only inform the customer about the energy savings and seasonal efficiencies without obligation.

For the calculation of the seasonal efficiency and the energy savings of the new high-quality system compared to the old heating system, a calculation method and tool was developed based on the "finger print method" of the German University of Applied Sciences in Wolfenbüttel.

The fingerprint of a boiler in a heating system is a tool, which allows to judge the performance of a boiler [17].

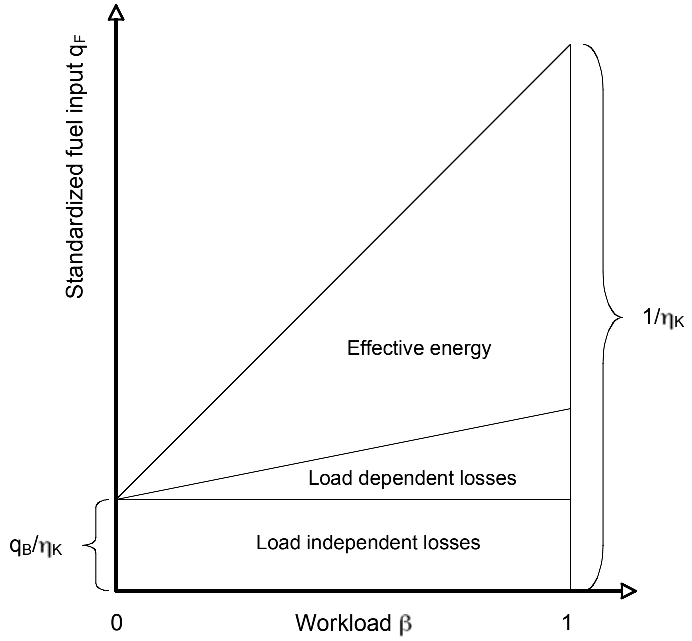


Figure 2 Fingerprint of a boiler in a heating system (Source: [17])
Parameter definition: q_B … average stand-by losses; η_K … efficiency of the boiler

Based on the fingerprint method two modules were worked-out for the GPQU within the BOILeff project:

- **Module I** – Applying the finger print method by executing of an audit at the end-consumer's site taking into account the characteristics of the building, the heating system and the customer's behaviour!
- **Module II** – Applying the finger print method by using an empirical equation(s) mainly taking into account the characteristics of the new boiler!

In **Module I**, the "finger print" method was adapted to the typical business models of installers as follows:

During the first visit(s) at the customer site the installer has to record the required input data for the calculation tool. Subsequently, he performs a heat load calculation of the building. Next steps include the calculation of the average power for the consumption of domestic hot water ($\dot{Q}_{TWW}$) and distribution loses ($\dot{Q}_d$).

Next steps include the identification – normally listed on the specification sheets – of the boiler capacity and the stand-by losses both of the old and the new boiler. After that, the calculation of the mean heating load ($\dot{Q}_{h,m}$) within the heating period has to be performed. From this value the mean boiler capacity ($\dot{Q}_{K,m}$) is derived and in consequence the mean fuel input ($\dot{Q}_{F,m,1}$) within the heating period is derived using the following equations:

$$\dot{Q}_{h,m} = H * (t_{HG} - t_{a,m}) \tag{2}$$

H = Heat load of building $[kW/K]$

t_{HG} = Average temperature level starting heating $[K]$

$t_{a,m}$ = Mean ambient temperature in the heating period $[K]$

$$\dot{Q}_{K,m} = \dot{Q}_h + \dot{Q}_d + \dot{Q}_{TWW} \tag{3}$$

$\dot{Q}_h$ = Heat output $[kW]$

$\dot{Q}_d$ = Losses of distribution system $[kW]$

$\dot{Q}_{TWW}$ = Power for domestic hot water $[kW]$

$$\dot{Q}_{F,m,1} = \left(\frac{1}{\eta_K} - \frac{q_B}{\eta_K}\right) * \dot{Q}_K + \frac{q_B}{\eta_K} * \dot{Q}_{K,N} \tag{4}$$

q_B = Specific standby losses [kW]

η_K = Efficiency of boiler [-]

$\dot{Q}_K$ = Nominal boiler capacity [kW]

$\dot{Q}_{K,N}$ = Nominal output of boiler [kW]

The second step includes the calculation of the mean fuel input ($\dot{Q}_{F,m,2}$) outside the heating period (summer period). The heat input for the domestic hot water production ($\dot{Q}_{TWW}$) and the distribution losses ($\dot{Q}_d$) have to be used as follows:

$$\dot{Q}_{F,m,2} = \left(\frac{1}{\eta_K} - \frac{q_B}{\eta_K}\right) * (\dot{Q}_K + \dot{Q}_{TWW}) + \frac{q_B}{\eta_K} * \dot{Q}_{K,N} \tag{5}$$

As a result of the calculations the “finger prints” of the old and the new heating systems is plotted. Figure 3 shows both the dependency of the combustion power from the outdoor temperature and the sockets for the domestic hot water.

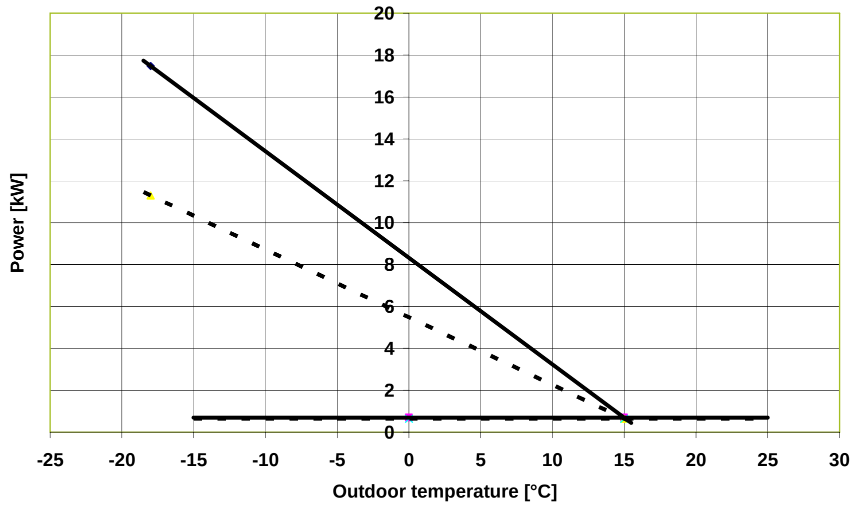


Figure 3 “Finger prints” for a typical single family house with a heat load of 10 kW equipped with an old boiler [30 kW / η = 76% (GCV[4])] continuous lines and a new condensing boiler [11,5 kW/ η = 95 % (GCV)] dashed lines (Source: Austrian Energy Agency)

The calculation of the seasonal efficiency of the boiler (respectively heating system) (η_a) is based on the operational hours in the heating period (winter season) (h_{HP}) and in the summer season (h_{SZ}) (following equations (5) and (6)). The operational hours are linked to the site-specific climate situation using statistical climate data sets (normally available by the central offices for meteorology and climatology).

$$Q_F = \dot{Q}_{F,m,1} * h_{HP} + \dot{Q}_{F,m,2} * h_{SZ}$$
$$\dot{Q}_{F,m,1} = \text{mean fuel input in the heating season [kW]}$$
$$h_{HP} = \text{operational hours in the heating period [h]} \qquad (6)$$
$$\dot{Q}_{F,m,1} = \text{Nominal output of the boiler [kW]}$$
$$h_{SZ} = \text{mean fuel input in the heating season [h]}$$

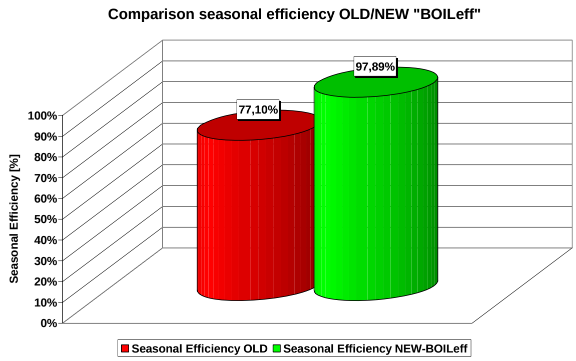
$$\eta_a = \frac{\left(\dot{Q}_K * h_{HP} + \left(\dot{Q}_d + \dot{Q}_{TWW}\right) * h_{SZ}\right)}{Q_F}$$
$$Q_F = \text{Fuel input [kWh]} \qquad (7)$$
Other parameters already defined in equations (2), (3), (4), (5).

Finally, the fuel consumption based on the average annual energy consumption (Q_F) by using the gross calorific value (GCV) of the used energy carrier can be calculated.

After comparing the seasonal efficiencies of the old and the new boiler system a comparison between the efficiencies of both boilers (respective heating systems) including the fuel consumption will be performed. Consequently, the end-consumer receives information concerning the efficiencies and

[4] GCV is the abbreviation for gross calorific value, also known as higher heating value.

future energy (and cost) savings. An example showing high efficiency savings in a typical Austrian refurbishment case with an old heating system from the 1970s is shown in Figure 4.



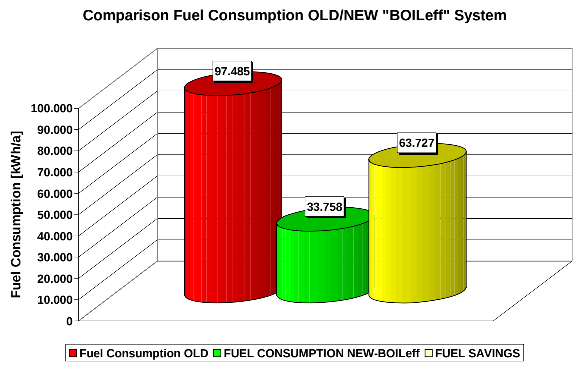


Figure 4 Energy savings based on “finger print” method using an Austrian refurbishment case with an old heating system from the 70s (boiler systems are the same than in Figure 3) (Source: Austrian Energy Agency)

The results of the field test showed that methods to forecast the energy consumption or the energy savings are far away from being accurate, but efficiencies can be forecasted very well – in the Austrian field test the deviation did not exceed 3 percentage points in any case (in depth analysis is carried in the next chapter).

The main part of the performance guarantee – **in Module II** – is an empirical formula to forecast the seasonal efficiency of an optimally installed gas or oil fuelled condensing boiler. This calculation method was developed by the Wuppertal Institute (WI) and verified and also refined by the Austrian Energy Agency (AEA) according to the results of the field test.

The following main criteria of the heating system were identified to be essential for the seasonal efficiency of an optimally installed[5] boiler:

5. Is the boiler located inside or outside the heated area?
6. Is the boiler equipped with a bypass valve?
7. Are radiators or panel heating systems used?
8. Is the boiler fuelled by gas or oil?

By the following formula the installer can forecast the seasonal efficiency of an optimally installed[5] gas or oil fuelled condensing boiler with a security band of three percentage points.

$$\eta_a = 89\% * (1 - 3\%*O) * (1 + 4\%*I) * (1 - 3\%*V) * (1 - 1{,}5\%*W) \qquad (8)$$

The four parameters (O, I, V und W) have to be chosen by the installer according to the specific heating system:

Oil fuelled condensing boiler	**O** =1	Gas fuelled condensing boiler	**O** = 0
Boiler located inside heated area	**I** = 1	Boiler located outside heated area	**I** = 0

5 Optimal installation means that the installation fulfils the criteria of the Declaration of High Quality Installation.

Boiler equipped with bypass valve			**V** = 1	Boiler without bypass valve	**V** = 0
Radiators	**W** = 1	Panel heating	**W** = –1	Radiators and panel heating	**W** = 0

The calculated seasonal efficiency are based on the gross calorific value (GCV).

Taking into account the discussions within the stakeholder meetings consensus was achieved to use the most – for the installer – user-friendly Module **II** concept. The national versions are attached in Annex 9.3.

4 Field Testing

4.1 Configuration of the Field Test

The main outcome of the field test was to assess the two market approaches (DHQUI and GPQU) under market conditions in real heating installations and to achieve concrete field test results. [18] - [20]

In total, 336 end-consumers and 110 installers showed interest in DHQUI and GPQU services in the participating countries. For example, URV-CREVER reported that BOILeff project provoked a great interest among installers and other stake-holders in the Spanish heating sector. More than 20 installers showed interest in taking part but finally only 7 of them were able to take part in the field tests. These installers presented a total of 14 installations located in Catalunya and Madrid. In Greece, focus was given to the development and the spread of DHQUI. RAE managed to gather more than 200 signed DHQUI forms, by over 10 boiler installers and associations, from all over Greece. More than 20 customers received the declaration and from now on, Greek boiler installers will inform their customers about the DHQUI approach.

The project partners had to experience a major drop-out rate concerning installations with measurement equipment. Although 53 end-consumers and 44 installers participated in the field testing exercise, at the very end metering results could be achieved in 29 systems (23 gas heating systems, 3 oil heating systems, 3 biomass systems) in Austria (13 cases), Germany (6 cases) and Hungary (10 cases). Unfortunately, none measurement results could be achieved in the southern countries in Spain and Greece.

Due to the low number of heating systems with oil and different biomass technologies (and biomass fuels), for comparison reasons, the in-depth analysis was only carried out for gas heating systems. 14 gas heating systems fulfil the criteria of the DHQUI in a sufficient way. The results of these 14 gas heating systems were analysed in detail. The results are shown in chapter 4.2.

4.2 Analysis of the Field Test Results

4.2.1 Accuracy of the GPQU Formulas

An important task of the BOILeff project was to create methods to forecast seasonal efficiencies of boilers. Therefore a formula was developed, as explained in the previous chapter. The following table shows the accuracy of this formula on the basis of the results of the transnational field test. The following table shows the key data for this analysis.

Table 2 Efficiency of the 14 gas heating systems in comparison to the forecasted values of the GPQU formula. AT stands for Austria, HU for Hungary. The numbers correspond to the consecutive numbers of the field test objects. (Source: Austrian Energy Agency)

Nr.	Measured efficiency [%] based on GCV[6]	Calculated efficiency by GPQU formula 1 [%]	Calculated efficiency by GPQU formula 2 [%]	Deviation of metered value from GPQU 1 [%]	Deviation of metered value from GPQU 2 [%]
HU 1	93,4	90,8	91,1	2,6	2,3
HU 2	90,1	87,3	87,6	2,8	2,5
HU 3	88,9	87,3	86,3	1,6	2,6
HU 5	83,8	87,3	86,3	-3,5	-2,5
HU 6	80,7	87,3	86,3	-6,6	-5,6
HU 7	80,0	87,3	85,0	-7,3	-5,0
AT 1	86,7	90,8	88,4	-4,1	-1,7
AT 2	87,8	90,8	88,4	-3	-0,6
AT 4	82,4	87,3	85,0	-4,9	-2,6
AT 5	94,8	93,6	91,9	1,2	2,9
AT 6	87,5	87,3	85,0	0,2	2,5
AT 7	91,3	90,0	89,5	1,3	1,8
AT 9	88,8	90,0	89,0	-1,2	-0,2
AT 11	89,8	90,0	90,3	-0,2	-0,5

The GPQU formula 1 [17] was created by means of the results of [4]. It shows a mean deviation of 2,89% from the metered values. The GPQU formula 2 was adapted according to the Austrian field test results [13] (see previous chapter). The mean deviation, also after including the Hungarian results, is reduced to 2,38%. The GPQU formula 2 shows deviations of more than 3% in five cases, the GPQU formula 2 in only two cases which also indicates that the GPQU formula 2 is more reasonable. The following graph shows the deviations of the metered values from the two GPQU formulas mentioned in Table 2.

[6] GCV is the abbreviation for gross calorific value also known as higher heating value.

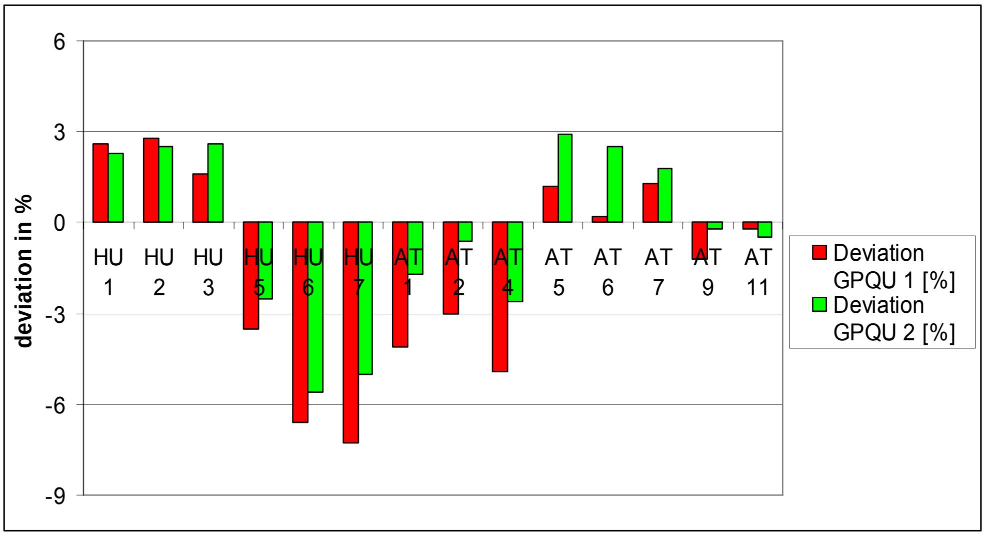


Figure 5 Deviations of the metered seasonal efficiencies from the forecasted value; a positive value indicates that the heating system performed better than forecasted by the GPQU formula; for the abbreviations see Table 2 (Source: Austrian Energy Agency)

The 8 Austrian test cases evaluated in this report show a maximum deviation of 3 percentage points of the determined seasonal efficiency from the calculated value. Due to this fact for Austrian heating systems installed according to the DHQUI a security band for the guaranteed seasonal efficiency of 3 percentage points can be considered. Unfortunately, two Hungarian test cases show a negative deviation of 5% resp. 5,6%. Accordingly for Hungary a larger security band (up to 6%) must be suggested.

Based on this evaluation it is concluded that both concepts could be successfully proved by the results of BOILeff project. Taking into account that there was a random choice of condensing boilers on a different price and efficiency level, it may be further concluded that the achieved performances of installations based on certain brands and models (of this brand) will outperform the values of GPQU formula (based on DHQUI installations)(!)

Although, the validation of both concepts could be achieved within the project a full validation and quantification of effects including the different boiler brands and models and also the different installation qualities would need a large-scale field test. The validation for interested installers – as already mentioned above – knowing best their installed boiler brands and models – may be achieved much easier by using their normal or slightly adapted business models.

4.2.2 Energy and CO_2eq savings

In this section, the efficiencies as well as the energy and CO_2eq savings and the workloads of the 14 gas heating systems are shown in bar charts. [21]

In the Hungarian test cases the climate corrected annual energy consumption was reduced by 44.397 kWh (Ø 7.400 kWh per test case), in Austria the reduction amounts to 62.311 kWh (Ø 7.789 kWh per test case). In total, energy savings of 106.708 kWh (Ø 7.622 kWh per test case) could be achieved, which is a mean reduction of almost 25% (see Figure 6).

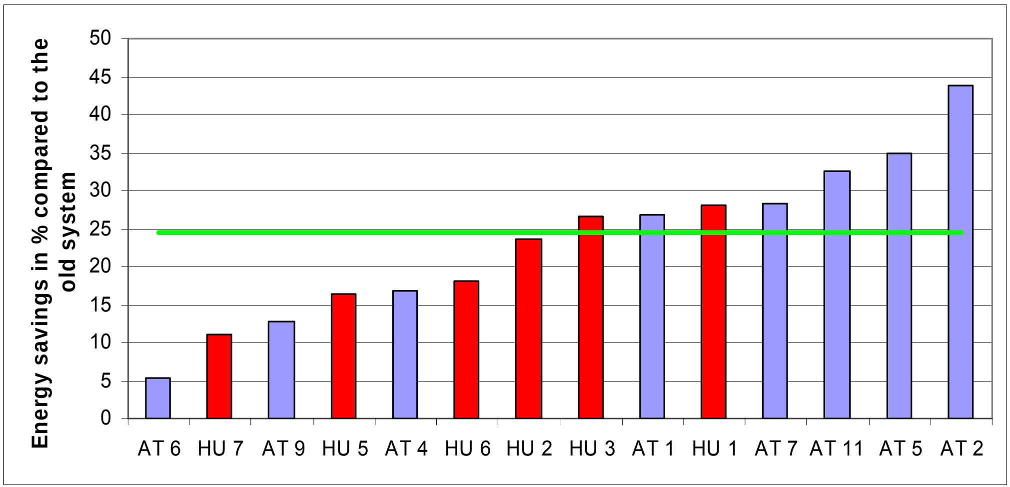


Figure 6 Energy savings in % compared to the old systems; the 6 Hungarian results are coloured red, the 8 Austrian are blue; the savings on average are shown by the green line; for the abbreviations see Table 2 (Source: Austrian Energy Agency)

The CO_2eq emissions of the Hungarian test cases were reduced by 8.441 kg/a (Ø 1.407 kg/a per test case), in Austria the reduction amounts to 15.765 kg/a (Ø 1.971 kg/a per test case). In total, the CO_2eq savings amount to 24.206 kg/a (Ø 1.729 kg/a per test case), which is a mean reduction of almost 30% (see Figure 7).

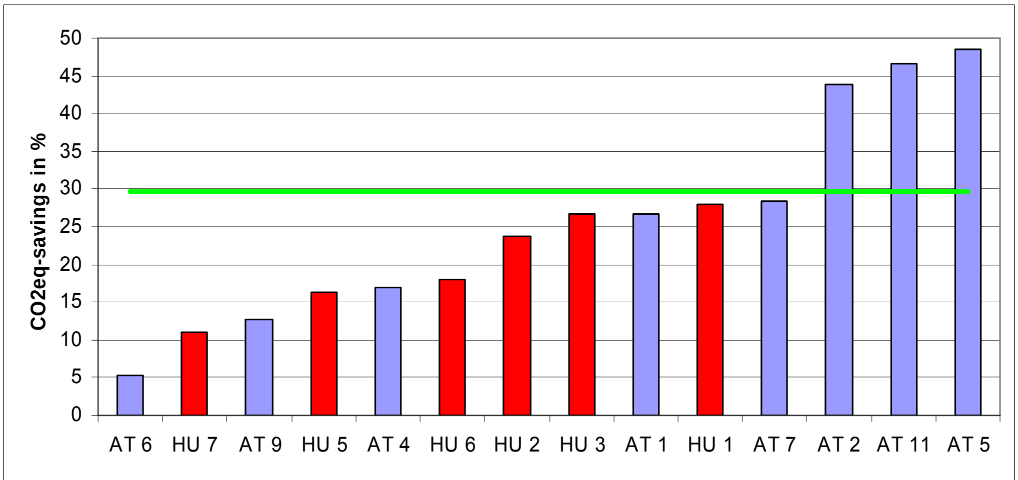


Figure 7 CO_2eq savings in % compared to the old systems; the 6 Hungarian results are coloured red, the 8 Austrian are blue; the green line indicates the average savings; remark: due to the weighted average (test cases with higher energy consumption contribute more) the green line does not seem to be the average, but it is; for the abbreviations see Table 2 (Source: Austrian Energy Agency)

According to Figure 8, a BOILeff system achieves a seasonal efficiency of 87,9% on average (GCV[7]; Austria: 89,63%, Hungary: 86,00%). In [5] the average efficiency of a gas condensing boiler was

[7] GCV is the abbreviation for gross calorific value, also known as higher heating value. NCV is the abbreviation for net calorific value also known as lower heating value.

determined to 86,2%, while low temperature gas boilers reach 75,5%. The efficiency of an Austrian standard heating system is 83% (NCV) or **75% (GCV)**. (No values for standard Hungarian systems are available.) Explanations concerning the two lowest efficiency values (HU 7, HU 6) are seen in the small surface of the radiators (following Innoterm, the Hungarian project partner). Consequently the return temperature was too high to enable condensation of the exhaust gases. Nevertheless, BOILeff installations following DHQUI quality criteria show significantly higher seasonal efficiencies than standard installations.

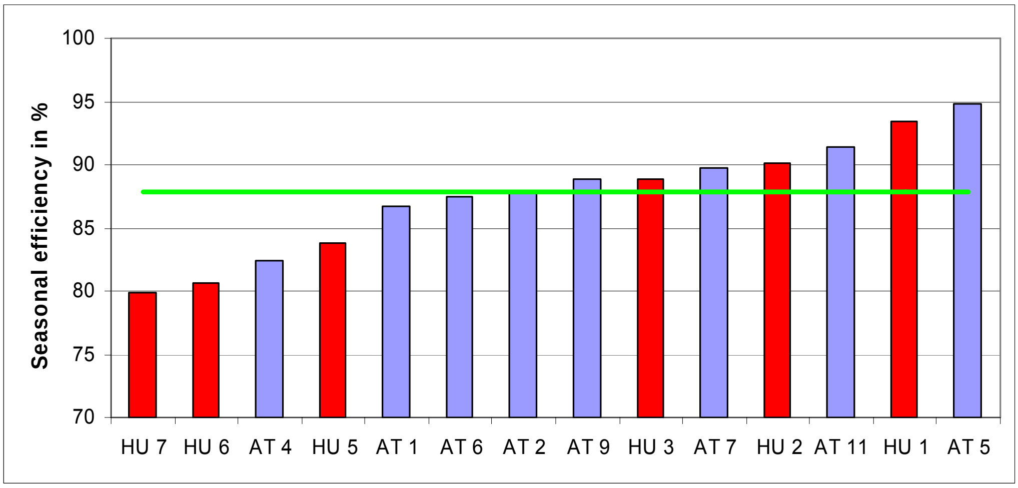


Figure 8 Seasonal efficiencies of the 14 evaluated heating systems of the field test; the seasonal efficiency on average is indicated by a green line; the 6 Hungarian results are coloured red, the 8 Austrian are blue; for the abbreviations see Table 2 (Source: Austrian Energy Agency)

The following figure shows the average annual workload of each test case.

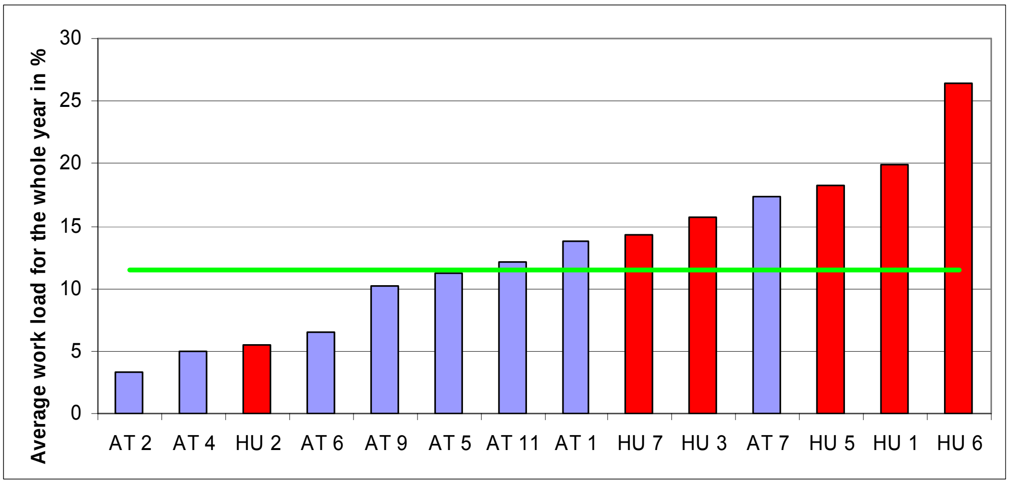


Figure 9 Achieved workloads; the 6 Hungarian results are coloured red, the 8 Austrian are blue; the mean workload on average is indicated by a green line; for the abbreviations see Table 2 (Source: Austrian Energy Agency)

In [17] the average work load of the tested gas condensing boilers was determined to 9%. The BOILeff heating systems performed with an average annual workload of 11,5% which is an indicator for an improved dimensioning as a result of the heat load calculations.

4.2.3 Causal interrelation of heating system parameters

A very important task is to find correlations between various variables like efficiency, workload, heat load, overdimensioning factor, hot water demand, energy consumption, boiler attributes, climate, etc. The most significant results were chosen and included in this section. For an optimal clarity of the correlation between these data sets, the results are shown in scatter diagrams. To most of the graphs a linear approximation was performed in order to show the tendencies. If a polynomial trend line is more reasonable this type of approximation was added to the graph (e.g. to show maxima which is not possible with a linear approximation). In most cases the Austrian and the Hungarian test cases can be distinguished by different colours as in the previous bar diagrams.

The first graph of this series shows the correlation between the heat loads of the test cases and the metered seasonal efficiencies. Obviously a higher heat load leads to a higher boiler efficiency.

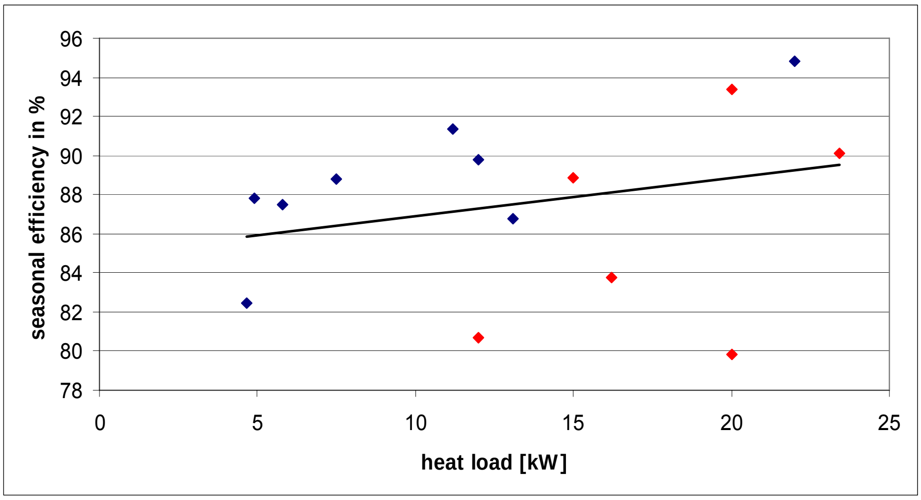


Figure 10 Seasonal efficiency vs. heat load of the 14 gas heating systems installed according to the DHQUI; the 6 Hungarian results are coloured red, the 8 Austrian are blue (Source: Austrian Energy Agency)

The next graph shows the correlation between the average boiler workload and the monthly efficiency. In [4] it was proposed that the efficiency increases strictly monotonic with growing workload. As the graph shows this is not the case with the heating systems of this field test.

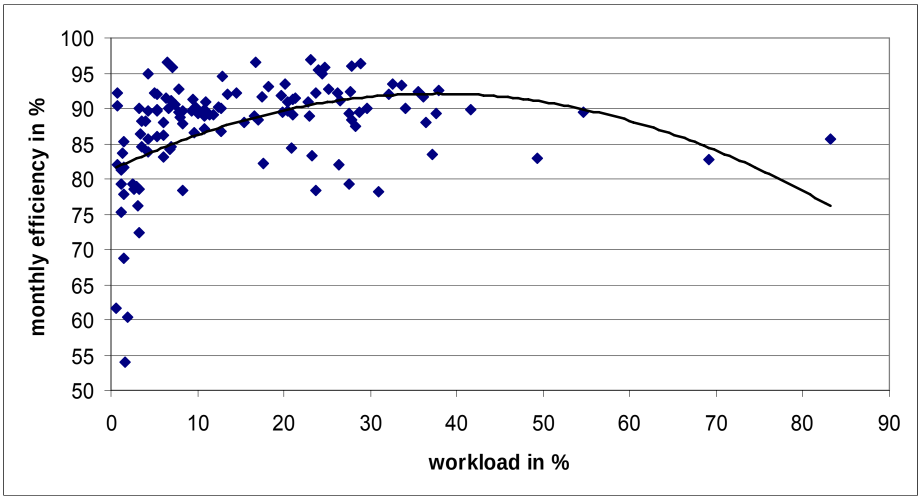


Figure 11 Polynomial approximation of the monthly efficiencies of the 14 gas heating systems (Source: Austrian Energy Agency)

The efficiency maximum is at 37,5%, with higher workloads the efficiency declines again. This seems to be contradicting to [4] where the efficiency was set to be strictly monotonic increasing with the workload. In [4] the highest metered workload is slightly above 43% and there is only a second data point above 40%. The data was just extrapolated to higher workloads by means of a theoretical model. In this field test higher workloads have been achieved which is an indicator for a well performed heat load calculation.

The next graph shows the same correlation, but with annual workloads and efficiencies.

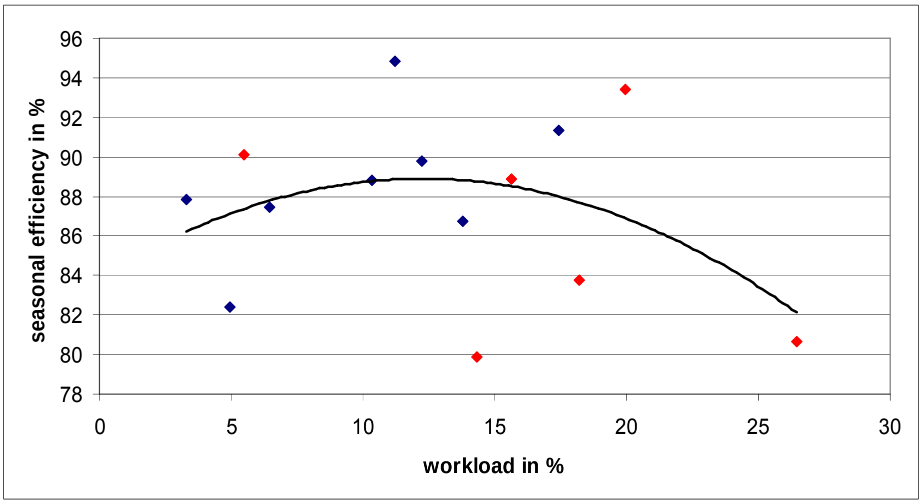


Figure 12 Polynomic approximation of the correlation between average annual workload and the seasonal efficiency; the 6 Hungarian results are coloured red, the 8 Austrian are blue (Source: Austrian Energy Agency)

Somehow this result is according to DIN 4702-8: starting from 13% the seasonal efficiency drops down; however these values are annual workloads while DIN-norm refers to instantaneous workloads.

The following graph shows the connection between the nominal boiler capacity and the heat load which indicates the level of overdimensioning. The line refers to the equality of heat load and nominal power output of the boiler (which is the optimal case and was achieved in 3 Hungarian installations). Especially for low heat loads it is sometimes difficult to find a suitable boiler. Still, since boilers are equipped with a modulation feature of the power output, the effect of this problem on the efficiency is reduced.

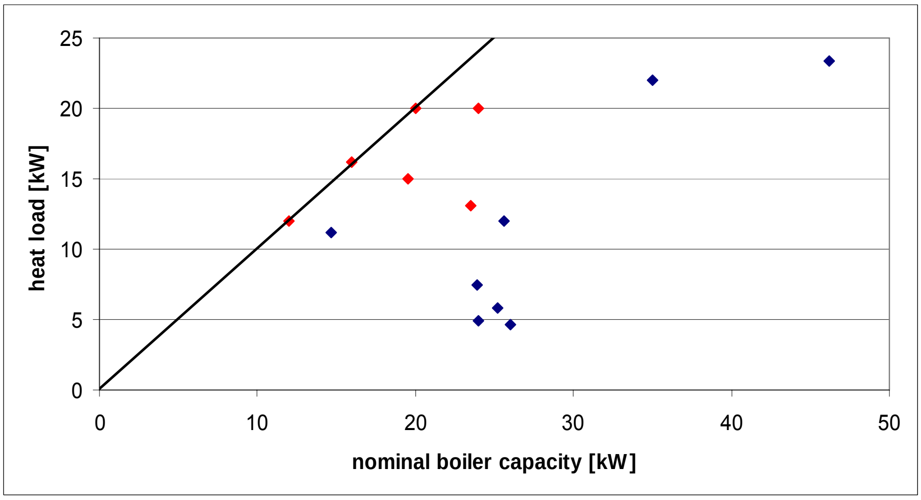


Figure 13 Nominal boiler capacity vs. heat load; the 6 Hungarian results are coloured red, the 8 Austrian are blue (Source: Austrian Energy Agency)

The factor of overdimensioning can be indicated by dividing the nominal boiler capacity by the heat load. The correlation between this ratio and the seasonal efficiency is shown in the next graph.

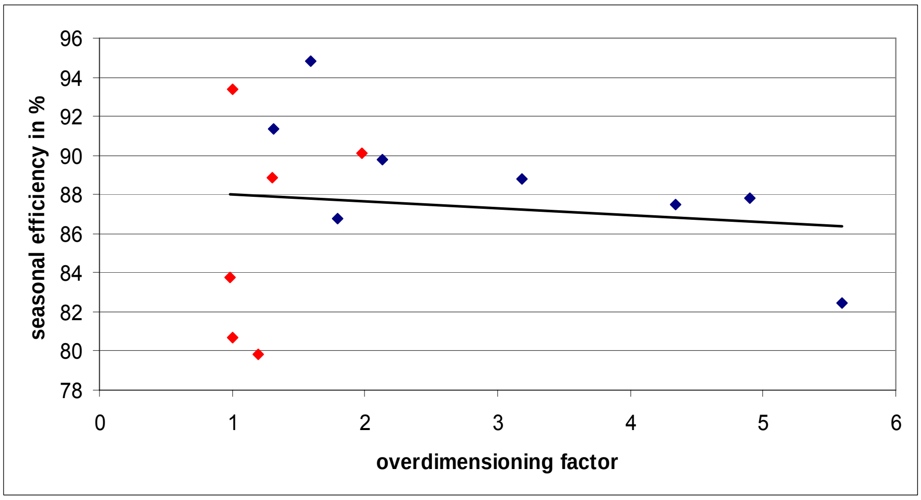


Figure 14 Dependency of the seasonal efficiency of the heating systems on the ratio of nominal boiler capacity and heat load; the 6 Hungarian results are coloured red, the 8 Austrian are blue (Source: Austrian Energy Agency)

Unfortunately, both systems in which too high return temperatures impeded condensation of the exhaust gases to a large extent (efficiencies of about 80%) are dimensioned almost perfectly. This pulls the trend line down towards lower efficiencies on the left side. Still the line shows that a proper dimensioning of the boiler has a positive influence on the efficiency of the system.

The following graph shows that a higher fraction of the domestic hot water on the energy consumption leads to a lower efficiency, according to the results of [4]. This can be explained by the fact that (especially in systems with floor heating) a higher flow temperature is needed for the hot water production which reduces the efficiency.

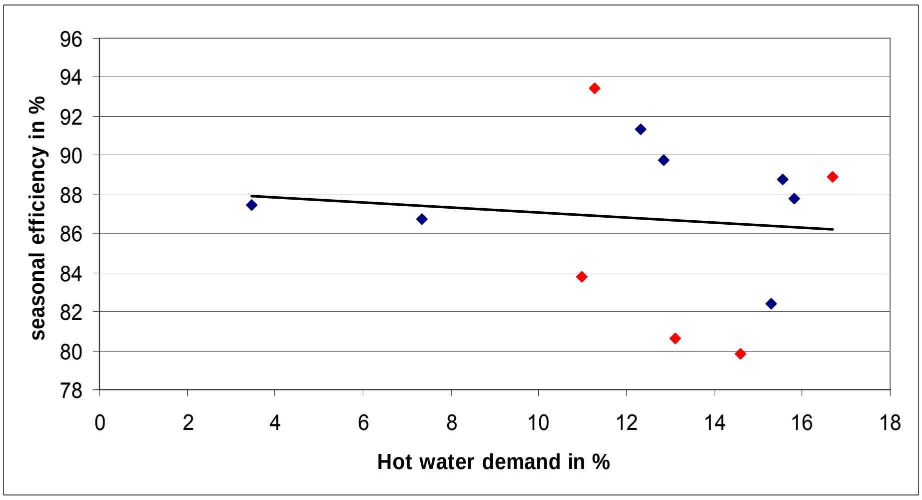


Figure 15 Seasonal efficiency vs. fraction of the energy consumption for domestic hot water; the 6 Hungarian results are red, the 8 Austrian are blue; there are only 12 data points, because in 2 test cases the domestic hot water demand could not be metered separately due to technical reasons but only together with the heating (Source: Austrian Energy Agency)

A further important result is documented by the following graph: The average workload of the boilers in the field test increases with the energy demand. The conclusion can be drawn that smaller boilers are overdimensioned more which can be caused by the fact that installers did not care if a test case had a low heat load or there was no suitable boiler model.

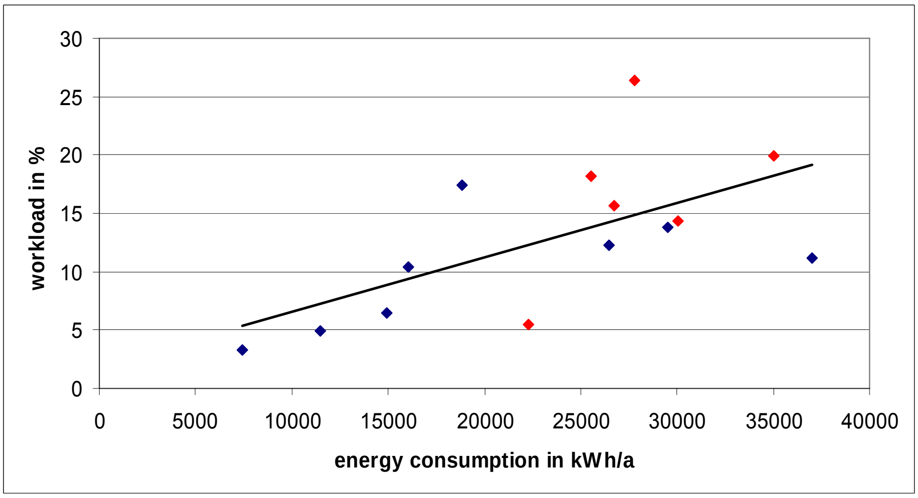


Figure 16 Connection between the annual energy consumption and the average annual workload; the 6 Hungarian results are red, the 8 Austrian are blue (Source: Austrian Energy Agency)

According to the results of [4] and of the Austrian field test in GPQU formula three attributes were identified that influence the seasonal efficiency of gas heating systems: (i) heat dissipation system, (ii) positioning of the boiler whether in the heated or in the unheated area, (iii) existence or absence of a bypass valve. The following figure shows the dependency of the boiler efficiency on these characteristics; furthermore the positive influence of a solar thermal systems is shown.

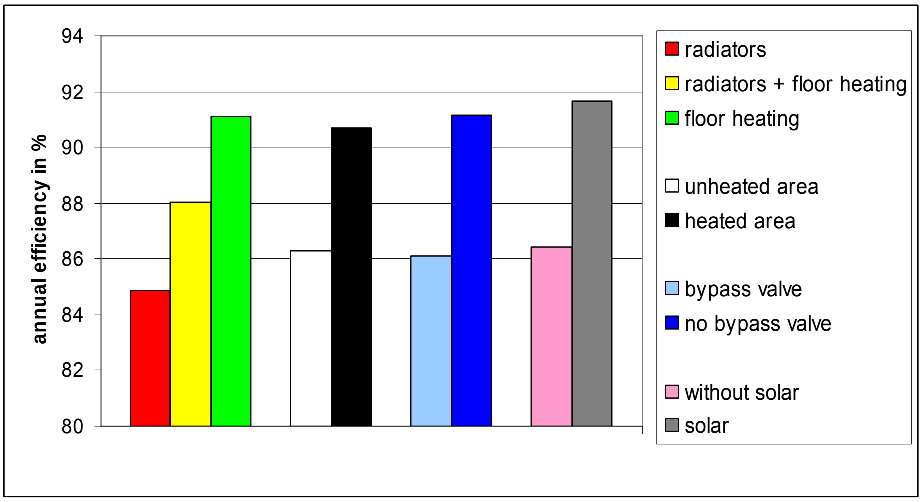


Figure 17 Influence of the heat dissipation system, the position and the type of the gas boiler as well as of a supporting solar thermal system on the seasonal efficiency (Source: Austrian Energy Agency)

Accordingly the dependencies of the efficiency according to the GPQU formula can be confirmed:

- Heating systems show a 4,3% higher efficiency if the boiler is placed in the heated area (and not in the unheated area) due to lower storage losses.
- The benefit of a floor heating is determined to 6,2% compared to a radiator heating system.
- The heating systems without a bypass valve show a 5% higher efficiency than those with.
- A solar thermal system reduces the losses in summer (caution: all (3 of 14) solar systems are connected with boilers without bypass valve, this might enlarge the difference); [4] resumed that there is almost no influence of solar thermal collectors on the efficiency; a larger number of test cases with a solar thermal system will be necessary to statistically verify this effect.

The efficiency of the heating systems is almost independent of the specific heat load (heat load per m²) as shown by the following graph.

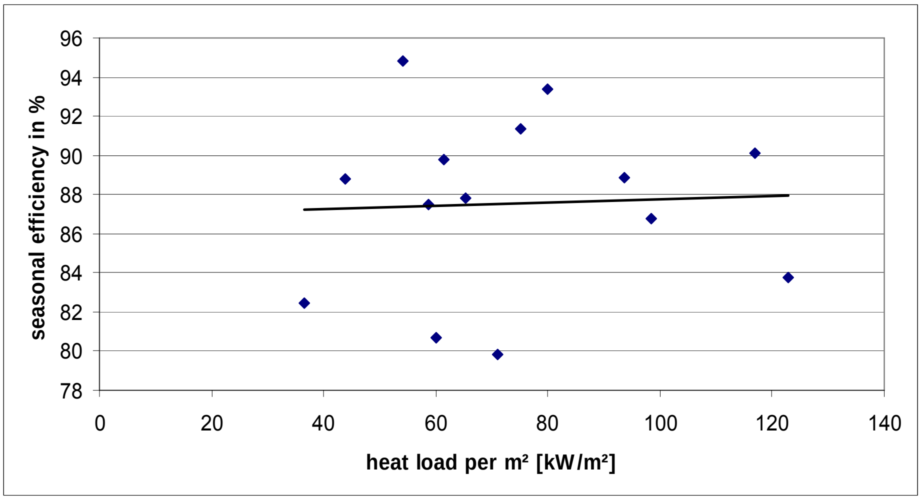


Figure 18 Correlation between heat load and seasonal efficiency; the 6 Hungarian results are coloured red, the 8 Austrian are blue (Source: Austrian Energy Agency)

In principle it could have been suggested that a higher heat load per m² leads to lower distribution losses because the heat transport runs over shorter distances (There is an analogue effect with district heating: If the objects to be heated are situated very closely together (high energy demand per area) the distribution losses decline.) Nevertheless, the graph shows only a little dependency. Possibly this effect does not play a role on a small scale of a flat or a house; moreover, it could indicate that the insulation of the pipes in the test cases impeded distribution losses to a large extent so that this effect is too small to be metered.

5 Success factors for a broad market introduction of DHQUI and GPQU

5.1 General

Beside, technical issues success is prevailingly defined through the perceived value from the side of the customers as well as from the side of the service providers. In order to assess this perceived value two questionnaires were developed (one for customers and one for installers, see Annex 9.4) dealing among others with the following topics: convincing arguments for the participation in the field testing, general satisfaction with the service and additional value resulting from the declaration of guarantee of a certain boiler installation quality. [22]

The BOILeff project provoked great interest among customers and installers and other agents of the sector in the participating countries. More than 352 customers/ boiler owners and 110 installers showed high interest in the project and the two services DHQUI and GPQU and a remarkable share participated in the field tests. The developed questionnaires were sent to the whole stakeholder group of boiler owners and installers. In total 99 returned questionnaires could be evaluated.

Table 3 Overview of the participating customers and installers (Source: Wuppertal Institute)

	Interested in DHQUI and GPQU		Participated in GPQU field tests and DHQUI implementation		Returned questionnaires	
	Customers/ boiler owners	**Installers**	**Customers/ boiler owners**	**Installers**	**Customers/ boiler owners**	**Installers**
Austria	78	36	13	12	10	10
Germany	40	18	6	3	9	5
Hungary	> 20	>10	20	10	20	10
Greece	> 200	26	>200	12	12	6
Spain	> 14	> 20	14	7	13	4
Total	**> 352**	**> 110**	**> 249**	**44**	**64**	**35**

In Austria a total of 78 interested customers (boiler owners) and 36 interested innovative installers were identified during the project. From this group 13 boiler owners and 12 installers participated in the Austrian field test. 10 boiler owners (60% participated in the field test) and 10 installers (40% participated in the field test) returned filled-in questionnaires.

In Germany, 18 boiler owners and 40 installers were interested in participating in the BOILeff project. Six boiler owners and three installers participated in the field tests. Some of those customers and installers, who didn't participate in the field tests, filled in the questionnaire.

In Hungary, in total more than 20 customers and 10 installers were interested in participating in the BOILeff project. 20 boiler owners and 10 installers participated in the field test and returned the questionnaire.

In Greece, RAE managed to gather more than 200 signed DHQUI forms, by over 10 boiler installers and associations from all over Greece. Specifically, 12 installers took part in the implementation of the DHQUI, while more than 26 installers showed interest for further collaboration. 12 customers and 4 installers returned the questionnaire.

In Spain, more than 20 installers were interested in taking part in the project, in the end seven of them were able to participate in the field tests. These installers presented a total of 14 installations, 13 customers and four installers returned the questionnaire.

As a first result from the answers of the installers it can be seen that the typical business areas of the participating installers are manifold. They include 38 % heating, 16 % solar, 11 % biomass, 10 % sanitary installation (3 % others). Especially the high percentage of solar and biomass business areas indicates a high interest in quality installations by installers who are active in these relatively new business fields.

5.2 Evaluation of customers' response

The questionnaire (see Annex 9.4.1) starts with a general part: questions about the project and the customer and his motivation for his interest in the two new BOIFeff services. This is followed by questions about the customer's expectations and the possible implementation of these new services.

Are the two BOILeff services DHQUI and GPQU realistic and practicable?

The question if the two proposed new services are realistic and practicable had different results. The majority of customers agrees with the DHQUI criteria but regarding the guaranteed performance (GPQU) more than half of the customers only partly agree.

This shows a high acceptance for high quality installations, whereas there might be open questions regarding the guaranteed performance by the installer.

Motives for the participation in the project

The following motives are fully applicable for 100% of the boiler owners in Germany and Austria for their interest in participating in the DHQUI and GPQU:

- A guaranteed high quality installation
- An energy-optimized highly efficient heating system
- Reduction of maintenance and repair services
- Reduction of greenhouse gas emissions
- Reduction of fuel consumption and costs

The response of customers in Hungary, Greece and Spain show a different picture: Only about half of them agrees, the other half has reservations regarding these new services and only partly agrees.

It can be stated that there is a difference in motivation between customers in Germany and Austria and customers in Hungary, Greece and Spain. Possibly the importance of heating is lower in the last-mentioned countries.

Expected energy savings

Only small differences were found in the participating countries. All interviewed customers expect energy savings between 10 and 30% by the implementation of the DHQUI and GPQU.

In Austria 60% of the customers expect energy savings of 20%, two customers expect energy savings of 15% and two of 30%. In Germany the range of expected savings is distributed between 10 % and 30 %, in Hungary and in Spain between 15 % and 20 %.

Acceptance of additional costs for highly efficient heating systems

The acceptance of additional costs varies a lot in the different countries. In Germany, Austria and Spain customers are willing to pay additional costs for high quality installations (according to the DHQUI and including a guarantee declaration) of up to 400 € or up to 10% of the total installation costs, in Hungary the interviewed customers are willing to pay additional costs of up to 250 €, in Greece up to 150 €. Restricted only to the Declaration of High Quality Installation additional costs of 250 € max. would be accepted, some customers wouldn't even accept any additional costs.

It can be stated that generally additional costs are accepted, though the amount differs.

Establishment of an independent arbitrator

With regards to the guaranteed installation, the individual installer will not be able to supervise his own work. Customers are asked if an independent control would be necessary in case of conflicts, and which institution would be adequate for this kind of control.

Country-independent most of the interviewed customers are of the opinion that an independent arbitrator is necessary to solve conflicts between installers and customers. For being this arbitrator, a majority of customers favours a local / regional expert board (representing the professional body, the chamber of crafts, the association of engineers, etc), some customers favour a body representing the government and a representative of the consumers, and some a scientific institute (university, university of applied science) in cooperation with an approved expert.

Quality label and professional training

In order to establish market transparency and to ensure the necessary quality standards, a quality label or a recognized certificate linked to professional training course can be established. Customers were asked if such kind of label would be useful.

All interviewed customers are of the opinion that a special certificate for a professional training or a product label named „guaranteed installation quality“ will be useful for the promotion of high quality installations. Furthermore the customers noted that this certificate should be granted due to a participation of the installer in a professional training; about half of all customers preferred such training in combination with a successfully established high quality installation (best practice project).

5.3 Evaluation of installers' response

The questionnaire (see Annex 9.4.2) also starts with a general part: questions about the installer's main application area and his motivation for being interested in the two new BOILeff services. This is followed by questions about success factors, barriers and cost data regarding the possible implementation of these new services.

Motives for the participation in the project

100% of the interviewed installers are interested in the DHQUI whereas the GPQU is only of interest for about half of the installers.

The question if the two proposed new services are realistic and practicable had different results. The majority of country-independent installers agrees with the DHQUI standard, though some of them only partly. Regarding the guaranteed performance (GPQU) installers in Greece and Hungary don't see this service as a new business segment, while about half of the installers in Germany, Austria and Spain regard it as practicable.

The following motives are applicable for all installers for their interest in applying DHQUI and GPQU services:

- Extension of business activities with the objectives energy efficiency and guaranteed quality for the customer
- Improvement of expertise and reputation in the field of energy efficiency and customer satisfaction
- Expectation of higher turn-over rates
- Clear differentiation from cheap installations

Important preconditions for the establishment of the DHQUI and GPQU

Nearly all interviewed installers are of the opinion that the following preconditions are important for the establishment of DHQUI and GPQU services:

- Open to new challenges; high technical expertise of the management and the executing staff
- The customers are open-minded and interested in the topics energy savings and climate protection
- Motivating the staff through professional trainings with specific training contents (hydraulic balance etc.)
- Public information

Expected energy savings

The answers regarding expected energy savings by the implementation of new heating systems according to the DHQUI reveal differences in the participating countries. Whereas the interviewed installers in Austria and Hungary expect energy savings between 15 and 20% the installers in Germany and Spain expect savings between 10 % and 30 %.

Obstacles or barriers for the success of the DHQUI or GPQU

This question is related to the practicability of the new services and the role of obstacles and barriers.

Nearly all of the installers in the participating countries agree or partly agree on the following obstacles and barriers for the success of DHQUI and GPQU services:

- Insufficient transparency of the installation quality of the heating system: For the customer it is very difficult to differentiate between a good quality installation and a less good installation (this obstacle can be overcome by DHQUI and GPQU)
- More personal efforts for the acquisition (advertising and dialogues with customers) and an additional inspection of the unit (heating system and distribution) is necessary

- More time effort to prepare quotations (pre-calculation) for the installation and the controlling of the guaranteed quality
- Higher efforts for the initial setup of the heating system and the subsequent maintenance are needed

Estimated additional costs for highly efficient heating systems

Assessment of additional costs varies quite a lot in the different countries. For the installation of the heating system according to the declaration of high quality, the installers in Austria and Germany expect additional costs between 150 and 1500 €[8] or 3 to 15% of the total installation costs. 80% of the interviewed installers expect additional costs of around 5% of the total installation costs. In Hungary, Spain and Greece, installers expect additional costs of 250 € (max).

General integration of heat and electric meters into the heating system

Some experts propose to integrate generally heat meters and an electricity meter to ease the evaluation of the heating system's efficiency.

The installers' feedback is quite different: 80% of the installers in Austria disagree to a general integration of heat and electric meters into the heating system because they are of the opinion that the system will become prone to errors and that the customer dialogue will become more challenging. Only 20% of the installers agree if the additional costs do not exceed 5% of the total installation costs. In Greece, all installers disagree even if the costs do not exceed 5 % of the total installation costs. In contrast, in Germany, Hungary and Spain about all installers agree if the costs for the meters do not exceed 5 % of the total costs.

Necessary additional time for carrying out the following steps according to DHQUI and GPQU

In the following table the distinct steps for the implementation of the DHQUI and the GPQU are listed together with the expected time needed in average. It shows that the assumptions are similar in the participating countries but strongly depend on the size of the building.

[8] Taking into account average total installation costs for a flat or single-family house (around 130 m² gross floor area).

Table 4 Expected time for the deployment of DHQUI and GPQU services

MEASURES	***SFH****	***MFH****	
Survey of the building for the heat load calculation	*1,5 to 3*	*3 to 12*	*h / house*
Survey of the heating network and rooms for the room by room heat load calculation and the calculation of the pipeline network	*0,2 to 3*	*0,3 to 15*	*h / room or house*
Implementation of a heat load calculation according to a valid standard (i.e. DIN EN 12831, ÖNORM EN 12831)	*0,5 to 4*	*2 to 15*	*h / house*
Calculation of the pipeline network and identification of the values for the thermostatic valves	*1 to 4*	*2 to 4*	*h / ThV*
Installation of a pre-adjustable thermostatic valve	*0,4 to 1,5*		*h / ThV*
Implementation of a hydraulic balance by adjusting the thermo-static valve	*0,2 to 0,5*		*h / piece*
Pump parameterisation and adjusting the central heating controls	*1 to 2*	*2 to 3*	*h / system*
Briefing the customer about his new heating system concerning fuel supply, boiler, circulation pump, control system, hot water storage tank and actions to be taken in case of malfunction as well as possibilities to optimise the system operation (e.g. proper use of the thermostatic valves).	*1 to 8*		*h / system*
Assembly time for the installation of heat and electricity meters	*1 to 2*		*h / meter*
Annual costs for monitoring the system (for the GPQU)	*No estimation, difficult to assess*		*Euro / house*

* SFH = single family house of about 130 m2 gross floor area,

MFH = multi family house with about 8 flats (80 m^2 gross floor area per flat)

Establishment of an independent arbitrator

With regards to the guaranteed installation quality according to DHQUI or GPQU services, the individual installer will not be able to supervise his own work. Installers were asked if an independent control would be necessary in case of conflicts, and which institution would be adequate for this kind of control.

With the exception of Austria all installers regard an arbitrator as necessary, though the question who could take that role is answered differently. In Austria, 80 % of the interviewed installers are of the opinion that an independent arbitrator isn't necessary to solve conflicts between installers and customers. Only 20 % agree with the idea to take into account a local/regional expert board as independent arbitrator, if necessary. In Germany most of the installers regard an arbitrator as necessary. This task should be carried out by an already existing local / regional expert board (representing the professional body, the chamber of crafts, the association of engineers, the house owners, other independent institutions or a university institute). In Spain, 50 % of installers agree with the idea of an independent arbitrator in case of conflicts. For this role they favour a body representing the government or the administration and a representative of the consumers. In Hungary and Greece, an arbitrator is regarded as necessary, 80 % of the installers in Hungary propose a qualified expert for this, 100 % of the Greek installers propose a committee consisting of one representative of the own professional body and one representative for the consumers´ interest.

Quality label and professional training

In order to establish market transparency and to ensure the necessary quality standards, a quality label or a recognized certificate linked to a professional training course could be established. Installers are asked if such kind of label would be useful.

In Austria, only 50% of the installers are of the opinion that a special certificate for a professional training or a product label „Guaranteed Installation Quality“ would be useful to promote high quality installations. In Germany, Hungary and Spain 70 % to 80 % of installers agree, while in Greece 100 % (partly) agree to such a label.

6 Recommendations for manufacturers of boilers and their components for detached and semi-detached houses and small apartment buildings

This section provides recommendations for manufacturers to further improve their boiler developments (including components) for detached, semi-detached and small apartment buildings.

6.1 Improving the hydraulics of small wall-mounted and floor-standing compact boilers

The biggest part of the gas boilers (and gas combination water heaters) available today are constructed either as low temperature or as condensing boilers. They are wall-mounted multi-purpose devices with integrated or separate small storage tanks; sometimes they are also floor-standing compact boilers with an integrated small storage tank.

Boilers of this construction type have to provide space heating as well as domestic hot water. They have a very low water content (about 3 to 6 litres at 14 to 24 kW of power); this is the only way to ensure comfortable and appropriately quick hot water supply using the instant water heater principle. The low boiler water content of these appliances induces:

- the need of a minimum water circulation inside the boiler to avoid overheating
- the installation of integrated pumps which are usually too big for downstream heating circuits (causing a high auxiliary energy consumption) because of the high hydraulic resistance of the heat exchanger
- the installation of bypass valves and sometimes the use of hydraulic nodes. This causes an increased return temperature, which will often impede condensation and thereby increase the fuel consumption of condensing boilers

Suggestions for the optimisation of wall-mounted and floor-standing compact boilers up to 24 kW with low water content:

- Realisation of a **higher power modulation range** than the current 1:3 or 1:4 between the lowest and highest power possible. The optimum is at 1:15, in combination with a base load as low as possible (below 4 kW) to avoid the need for a minimum water circulation inside the boiler.
- Constructive **redesign of the appliance hydraulics** including the increase of boiler water content (at least 10-20 l) aiming at a low overall pressure loss in the heat generator (about 50 mbar at rated load).

6.2 Installation of measurement devices in heating systems for an automated energy balance

If the installation contractor wants to guarantee the achieved energy efficiency improvement via the standardised annual overall efficiency, **a targeted energy monitoring** of small heating appliances by measuring fuel input and heat output is required. It will be advantageous, if the measuring is not conducted manually – causing high effort – but automatically using appropriate measurement devices.

Appropriate heat meters with a small pressure loss (for example using ultrasound) should measure the energy transfer to the heating system respectively to the domestic water heating as well as further energy input (solar, biomass, …).

Fuel use may be monitored with gas or oil quantity meters. It is also possible to additionally gauge the condensate quantity of condensing boilers, which is a measure for the effectiveness of operation in the condensing mode.

Using these data, it will be possible to set up an energy balance, which can be used to control the boiler efficiency.

The data must be saved and stored on site; they may be gathered and analysed once a year at the end of the heating season by the service provider on-site or via remote access.

Suggestions for the installation of measurement devices in heating systems for an automated energy balance:

- The heat and fuel meters and interfaces for data transfer needed for automatic data logging should be integrated into heating systems by default.[9]

6.3 Reduction of auxiliary electrical energy consumption in small heating systems for detached and semi-detached houses

The auxiliary energy use of a heating system normally consists of the energy requirements of the various pumps (space heating water circulation, domestic hot water circulation, and boiler charging pump), the energy requirement of the fan and the electronics. Starting points for the reduction of auxiliary energy use are particularly the pumps. Energy-saving EC-motor pumps are now available on the market, enabling savings of up to 80%. Additional savings can be achieved by demand-driven control of pumps.

The operating times of hot water circulation pipes are often set too high. Reliable recommendations for use-oriented, hygienically safe system operation standards are lacking. Another factor causing high energy consumption are control electronics. This is mainly caused by inefficient transformers with a high stand-by consumption and would be easily avoidable by using electronic power supplies.

Suggestions for the reduction of auxiliary energy:

- Boiler and space heating circuits, hot water circulations and the boiler charging circuit should be fitted with class A (rsp. EC motor) circulating pumps as standard. For boiler and heating circuits, the EuP regulation makes class A pumps mandatory anyway from 2015 onwards, therefore it will be useful to start with the integration as early as possible.
- The controls of the boiler must allow individual settings for an efficient and demand-orientated mode of operation of the different hydraulic elements (pumps, valves).
- Concerning the determination of reliable parameters (operation time, temperatures, etc.) and concepts for an energy-efficient and hygienically safe operation of the domestic hot water circulation, comparative EU-wide studies should be conducted. These should take into account

[9] This advice is not based on present costs but assumes reduction of costs in case of integration and therewith mass production.

the differences between typical storage concepts in compact systems: instant heater for hot water, buffer storage concept, external fresh water station.
- Reduction of the stand-by energy consumption of the heating controls.

6.4 Improving the overall efficiency of integrated heating systems, especially heating systems in combination with thermal solar systems for hot water generation and space heating

Extensions of heating systems by solar thermal systems have been more and more successful recently. In space heating and hot water generation it offers a big potential for savings of fossil fuels and reducing emissions. But often the interaction of heating systems with solar thermal systems, following current studies and the Boileff metering results, may be judged as not hydraulic optimised.

Suggestions for boiler producers and component suppliers for a better hydraulic integration of several heat generating systems into a complete system

- Optimisation of the hydraulic integration of several heat generating systems into a highly efficient complete system. The installers can be qualified by manufacturers through training courses on site, using optimised demonstration systems and well-known hydraulic standard schemes combined with practice-oriented guidelines.
- Mandatory installation of heat meters and - where required - retrofitting of a so-called “acoustic function control” into the controls panel of solar thermal systems for heating support.

7 Conclusions

Insufficient installation of heating systems often leads to low efficiency of new – even condensing – boilers. Although test cases demonstrate that new boilers may achieve high efficiency, their real performance is often much lower. The BOILeff project was initiated to develop and to assess two new market approaches for improving the efficiency of boiler installations.

The first market approach is a high quality declaration (DHQUI). This declaration is included in the contract between installers and end consumers. It provides a checklist of quality criteria for a "high quality installation". The second approach is a "performance guarantee" (GPQU). The installer should be able to guarantee a certain efficiency of the boiler as a result of a "high quality installation".

These two approaches were tested and evaluated by field tests under real conditions in the heating period 2008/2009. For the field tests, typical residential buildings with heat loads up to 20 to 25 kW have been taken into account.

In total, metering results were achieved in 23 gas heating systems, 3 oil heating systems and 3 biomass heating systems in Austria, Germany and Hungary. Due to the low number of heating systems with oil and different biomass technologies (and biomass fuels), for comparison reasons, an in-depth analysis was only carried out for gas heating systems.

In average, the gas heating systems achieved a seasonal efficiency of 87,9% (GCV), the two oil heating systems 85,0% (GCV), the pellets system 90,6% (NCV) and the firewood boiler 74,2% (NCV). BOILeff installations outperform standard systems (stock consideration) by 11,9 (gas), 10,0 (oil), 16,6 (pellets) resp. 7,2 (firewood) percentage points.

The energy savings that can be achieved by the deployment of both market instruments are expected to be quite considerable.

In Austria presently approximately 62,545 GWh/a are required for space heating and domestic hot water. The Austrian Energy Agency assumes final energy savings of up to 13.3% by a total exchange of the heating system stock to optimally installed highly efficient heating systems. This correlates to a possible reduction of greenhouse gas emissions of up to 4.74 Mio. t per year. Final energy savings of 4,300 GWh/a and a reduction of greenhouse gas emissions of 890,000 kg/a can be achieved. Innoterm expects energy savings of 3,200 MWh/year in Hungary. URV Crever estimates annual energy savings of about 350 MWh/year in Spain.

The analysis shows that the GPQU method (formula) can forecast the efficiency within a security band of 3 percentage points in Austria and of 6 percentage points in Hungary. The following parameters contribute positively to the seasonal efficiency: (i) boiler is placed in the heated area, (ii) boiler has no bypass valve, (ii) heat dissipation by floor heating system, and (iv) additional solar thermal system. Positive correlations to the seasonal efficiency were analysed for the following parameters: (i) increasing heat and work load, (ii) low overdimensioning, (iii) low domestic hot water demand, and (iv) high energy demand. Problems could be identified in test cases with low heat loads. In these cases boilers are often overdimensioned; sometimes installers did not care to perform heat load calculations or there was no suitable boiler model available.

Based on the evaluations made it is concluded that both market approaches could be successfully proved by the results of BOILeff project. Taking into account that there was a random choice of condensing boilers on a different price and efficiency level, it may be further concluded that the achieved performances of installations based on certain brands and models (of this brand) will outperform the values of GPQU formula (based on DHQUI installations)(!)

When assessing the two new proposed market approaches in the participating countries only small differences exist in the participating countries. The customers as well as the installers regard the DHQUI approach as realistic whereas the GPQU is only partly agreed with at the moment. It seems that too many questions are still open (e.g. the open question regarding an independent arbitrator in case the guaranteed efficiency is not achieved).

Generally the agreement in Austria and Germany is higher than in Hungary, Greece and Spain but the customers' motivation to implement a high quality installation matches the installers' in all participating countries: Customers want a high quality installation to save greenhouse gas emissions and money, installers see the possibility to extend their business activities via a clear differentiation from cheap installations.

Because of the higher installation quality, both the customers and the installers expect fuel savings between 5 % and 30 %. The customers principally accept additional costs, which will result from DHQUI and GPQU, though there are some differences between countries regarding the amount of the additional costs. It is agreed that additional costs could be reduced partly by general integration of heat and electricity meters into the heating system.

One major problem are obstacles for future implementation, which have to be overcome: Insufficient transparency of the installation quality for customers, more personal and time efforts for acquisition and higher efforts for the initial setup by installers.

These obstacles can partly be overcome by the installation of an independent arbitrator, who can mediate in case of problems. Nearly all customers and installers in the participating countries agree to such an institution, though big differences and uncertainties exist concerning the question which institution or person could execute such a role.

An important measure to overcome insufficient transparency for the customer and to reduce time efforts for acquisition of the installer could be the invention of a "Guaranteed Installation Quality Label" for installers who are certified to carry out high quality installations. All customers in the participating countries agree, the installers generally agree as well but show a different grade of agreement in the different countries: Austria 50 %, Germany, Hungary, Spain 70 % to 80 % and Greece 100 %.

Recommendations to the boiler manufacturers focussed on the following issues:

- Improvement of the hydraulics of small wall-mounted and floor-standing compact boilers
- Installation of measurement devices in heating systems for achieving automated energy balances
- Reduction of auxiliary electrical energy consumption in small heating systems for detached and semi-detached houses
- improving the overall efficiency of integrated heating systems, especially heating systems in combination with thermal solar systems and/or other RES systems for hot water generation and space heating

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9 Annex

9.1 DHQUI and GPQU – English versions

9.1.1 DHQUI

Declaration of high quality
Information

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Guaranteed performance by high quality installation

Due to missing information in the offers of installers, the costumer is not able to evaluate the efficiency of a new heating system. The main selection criteria for the system and the installer is the price. In order to visualise an optimum of efficiency the Austrian Energy Agency developed in the frame of the European project "BOILeff" a declaration of high quality and a performance guarantee for high efficient installations.

The declaration of high quality contains the main quality criteria for an optimal refurbishment or new installation of a heating system. The compliance of these quality criteria should become part of the quotation of the installer to the end-consumer. This is not only in the interest of the customer but also of the installer, who will be able to prove the value of his work and this allows to differ from cheap "inefficient" quality.

By the use of the performance guarantee the installer has the possibility to guarantee the end-consumer the high seasonal efficiency of his new high efficient heating system.

In principle before the refurbishment or new installation of a heating system a detailed energy consulting of the customer has to take place to enable a high efficient heating system and maximum energy and cost savings.

The declaration of high quality is split into a general part and check lists of the heating system. The general part makes the quality criteria accessible for the end-consumer and supports the installer by the argumentation against cheap standard offers. The check lists provide the quality criteria of a high quality installation. The check lists can and should be part of the offer of the installer. By the declaration of high quality the customer is able to differ between a high quality and a cheap standard offer.

Advantages for the End-consumer

- Reduction of fuel consumption and costs
- Reduction of maintenance and repair services
- Increased seasonal efficiency
- Higher comfort through optimal heat distribution

And the installer:

- Clear differentiation from cheap installations
- Higher turnover rates
- Increased customer satisfaction
- Avoiding maintenance and repair services

By the use of the declaration of high quality and the performance guarantee the maximum cost-, energy- and CO_2- savings of new high efficient boilers (f.ex. condensing boilers) can be realized!

Calculation of the heat load of the building

The calculation of the heat load of the building is the basic principle for the dimensioning of a heating system. Basically the European standard EN 12831 has to be taken into account for the heat load calculation. This standard includes a calculation method which is binding for all European countries.

The heat load of the building is calculated by transmission and ventilation losses. The transmission heat losses include heat losses to exterior and between the heated space. Transmission heat losses between heated space result in the fact that different rooms are heated up to different indoor temperatures. Ventilation losses include heat losses to exterior and between the heated space [L 1].

The European standard EN 12831 includes a simplified and a detailed calculation method. The simplified calculation method can be taken into account for residential buildings with a maximum of three accommodation units with a high leak tightness ($n50 \leq 3{,}0\ h^{-1}$)[1] . The simplified method differs to the detailed calculation method by the following characteristics [L 1]:

- Losses to soil are simplified calculated.
- Thermal bridges are simplified calculated.
- Indoor temperatures for unheated space are assumed.
- Ventilation losses are calculated on base of the minimum air change.

It has to be mentioned that a room by room heat load calculation is essential for an energy efficient dimensioning of the heating system. Only by a documented heat load calculation it is possible to dimension the components (pumps, radiators, boiler, …) of the heating system optimal to the requirements of the building and the needs of the end-user.

Design of the boiler

On base of the heat load calculation and the efficiency of the boiler the required power output of the boiler has to be identified. It has to be mentioned that an additional raise of the heat load for heating-up after night set back has to be agreed between the installer and the end-consumer and has to be already included in the heat

[1] At a pressure difference of 50 Pa between inside and outside of the building a air change ratio of ≤ 3,0 per hour occurs.

load calculation. For this reason no further surcharges to the calculated heat load have to be taken into account!

In case the boiler supplies heating and domestic hot water the installation of an extern hot water storage tank is strongly recommended to raise the efficiency of the system. Furthermore the boiler control should avoid the heating up of the boiler and the hot water storage tank at the same time. In case of buildings or apartments with low heat load the required power output for domestic hot water defines the required power output of the boiler.

For the calculation of the required boiler output (boiler supplies heating and domestic hot water) the following formula can be taken into account:

$$\dot{Q}_f = (\dot{Q}_{HL} + \dot{Q}_{TWW} + \dot{Q}_d) * \frac{1}{\eta_K}$$

$\dot{Q}_f$........Combustion performance of the boiler [kW]

$\dot{Q}_{HL}$......Heat load of the building [kW]

$\dot{Q}_d$.......Pipeline losses [kW]

$\dot{Q}_{TWW}$....Required power output for domestic hot water [kW]

ηK ....Boiler efficiency

To achieve a high performance of the heating system a boiler with low stand by losses and a high efficiency has to be chosen (f.ex. condensing technology)!

To achieve a high boiler efficiency (especially in the case of condensing boilers) the chosen boiler shouldn't require a minimum water circulation that means a boiler with a high water content and without a integrated bypass valve has to be chosen.

To provide the optimal match of the delivery height of the pump and the requirements of the specific building a boiler with extern or interchangeable circulation pump has to be chosen.

The quality criteria of the check list „heating boiler and control devices" have to be achieved to enable a high efficient heating system.

Design of the circulation pump

The precise dimensioning of the hot water distribution (pipelines, pumps,...) is a main criteria to enable a high efficient heating system. Only by the exact dimensioning of pipelines and pumps in connection with the implementation of a hydraulic balance thermostatic values are able to regulate the room temperature exact and undesirable high indoor temperatures can be avoided. Furthermore the boiler is only able to achieve its maximum seasonal efficiency if an optimal heat distribution is enabled. Especially in the case of condensing boilers which require a low return flow temperature an optimal design of the hot water distribution is required.

<u>Volume flow rate</u>

The volume flow rate is the volume of water that the circulation pump has to carry throw the system. This flow rate depends on the heat demand of the building and is expressed in cubic meter per hour [m3/h] or in litre per hour. By the following formula the required volume flow rate of the circulation pump can be calculated:

$$\dot{V} = \frac{\dot{Q}_N}{c_p * \Delta T}$$

$\dot{V}$ .....Required volume flow rate of the pump in design point [m3/h]

$\dot{Q}_N$...Heat demand of the building [kW]

c_P ...Thermal capacity of one litre water (= 1,163 [Wh/kgK])

Δ T...Temperature difference (temperature spread) between flow and return flow [K]

<u>Delivery height</u>

The delivery height of the circulation pump is expressed in meter water column [m WC] or milibar [mbar] and describes the resistance in the pipelines of the heating system. The required delivery height of the pump is caused by the pressure losses of the heating system. The main parameters for the calculation of the required delivery height of the pump are length and diameter of the pipelines, type of boiler, type and number of thermostatic valves, etc.

Due to the fact that in case of a heat system refurbishment the laying and the diameter of the pipelines are not exactly known the following formula can be taken into account for a rough calculation of the delivery height of the circulation pump:

$$H_{PU} = \frac{R * L * ZF}{10.000} [m]$$

H_{PU} ...Delivery height of the pump [m]

R ......Losses in straight pipelines [Pa/m]

L........Length of the most unfavourable located pipeline [m] (flow and return flow)

ZF......Surcharge factor for thermostatic valves, heat meters, fittings, etc.

For standard systems in single and multi family houses the pipeline losses R can be taken into account with 30 Pa/m to 100 Pa/m (according to the year of construction of the building; older buildings show lower pressure losses 30 – 50 Pa/m because of the larger diameter of the used pipes).

The length of the most unfavourable located pipeline can be assumed by the following empiric formula:

L = (length of the building + width of the building + height of the building) x 2

After the required volume flow rate and delivery height are identified the required hydraulic power of the pump can be calculated:

$$P_{Hy} = \frac{\rho * \dot{V} * H_{PU} * g}{3,6}$$

P_{Hy}...Hydraulic power output [W]

ρ .....Dense of the heat transmission media [kg/dm3]

g .....Gravitation, (g) = 9,80665 m/s²

Finally the following formula can be taken into account to calculate the required electric power input:

$$P_{el} = \frac{P_{Hy}}{\eta}$$

P_{el}....Electric power input [W]

η......Efficiency [-]

The use of high efficient pumps is strongly recommended because of there higher efficiency (efficiency 25 to 35%) in comparison to standard pumps (efficiency between 10 and 15%) and high efficient pumps!

Selection of the pump

After the required volume flow rate and delivery height are calculated the required pump has to be chosen according to a pump diagram. The system characteristic and the pump characteristic show up the design point of the pump.

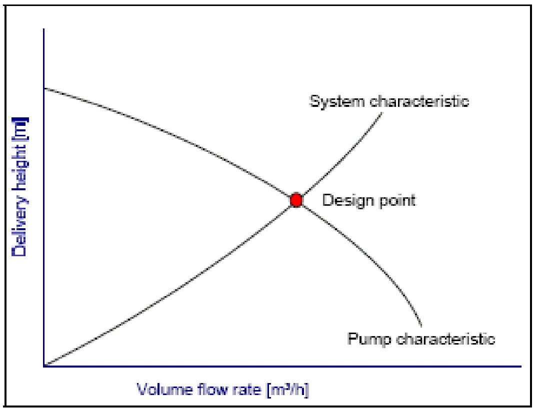

Figure 1: Example of a pump diagram: the required volume flow rate [m³/h] and delivery height [m] show up the design point of the pump [Source: Austrian Energy Agency]

It has to be recommended that no further surcharges to the required delivery height should be added because a reduction of the volume flow rate effects the heat emission of the radiators only minimal and can be easily corrected by a slight raise of the flow temperature if necessary.

The quality criteria of the check list „circulation pump" have to be achieved by the design and selection of the circulation pump to enable a high efficiency of the heating system.

Design of the domestic hot water system

The domestic hot water demand depends of multiple factors like size of the building, number of inhabitants, age of inhabitants, job of the inhabitants, season of the year, etc. Due to the raise of good insulated buildings the energy demand for domestic hot water can increase up to 50% of the total useful heat demand.

Field tests show that the seasonal boiler efficiency decline by increasing domestic hot water demand. The following reasons for the decline of the boiler efficiency have been identified [L 7]:

- For domestic hot water production the boiler has to supply flow temperatures of approx. 65 to 70 °C. This leads to high return flow temperatures and a condensation of the exhaust gas isn't possible. Due to this reason a condensing boiler can't achieve his technical possible high efficiency.
- Often only one pump is used for the heating and the domestic hot water circuit. For this reason the power output of the pump is to high for the domestic hot water circuit and the return flow temperature gets raised by the high volume flow rate.
- The boiler has to be in stand by operation during the summer period what leads to high stand by losses in relation to the low hot water demand.
- In case the power output of the boiler had to be designed according to the domestic hot water demand the boiler operates always in part load in the heating season. If part load operation is below 10 to 20% a decline of the boiler efficiency has to be taken into account.

Due to this reasons it is very important to avoid any surcharges by the design of the domestic hot water system. For the design of domestic hot water systems the European standard EN 12828 has to be taken into account.

The quality criteria of the check list „domestic hot water system" have to be achieved to enable a high efficient heating system.

Heat distribution

Basically the effective standards, guidelines and hygienic regulations have to be taken into account for the installation and design of the heat distribution network of single, multi family houses and flats.

Panel heating (f.ex. floor heating systems) need a low flow temperature in comparison to radiators. For this reason panel heating supports the optimal function of condensing boilers and solar systems. Furthermore panel heating leads to a smooth heat distribution and space savings (no space for radiators is needed).

The only disadvantages of panel heating is the high inertia of the heating surface (slow control of the indoor temperature) and the higher invest costs in comparison to a radiator system.

Insulation requirements of pipelines and fittings

The following Austrian regulations can be taken into account for minimum insulation requirements of pipelines and fittings of the heat distribution:

Table 1 Minimum insulation requirements of pipelines and fittings [L 6]

Type of pipeline and fitting	Minimum insulation requirements[2]
Pipelines and fittings in unheated area	2/3 of the pipeline diameter (maximum 100 mm)
Pipeline/fitting in-wall	1/3 of the pipeline diameter (maximum 50 mm)
Pipelines and fittings in heated area	1/3 of the pipeline diameter (maximum 50 mm)
Pipelines in floor	6 mm

The quality criteria of the check list „heat distribution" have to be achieved to enable a high efficient heating system.

Exhaust system

The exhaust system is an essential part of the heating system and has to meet several demands. Basically the exhaust system has to be installed stable and resistant against heat, exhaust gas and soot production.

Exhaust gas has a higher temperature than the outdoor temperature. For this reason a natural thermal lift occurs in the chimney and removes the exhaust. The required thermal lift is provided by the correct design of the exhaust gas system to the boiler. The dimensions of the exhaust system have to match the exhaust gas volume and temperature.

Because of different used fuels (gas, oil, biomass) and technical developments of the boilers also the exhaust system had to develop.

For a long time the single hull exhaust system was used because of its simple and quick installation. Due to oil fuelled boilers the exhaust system had to become acid-proof. This lead to the development of the acid resistant double hull exhaust system.

Presently the three hull exhaust system is state of the art. This system was developed because of low temperature boilers. The third hull is a thermal insulation which prevents the cooling down of the exhaust gas in the chimney.

The last stage of development is the humidity resistant exhaust system with integrated combustion air supply. By this system the combustion air supply is guaranteed independent to the compartment air (required for condensing boilers).

In case of the exchange of the heating system it is strongly recommended to check if the exhaust system fulfil the requirements of the new installed heating system!

For the check of the exhaust system and the dimensioning of the new heating system the responsible expert (f.ex. chimney sweeper in Austria) has to be consulted. Generally a renovation of the exhaust gas system will be necessary to support the new high efficient boiler.

The European standard EN 13384-1 and 2 includes calculation methods for exhaust systems according to used fuel, heat load, exhaust gas temperature, etc.

It is strongly recommended to consult an expert for the final selection of the required exhaust system!

The quality criteria of the check list „exhaust system" have to be achieved to enable a high efficient heating system.

Literature

[L 1] Recknagel, Sprenger, Schramek: „Taschenbuch für Heizung und Klimatechnik 07/08", Oldenbourg Industrieverlag, München 2007

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[L 3] ÖNORM EN 12831: „Heizungsanlagen in Gebäuden, Verfahren zur Berechnung der Norm-Heizlast", Österreichisches Normungsinstitut, Wien 2003

[L 4] ÖNORM Vornorm H 7500: „Heizungsanlagen in Gebäuden, Verfahren zur Berechnung der Norm-Heizlast", Österreichisches Normungsinstitut, Wien 2006

[L 5] DIN 4708: „Zentrale Wassererwärmungsanlagen", Deutsches Institut für Normungen, Berlin 1994

[L 6] OIB Richtlinie 6: „Energieeinsparung und Wärmeschutz", Österreichisches Institut für Bautechnik, Wien 2007

[L 7] Wolff, Teuber, Budde, Jagnow: „Felduntersuchung: Betriebsverhalten von Heizungsanlagen mit Gas-Brennwertkesseln", Abschlussbericht, Wolfenbüttel, April 2004

[L 8] ÖNORM EN 12828: „Heizungsanlagen in Gebäuden, Planung von Warmwasser-Heizungsanlagen", Österreichisches Normungsinstitut, Wien 2003

[L 9] MA 27, EU-Strategie und Wirtschaftsentwicklung: „Technologieleitfaden, Umwälzpumpen", Friedrich VDV, Wien 2007

[L 10] Technischer Leitfaden für das Rauchfangkehrerhandwerk, Bundesinnung der Rauchfangkehrer (Hrsg.), Wien 2005

[2] The minimum insulation requirements base on a thermal conductivity of the insulation material of 0,035 W/(mK).

Declaration of high quality
Checklists

The following check lists have been developed in close cooperation with installers and other stakeholder groups. The included quality criteria have to be achieved by an optimal installed high efficient heating system to realize maximum cost-, energy- and CO_2- savings of new high efficient boilers (f.ex. condensing boilers).

It has to be mentioned that due to different specific requirements of the building or costumer needs it is possible that not every quality criteria can or has to be fulfilled by the new heating system. However the installer has to be able to argue every not fulfilled quality criteria comprehensible. In case of doubt the customer is strongly recommended to recheck the reasons given by the installer by a competing installation company.

Checklist - Heating boiler and control devices

	YES	NO
For the dimensioning of the boiler a heat load calculation based on the European standard 12831 has been carried out.	☐	☐
The power output of the boiler fits optimal to building and user requirements.	☐	☐
A boiler with low stand by losses and a high efficiency will be installed (f.ex. a condensing boiler).	☐	☐
The chosen boiler doesn't require a minimum water circulation that means that a boiler with a high water content and without a bypass valve will be chosen.	☐	☐
To provide the optimal match of delivery height of the pump and requirements of the specific building a boiler with an extern or interchangeable heating pump has been chosen.	☐	☐
The boiler control is optimised according to building and user behaviour (f.ex. the flow temperature and the heating curve matches optimal the requirements of building and user).	☐	☐
The boiler operates according to atmospheric conditions.	☐	☐
The boiler control has a daily, weekly and holiday schedule. It is possible for the user to optimise individual parameters.	☐	☐
For easy monitoring, every heating circle is equipped with identification labels and temperature controls on flow and return flow.	☐	☐
The combustion air supply is guaranteed independent to the compartment air by a optimal dimensioned vent.	☐	☐
The quality of the heating circuit water corresponds to the requirements of the heating system.	☐	☐

Notes by the installer:

Checklist - Circulation pump

	YES	NO
A calculation of the pipeline network will be carried out to enable an optimal dimensioning of the circulation pump.	☐	☐
A documented hydraulic balance of the heat distribution and dissipation will be carried out.	☐	☐
In case of an interchangeable circulation pump an electronic commutated energy efficient circulation pump will be installed	☐	☐
The circulation pump will be adjusted to the optimal level.	☐	☐
The control device of the circulation pump will be linked to the boiler control system and adjusted by the installer.	☐	☐

Notes by the installer:

Checklist - Domestic hot water system

	YES	NO
The heat distribution pipelines will be insulated according to the minimum insulation requirements for pipelines and fittings in Austria.	☐	☐
The chosen domestic hot water storage tank is optimal isolated against heat losses.	☐	☐
The chosen domestic hot water storage tank supports the integration of a solar hot water system.	☐	☐
The used temperatures of the domestic hot water storage tank correspond to the present hygienic regulations.	☐	☐
In case of the installation of a domestic hot water circulation pipeline the daily circulation period will be limited according to the present hygienic regulations for domestic hot water production.	☐	☐
The loading times of the domestic hot water storage tank are adjusted by an expert according to the planned loading strategy.	☐	☐
The losses of the distributing network will be calculated and a hydraulic balanced implemented.	☐	☐
The domestic hot water demand and the required volume of the domestic hot water storage tank will be calculated by the installer.	☐	☐
The temperature level of the stored hot water is displayed on the domestic hot water storage tank.	☐	☐
The tapping points will be equipped with water-saving fittings.	☐	☐

Notes by the installer:

Checklist – Heat distribution

	YES	NO
The pipelines, fittings, boiler and hot water storage tank will be isolated against heat losses according to present regulations.	☐	☐
A documented hydraulic balance of the heating system will be carried out.	☐	☐
The heat emitters (f.ex. radiators) are designed according to a room by room heat load calculation.	☐	☐
All rooms or heat emitters are equipped with an individual temperature control device.	☐	☐
For the implementation of the hydraulic balance all radiators are equipped with a preadjustable thermostatic valve (adjustable Kv-value[1]).	☐	☐
The Kv-value will be adjusted by an expert during the implementation of the hydraulic balance.	☐	☐

Notes by the installer:

Checklist - Exhaust system

	YES	NO
The exhaust system will be adjusted to the installed boiler and used fuel.	☐	☐
The calculation of the exhaust system bases on the European standards EN 13384-1 and 2.	☐	☐
For the check of the exhaust system and the dimensioning of the new heating system the responsible expert (f.ex. chimney sweeper in Austria) will be consulted.	☐	☐

Notes by the installer:

Checklist - Operation start-up and adjustment

The following actions will be implemented to optimize the efficiency of the heating system:	YES	NO
all performance data of the system will be monitored and documented,	☐	☐
all settings (time schedule, temperatures, levels) will be adjusted accordingly to the performed calculations,	☐	☐
the adjustment of the room temperature and the Kv-values will be implemented and documented,	☐	☐
the hydraulic balance of heat distribution and dissipation system will be carried out,	☐	☐
the heating system will be ventilated.	☐	☐
All settings will be recorded in the start up log.	☐	☐

The customer will be briefed concerning:	YES	NO
function of the fuel supply, boiler, blower, circulation pump, control system, domestic hot water storage tank and heat emitters,	☐	☐
safety-related devices (safety relief valve, filing capacity/manometer, expansion tank),	☐	☐
optimisation of system operation (boiler operation hours, temperature levels of flow and return flow,…),	☐	☐
maintenance rates of the system,	☐	☐
actions to be taken during malfunction.	☐	☐

Notes by the installer:

By signing this document the installers guarantees the end consumer to implement the with YES marked quality criteria of the check lists. Quality criteria that won't be implemented have to be marked with NO and agreed by the customer (expected efficiency reduction by not implemented quality criteria have to be pointed out by the installer).

Address of the building

Place and date

(Signature of installer and company stamp)

Contact

Austrian Energy Agency
Mariahilfer Straße 136
1150 Vienna (Austria)
www.energyagency.at

Project Management

Günter Simader I guenter.simader@energyagency.at
Georg Trnka I georg.trnka@energyagency.at

www.energyagency.at/boileff

In cooperation with

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Wuppertal Institute for Climate, Environment and Energy
PAE RAE
CREVER Universitat Rovira i Virgili

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Published in charge of Federal Ministry of Agriculture, Forestry, Environment and Water Management, project management division V/10

9.1.2 GPQU

Performance guarantee
Information

BOIL EFF

AUSTRIAN ENERGY AGENCY

Guaranteed performance by high quality installation

Due to missing information in the offers of installers, the costumer is not able to evaluate the efficiency of a new heating system. The main selection criteria for the system and the installer is the price. In order to visualise an optimum of efficiency the Austrian Energy Agency developed in the frame of the European project "BOILeff" a declaration of high quality and a performance guarantee for high efficient installations.

The declaration of high quality contains the main quality criteria for an optimal refurbishment or new installation of a heating system. The compliance of these quality criteria should become part of the quotation of the installer to the end-consumer. This is not only in the interest of the customer but also of the installer, who will be able to prove the value of his work and this allows to differ from cheap "inefficient" quality.

By the use of the performance guarantee the installer has the possibility to guarantee the end-consumer the high seasonal efficiency of his new high efficient heating system.

Advantages for the End-consumer

- Reduction of fuel consumption and costs
- Reduction of maintenance and repair services
- Increased seasonal efficiency
- Higher comfort through optimal heat distribution

Advantages for the installer:

- Clear differentiation from cheap installations
- Higher turnover rates
- Increased customer satisfaction
- Avoiding maintenance and repair service

By the use of the declaration of high quality and the performance guarantee the maximum cost-, energy- and CO_2- savings of new high efficient boilers (f.ex. condensing boilers) can be realized!

Calculation of the performance guarantee

The main part of the performance guarantee is an empirical formula to forecast the seasonal efficiency of an optimal installed gas or oil fuelled condensing boiler. This calculation method was developed by the Wuppertal Institute and the Austrian Energy Agency and verified by Europe-wide field tests.

The following main criteria of the heating system have been identified as essential for the forecasting of the seasonal boiler efficiency:

1) Is the boiler located inside or outside the heated area?
2) Is the boiler equipped with a bypass valve?
3) Are radiators or panel heating systems used?
4) Is the boiler fuelled by gas or oil?

By the use of the following formula[1] the installer can forecast the seasonal efficiency of an optimal installed[2] gas or oil fuelled condensing boiler with a security band of three percentage points.

The four parameters (O, I, V und W) have to be changed by the installer according to the specific heating system:

$$\eta_a = 89\% * (1 - 3\%*O) * (1 + 4\%*I) * (1 - 3\%*V) * (1 - 1{,}5\%*W)$$

<table>
<tr><td colspan="2">Oil fuelled condensing boiler</td><td>O =1</td><td colspan="3">Gas fuelled condensing boiler</td><td>O = 0</td></tr>
<tr><td colspan="2">Boiler located inside heated area</td><td>I = 1</td><td colspan="3">Boiler located outside heated area</td><td>I = 0</td></tr>
<tr><td colspan="2">Boiler equipped with bypass valve</td><td>V = 1</td><td colspan="3">Boiler without bypass valve</td><td>V = 0</td></tr>
<tr><td>Radiators</td><td>W = 1</td><td colspan="2">Panel heating</td><td>W = –1</td><td>Radiator and panel heating</td><td>W = 0</td></tr>
</table>

[1] The developed formula can only be taken into account for gas and oil fuelled condensing boilers which are installed following the declaration of high quality. The calculated seasonal efficiency bases on the higher heating value (HHV).

[2] Optimal installation means that the installation fulfils the high quality level required by the declaration of high quality.

Performance guarantee

Commitment

Our installed heating system is in accordance to the highest technical and qualitative standards. For this reason we guarantee the following boiler efficiency for our high efficient heating system for two years after start up under the following preconditions:

1) Referring to the following preconditions we guarantee a minimum seasonal boiler efficiency of ....%.
2) The heated area gets heated up to the predefined indoor temperature. In case of a high reduction of the average indoor temperature the case of warrantee doesn't occur.
3) Heat and fuel meters are or will be installed to control the guaranteed seasonal efficiency of the boiler.
4) If the boiler doesn't show the guaranteed seasonal efficiency, we repair or adjust the system on our own costs. The period of warrantee won't get changed by this.
5) The case of warrantee doesn't occur under the following circumstances:
    - Insufficient maintenance of the heating system
    - Use of force or incorrect use of the heating system
    - Rebuilding or conversion of the building or parts of the building
    - Unprofessional modification of the heating system

Address of the building

-- ---

Place and date (Signature of installer and company stamp)

Contact
Austrian Energy Agency
Mariahilfer Straße 136
1150 Vienna (Austria)
www.energyagency.at

Project Management
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Georg Trnka I georg.trnka@energyagency.at

www.energyagency.at/boileff

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9.2 DHQUI – national versions

9.2.1 Greece

BoilEFF – Raising the efficiency of Boiler Installations

www.rae.gr/boileff

Το πιστοποιητικό συντάχθηκε με συνεργασία της «Πανελλήνιας Ομοσπονδίας Εγκαταστατών – Συντηρητών Καυστήρων Υγρών & Αέριων Καυσίμων» και του Εργαστηρίου ΕΜΣΚ του ΕΜΠ.

"Πιστοποιητικό Υψηλής Ποιότητας στην Εγκατάσταση Λεβήτων"

Η εγκατάσταση του συστήματος θέρμανσης έγινε με υψηλές προδιαγραφές και ποιοτικά κριτήρια.
Για τη δική σας ενημέρωση, ο εγκαταστάτης σας συμπληρώνει το παρακάτω ερωτηματολόγιο που περιγράφει τα τεχνικά χαρακτηριστικά του συστήματος. Διευκρινίζεται ότι δεν είναι απαραίτητη/δυνατή η καταφατική απάντηση σε όλες τις ερωτήσεις.

Σύστημα Θέρμανσης	ΝΑΙ	ΟΧΙ
Είναι το σύστημα διαστασιολογημένο σύμφωνα με τις ανάγκες του πελάτη;		
Υπάρχει σύστημα αντιστάθμισης της εξωτερικής θερμοκρασίας μαζί με χρονοδιακόπτη;		
Υπάρχουν θερμοστατικές κεφαλές και βάνες εξισορρόπησης, οι οποίες να έχουν ταυτοποιηθεί θερμοκρασιακά;		
Έχει τοποθετηθεί απομακρυσμένο χειριστήριο που επιτρέπει στον χρήστη να ρυθμίσει τη θερμοκρασία (έμμεση διόρθωση της καμπύλης);		
Υπάρχει ένας (μονοβάθμιος) ή δύο (διβάθμιος) ωρομετρητές για τις ώρες που λειτουργεί ο καυστήρας;		
Υπάρχει φυσικός αερισμός λεβητοστασίου;		
Υπάρχει ντάμπερ βοηθητικού αέρα (σταθεροποίησης εφελκυσμού καμινάδας);		
Υπάρχει μονοβάθμια/διβάθμια λειτουργία (διαχείρηση μερικού φορτίου) του καυστήρα;		
Υπάρχει αναλογική λειτουργία του καυστήρα με PID έλεγχο;		

Ζεστό Νερό	ΝΑΙ	ΟΧΙ
Έχει ρυθμιστεί το νερό στους 52-55°C και υπάρχει χρονοδιακόπτης ή δυνατότητα χρονοπρογραμματισμού;		
Υπάρχει ξεχωριστό σύστημα για τη φόρτιση του boiler ;		
Υπάρχει διαφορικός θερμοστάτης διαχείρισης του ηλιακού συλλέκτη ;		
Υπάρχουν διατάξεις υγιεινής για την αποφυγή της νόσου της λεγεωνέλας;		
Υπάρχει σύστημα ουδετεροποίησης συμπυκνωμάτων καύσης;		

Κυκλοφορητές	ΝΑΙ	ΟΧΙ
Υπάρχει κυκλοφορητής ή τρίοδη προστασία του λέβητα;		
Υπάρχει inverter ;		
Είναι ρυθμισμένες οι αντλίες στην καλύτερη ταχύτητα, όταν υπάρχει εξισορρόπηση;		

BoilEFF – Raising the efficiency of Boiler Installations

Σύστημα Διανομής Θερμότητας	ΝΑΙ	ΟΧΙ
Οι συλλέκτες, οι σωλήνες διανομής και οι δεξαμενές αποθήκευσης νερού θέρμανσης και χρήσης, είναι μονωμένα επαρκώς;		
Υπάρχουν δίοδες βάνες ;		
Έχουν ταυτοποιηθεί οι θερμοστατικές κεφαλές;		
Έχει γίνει εξισορρόπηση δικτύου ;		

Θερμικές απώλειες	ΝΑΙ	ΟΧΙ
Υπάρχει ψηφιακός θερμοστάτης χώρου (μονοκατοικία);;		
Έχει γίνει υπολογισμός για σύστημα με θερμαντικά σώματα στους 60°C και για ενδοδαπέδια 45°C (max);		
Έναρξη λειτουργίας	**ΝΑΙ**	**ΟΧΙ**
– Τηρείται φύλλο ελέγχου ;		
– Καταγράφονται τα ειδικά χαρακτηριστικά της εγκατάστασης (ετήσια κατανάλωση, περιοχή, μέση θερμοκρασία κτλ);		
– Οι ρυθμίσεις (χρονοδιαγράμματα, θερμοκρασίες, επίπεδα) γίνονται βάσει των αναγκών του πελάτη στα πλαίσια της μελέτης;		
– Η ρύθμιση των θερμοκρασιών γίνεται μέσω θερμίστορ;		
– Η υδραυλική εξισορρόπηση και η αντιστάθμιση εξασφαλίζει την ίδια παροχή θερμότητας σε όλα τα θερμαντικά σώματα;		
– Όλες οι ρυθμίσεις καταγράφονται με το πέρας της εγκατάστασης;		
Ο πελάτης έχει ενημερωθεί σε σχέση με:	**ΝΑΙ**	**ΟΧΙ**
– Λειτουργία των συστημάτων παροχής καυσίμου, του λέβητα, του εξαερισμού, των αντλιών, του συστήματος ελέγχου και της διανομής της θερμότητας;		
– Συσκευές σχετιζόμενες με την ασφάλεια της εγκατάστασης (ανακουφιστική βαλβίδα ασφαλείας, δυνατότητα πληρότητας/μανόμετρα, δοχείο διαστολής, αισθητήρας CO, θερμοκρασιακή επιτήρηση χώρου, ανίχνευση διαρροής αερίου-alarm κλπ);		
– Βελτιστοποίηση της λειτουργίας, χρόνος λειτουργίας, θερμοκρασιακά επίπεδα και τήρηση βιβλίου γεγονότων (ημερολόγιο λεβητοστασίου);		
– Κατευθύνσεις για οριακές καταστάσεις ασφαλείας (υπάρχουν γραπτές οδηγίες σε περίπτωση κινδύνου) ;		

Παρατηρήσεις:

Στοιχεία	
Ημερομηνία Εγκατάστασης	
Εγκαταστάτης Υδραυλικός	Εγκαταστάτης Συντηρητής Καυστήρων
Αρ.Αδείας	Αρ.Αδείας

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Intelligent Energy Europe

9.2.2 Spain

Logo empresa instaladora — CREVER — Universitat Rovira i Virgili — BOIL EFF

Declaración de una instalación de alta calidad

1- Generación/Producción de Calor	sí	no
La caldera está diseñada y se garantiza su cumplimiento de acuerdo con el Reglamento de Instalaciones Térmicas en los Edificios (RITE).	☐	☐
El programador para la regulación de la caldera tiene una programación diaria, semanal y de festivos.	☐	☐
Los parámetros del sistema de control están optimizados para la instalación y pueden ser ajustados en el dispositivo de control. El usuario puede optimizar los parámetros individuales de manera independiente (control individual por zona).	☐	☐
Con el fin de optimizar la instalación, el usuario puede cambiar la curva de calefacción de manera independiente (en el caso en que el control sea por sonda externa).	☐	☐
Para una fácil monitorización, cada circuito hidráulico dispone de su etiqueta identificativa así como de indicadores de temperatura tanto en la impulsión como en el retorno.	☐	☐
Para controlar el consumo energético se dispone de contadores de tiempo de operación y, opcionalmente, contadores de energía.	☐	☐
El suministro de aire para la combustión se garantiza con un sistema adecuado de ventilación y no únicamente con ventanas.	☐	☐
Se dispone de sistema de apoyo a la calefacción por energía solar.	☐	☐

2- Distribución del calor	sí	no
Se encuentran aislados para evitar pérdidas de calor y según la normativa vigente:		
- Tuberías y depósitos de almacenamiento	☐	☐
- Válvulas y accesorios	☐	☐
Todos los accesorios y conexiones están instalados para asegurar el balance hidráulico de la instalación.	☐	☐

3- Disipación de calor	sí	no
Todas las zonas están equipadas con un control individual (válvulas termostáticas y/o de zona). Las válvulas termostáticas deben estar correctamente ajustadas para el uso de la zona (ajuste de temperatura).	☐	☐
Se utilizan preferentemente sistemas de baja temperatura como por ejemplo suelo radiante.	☐	☐

4- Bombas de circulación	sí	no
Las bombas de circulación se escogieron siguiendo criterios de bajo consumo (Clase A).	☐	☐
La bomba de circulación está instalada para asegurar un funcionamiento óptimo.	☐	☐

5- Generación/Producción de agua caliente	sí	no
Los tiempos de carga del sistema de acumulación han sido ajustados por un experto de acuerdo con la estrategia de carga planificada.	☐	☐
Si hay acumulador, la temperatura del agua se muestra y puede ser ajustada por el usuario.	☐	☐

6- Arranque de operación y ajuste	sí	no
Referente a la optimización energética se han tenido en cuenta los siguientes aspectos:		
– Todos los datos de funcionamiento están monitorizados.	☐	☐
– Todos los ajustes (horarios, temperaturas, niveles) están realizados de acuerdo con los cálculos de dimensionado de la instalación.	☐	☐
– El balance hidráulico de distribución y disipación de calor se ha realizado.	☐	☐
– Todos los ajustes están registrados en el informe de puesta en marcha.	☐	☐
El cliente ha sido informado sobre:		
– El funcionamiento del suministro de combustible, la caldera, el calefactor, la bomba, el sistema de control, el sistema de calentamiento de agua y la disipación de calor.	☐	☐
– Dispositivos relacionados con la seguridad (válvula de seguridad, capacidad de llenado/manómetro, tanque de expansión).	☐	☐
– Operaciones de optimización, tiempos de funcionamiento, niveles de temperatura, libro de mantenimiento y manual de uso.	☐	☐
– Qué debe hacer en caso de mal funcionamiento.	☐	☐

7- Firmas		
Lugar, fecha		Referencia
El Usuario		El Instalador

9.2.3 Hungary

innoterm
Energetikai és Környezetvédelmi Fejlesztő Kft.
Environment Protection and Development Ltd.

BOIL EFF

Kazánbeépítés minőség ellenőrzése

Általános adatok

Az ingatlan tulajdonosának vagy üzemeltetőjének adatai:

Név: ....

Cím: ....

Telefon: ....

Az ingatlan adatai, ahol a fűtési rendszer működik:

Cím: ....

Használat módja: ☐ Lakás ☐ Hotel ☐ Vendéglátóüzem
☐ Irodaépület ☐ Iskola ☐ ....

Építés éve: ....

Az összes fűtött helyiség hasznos alapterülete: .... m²

A fűtött helyiségek bruttó alapterülete: .... m²

Az épület méretezési hőigénye: .... kW

Hőigényadat forrása: ☐ Energiatanusítvány ☐ Hőszükséglet-számítás
☐ Ismeretlen

Kazán / Tüzelőberendezés:

Gyártmány: ....

Tüzelőanyag: ☐ földgáz ☐ PB-gáz ☐ tüzelőolaj ☐ egyéb:....................

Típus: ☐ Nyitott égésterű ☐ Zárt égésterű ☐ Kondenzációs

Évjárat: .... **Névleges hőteljesítmény (Adattábla szerint):** .... kW

Kiegészítő / Tartalékfűtés:

☐ Hőszivattyú (HMV készítés) ☐ Egyedi-/ Cserépkályha ☐ Villamos fűtés

☐ Egyéb: .... ☐ Napkollektor (.............m²) ☐ nincs

Intelligent Energy Europe

Használati melegvíz (HMV) készítés

Fűtési időszakban: ☐ Fűtéssel kombinált ☐ Önálló berendezéssel
☐ Egyéb: …………………..…………………………….

Fűtési időszakon kívül: ☐ Fűtéssel kombinált ☐ Önálló berendezéssel
☐ Egyéb: …………………..…………………………….

HMV készítés összesen ……... személy részére

HMV tároló: ☐ van (Térfogat: ……………l) ☐ nincs

Megjegyzés:

Hőelosztás és hőleadás:

Hőleadás: ☐ Fűtőtestekkel ☐ Felületfűtéssel ☐ Egyéb:……………................

Szabályozás módja: ☐ Időjárásfüggő ☐ Helyiséghőmérsékletről

☐ Zónás szabályozású ☐ Thermosztatikus szeleppel ☐ Időkapcsolással

☐ Egyéb:…………………………………………………………………………………………...

Elosztó rendszer: ☐ Egycsöves ☐ Kétcsöves

Csatlakozó csővezetékek: ☐ hőszigeteltek ☐ nem hőszigeteltek

Vezetékek hőszigetelése:

☐ ≥ 2/3 csőátmérő, vagy 3 cm ☐ < 2/3 csőátmérő ☐ nincs

Szerelvények hőszigetelése: ☐ van ☐ nincs

Keringető szivattyúk kivitele: ☐ A energiaosztály ☐ Szabályozott ☐ Hagyományos

Keringető szivattyú(k) évjárata(i): ………………………………………………

Keringető szivattyúk száma: ……………………….……………………………db

Cirkulációs szivattyú: ☐ van ☐ nincs

Cirkulációs szivattyú kivitele: ☐ A energiaosztályú ☐ szabályozott ☐ hagyományos

Működésmód: ☐ Időszabályozott ☐ Hőmérsékletről szabályozott ☐ Tartós üzemű

Kazánbeépítés minőség ellenőrzés

1- Hőtermelés	igen	nem
A kazán teljesítménye a "A kazánok méretezési alapelvei" szerint van meghatározva?".	○	○
A vízmelegítőnek van napi, heti és vakációs programja?	○	○
A vezérlőrendszer paraméterei az épülethez vannak beállítva és a vezérlőn keresztül állíthatóak. Lehetséges a felhasználó számára a különböző paraméterek külön-külön bealítása?(szobánként).	○	○
A fűtési görbe egyedileg állítható?	○	○
A nagyobb átláthatóság érdekében, minden fűtési ág fel van címkézve és a hőmérsékletadatok szerepelnek mindkét irányban a csöveken?	○	○
Az energiafogyasztás, vagy üzemidő mérők vannak felszerelve	○	○
Az égéslevegőellátás egy megfelelő nagyságú ventilátor által van biztosítva, nem szellőzőnyílásokon, vagy nyílászárókon keresztül	○	○
2- Hőszállítás	igen	Nem
Mindegyik csővezeték, szerelvény, tároló és melegvíztartály megfelelően le van szigetelve?	○	○
Minden szükséges szerelvény és szabályozó bekötése olyan, hogy a megfelelő hidraulikus egyensúlyt biztosítsa az épületben?	○	○
3- Hőleadás	igen	Nem
Minden helyiség fel van szerelve egyéni szabályozóval (előre beállítható termosztatikus szelep). A szelepek a helyiségeknek megfelelően vannak bealítva.	○	○
Lassú, felületi fűtések (pl. a padlófűtés, amelyek legtöbbször 30°C-on működnek) vannak beépítve, az egyéni helyiségszabályozás emiatt elhanyagolható.	○	○
4- Keringető szivattyúk	igen	Nem
A keringető szivattyúk a "Leírás a keringető szivattyúk méretezéséhez"-ben ismertetettek szerint lettek kiválasztva?	○	○
A keringető szivattyú az optimális szintre van beállítva?	○	○
5- HMV előállítás	igen	Nem
A fűtési idők szakember által, és megtervezett töltési stratégia szerint lettek beállítva.	○	○
A tárolt víz hőmérséklete látható a vízmelegítőn (hőmérő) és állítható a felhasználó által	○	○
6- Üzembehelyezés és beszabályozás	igen	Nem
Az energia optimizálás terén következők állapíthatók meg:	○	○
– Minden teljesítmény adat ellenőrizhető.	○	○
– Minden beállítás (időzítés, hőmérsékletek, szintek) az épületre vonatkozó hőszükséglet számítás szerint van beállítva.	○	○
– A helyiségek hőmérséklete a termosztatikus szelepeken keresztül van szabályozva.	○	○
– A hőleadás-és továbbítás hidraulikus egyensúlya be van szabályozva, és az égéslevegőt ventilátor biztosítja.	○	○
– Minden beállítás fel van jegyezve az üzembehelyezési naplóban.	○	○
A felhasználó felvilágosítást kapott a következőkről:		
– A fűtőanyag ellátásról, a kazán, a szellőző, a szivattyú, vezérlőrendszer, vízmelegítő és hőszállító rendszer működéséről.	○	○
– A biztonsági berendezésekről (biztonsági szelep, töltési lehetőség/nyomásmérő, kiegészítő tartály)	○	○
– Működés optimizálása, üzemeltetési idők, hőmérsékletfokok, energiakönyv vezetés	○	○
– Teendők nem megfelelő működésnél	○	○

Megjegyzés:

Kazánbeépítés minőség ellenőrzés 3/4

Tüzelőanyag (gáz) fogyasztásmérő:

Típusa: ……………………………………………….

Előző évi fogyasztás: ………………………… m^3

Induló óraállás: ………………………… m^3

Végső óraállás: ………………………… m^3

Egyéb fogyasztók:	**Névleges teljesítmény**	**Éves fogyasztás**
Tűzhely: ☐	……………………kW	………………. m^3
Vízmelegítő: ☐	…………………… kW	………………. m^3
Egyéb:……………………	…………………… kW	………………. m^3

ÉVES HATÁSFOK SZÁMÍTÁSÁHOZ SZÜKSÉGES HŐMENNYISÉGMÉRŐ:

☐ **VAN** ☐ **NINCS**

Hőmennyiségmérő:	**1.**	**2.**
Típusa:	…………….…………	………………………..
Induló óraállás:	……………………MJ	……………………MJ
Végső óraállás:	……………………MJ	……………………MJ

Beépítési hely: **Kazán visszatérő** ☐ **HMV hidegvízág** ☐

Fűtési visszatérő ☐

Villamos energiamérő:	**1.**	**2.**
Típusa:	…………………………	…………………………..
Induló óraállás:	……………………kWh	………………………kWh
Végső óraállás:	……………………kWh	………………………kWh

Mért fogyasztók: **Fűtési rendszer teljes** ☐ **HMV készítés** ☐

Fűtési + HMV rendszer ☐

Megjegyzés:

A beépítést végző adatai:

Név: ……………………………………………… **Cég:**…………………………………….…

Cím:……………………………………………………………………………………………

Telefon: ………………………………………………..

Beépítés Dátuma:……………………… **Méréskezdet Dátuma:**……………….…………

Mérésbefejezés Dátuma:………………………

________________________ ________________________

A beépítést végző aláírása Tulajdonos / üzemeltető aláírása

Kazánbeépítés minőség ellenőrzés 4/4

9.2.4 Germany

BOIL EFF

Erklärung für die qualitätsgesicherte Installation (Qualitätsprotokoll)

1- Wärmeerzeugung	
Der Kessel wird gemäß der "Auslegungshilfe Gas- und Ölheizungen" ausgelegt.	○
Die Regelung der Heizung verfügt über ein Tages-, Wochen- und Ferienprogramm.	○
Die regeltechnischen Parameter werden auf die Anlage optimiert und im Regelgerät eingestellt. Der Benutzer hat die Möglichkeit einzelne Parameter selbständig zu optimieren (Einzelraumregulierung).	○
Um die Anlage zu optimieren, kann der Benutzer die Heizkurve selbstständig einstellen.	○
Zur einfachen Kontrolle wird jeder hydraulische Kreis am Vor- und Rücklauf mit Bezeichnungsschildern und Temperaturanzeigen ausgerüstet.	○
Um den Energieverbrauch überprüfen zu können, ist ein Betriebsstundenzähler und ein Durchflussenergiezähler eingebaut (optional).	○
Die Verbrennungsluft wird über ein hierfür ausgelegtes Gebläse zugeführt, ein geöffnetes Fenster ist nicht ausreichend.	○
2- Wärmeverteilung	
Sämtliche Leitungen, Armaturen, Speicher und Wassererwärmer werden gemäß den Vorschriften gegen Wärmeverluste gedämmt.	○
Es werden alle notwendigen Armaturen und Messstutzen installiert, um einen hydraulischen Abgleich der Anlage vorzunehmen.	○
3- Wärmeabgabesystem	
Alle Räume werden mit einer selbstständigen Regelung (voreinstellbare Thermostatventile) ausgerüstet. Die Thermostatventile sind auf die Nutzung des Raumes abzustimmen (Temperatureinstellung).	○
Es werden vorwiegend träge Flächenheizungen (z. B. Fußbodenheizung) installiert, die mit höchstens 30°C Vorlauftemperatur betrieben werden. Die selbstständige Raumregelung (Thermostatventil) entfällt dadurch.	○
4- Umwälzpumpen	
Die Umwälzpumpen werden gemäß der "Auslegungshilfe Umwälzpumpen" ausgewählt.	○
Die Umwälzpumpe wird auf die optimale Betriebsart und Leistungsstufe eingestellt.	○
5- Warmwasserbereitung	
Die Ladezeiten werden durch eine Fachkraft gemäß der vorgesehenen Ladestrategie eingestellt.	○
Das Temperaturniveau des gespeicherten Wassers wird auf dem Warmwasserspeicher angezeigt (Thermometer) und kann durch den Benutzer eingestellt werden.	○
6- Inbetriebnahme und Einregulierung	
In der Anlage werden zur Energieoptimierung:	○
– Sämtliche Leistungsdaten kontrolliert	○
– Sämtliche Einstellungen (Zeiten, Temperaturen, Stufen) nach der Auslegungsberechnung eingestellt	○
– Die Einstellung der Raumtemperatur an den Thermostatventilen vorgenommen	○
– Der hydraulische Abgleich der Wärmeverteilung und Wärmeabgabe wird durchgeführt und die Anlage wird entlüftet	○
– Sämtliche Einstellungen werden im Inbetriebnahmeprotokoll festgehalten	○
Der Kunde wird instruiert bezüglich:	
– Funktion von Brennstoffzufuhr, Heizkessel, Brenner, Pumpe, Regulierung, Wassererwärmer und Wärmeabgabe	○
– Den sicherheitstechnischen Einrichtungen (Sicherheitsventil, Füllmenge/Manometer, Ausdehnungsgefäß)	○
– Betriebsoptimierung, Laufzeiten, Temperaturniveu, Stufen und Energiebuchhaltung	○
– Dem Verhalten bei Störungen	○
Erläuterungen zu einzelnen Punkten (falls erforderlich):	

7- Unterschriften		
Ort, Datum		Objekt
Bauherr/Nutzer	Bauherrenvertreter/Architekt/Planer	Unternehmer

Intelligent Energy Europe

9.2.5 Austria

Qualitätsprotokoll
Information

BOIL EFF — AUSTRIAN ENERGY AGENCY

Einleitung

Derzeit entscheidet primär der Preis und nicht die Qualität über die Wahl des Installateurs. Qualitativ hochwertige Angebote können vom Kunden nicht von Billigstangeboten unterschieden werden. Daher haben Installateure, die auf Qualität setzten, keine Möglichkeit sich am Markt gegenüber Billigstanbietern durchzusetzen.

Um diese Problematik zu überwinden wurde von der Österreichischen Energieagentur ein Qualitätsprotokoll und eine Garantieerklärung zur Forcierung von qualitativ hochwertigen Heizungsinstallationen entwickelt.

Das Qualitätsprotokoll enthält die wichtigsten Qualitätskriterien für eine optimale Sanierung oder Neuinstallation einer Heizungsanlage. Die Einhaltung dieser Qualitätskriterien soll zu einem Teil des Angebots des Installateurs werden. Dadurch wird es für den Installateur möglich sich von „Billigstanbietern" zu differenzieren und für den Kunden möglich zwischen Best- und Billigstangebot zu unterscheiden.

Zusätzlich zum Qualitätsprotokoll wird es für den Installateur durch die Garantieerklärung möglich dem Kunden die hohe Effizienz seiner optimalen Installation durch einen garantierten Jahresnutzungsgrad zu gewährleisten.

Grundsätzlich sollte vor jeder Sanierung oder Neuinstallation des Heizsystems eine ausführliche Beratung des Kunden durch einen qualifizierten Energieberater durchgeführt werden, um eine optimale Energieeinsparung des Heizungssystems im Einklang mit dem Gebäude zu gewährleisten.

Das vorliegende Qualitätsprotokoll gliedert sich in einen allgemeinen Teil und in die dazugehörigen Checklisten auf. Der allgemeine Teil dient dazu dem Kunden die geforderten Qualitätskriterien näher zu bringen und den Installateur bei seiner Argumentation zu unterstützen. Die Checklisten geben vor, welche grundlegenden Effizienzkriterien eine „hochwertige" Installation beinhalten sollte. Diese Checklisten sollen zu einem Teil des Angebots des Installateurs werden. Dadurch wird es für den Installateur möglich sich von „Billigstanbietern" zu differenzieren sowie für den Kunden das Angebot auch nach der Qualität zu bewerten.

Anhand des Qualitätsprotokolls wird es für den Kunden möglich eine qualitativ hochwertiges Angebot zu erkennen und zwischen Best- und Billigstangeboten zu unterscheiden. Dem Installateur wird es durch das Qualitätsprotokoll möglich dem Kunden seine hochwertige Installation und die damit anfallenden Kosten klar darzustellen und sich somit gegenüber Billigstangeboten am Markt zu differenzieren und durchzusetzen.

Ziel des Qualitätsprotokolls ist es mögliche Kosten-, Energie- und CO2-Einsparungen von neuen hocheffizienten Kesseln (z.B. Brennwerttechnologie) durch qualitativ hochwertige Installationen optimal auszuschöpfen. Optimale Heizungsinstallationen sollen Standard werden!

Ermittlung der Heizlast

Die Ermittlung der Gebäudeheizlast ist die Grundlage für die Auslegung eines Heizungssystems. Grundsätzlich ist für dieses Berechnung die ÖNORM EN 12831 heranzuziehen. Diese europäische Norm enthält einen für alle Länder verbindlichen Rechenteil. Für Österreich wurde des weiteren die Vornorm ÖNORM H 7500 als nationaler Anhang herausgegeben, welchem spezifische Rechenwerte für Österreich zu entnehmen sind. (Die ÖNORM H 7500 enthält Tabellen für Norm-Innentemperaturen, Rechenwerte für Temperaturen in Nachbarräumen, sowie in nicht beheizten eingebauten Treppenräumen, Dachräumen und dgl.)

Die Normheizlast berechnet sich aus den Anteilen für Transmission und Lüftung. Die Transmissionswärmeverluste enthalten einerseits die Wärmeverluste nach außen aufgrund von Wärmedurchgang durch die umschließenden Flächen sowie andererseits den Wärmefluss aufgrund von Wärmedurchgang zwischen beheizten Räumen. Letzterer entsteht dadurch, dass Räume auf unterschiedlichen Temperaturniveaus beheizt werden. Die Lüftungswärmeverluste enthalten Wärmeverluste nach außen aufgrund der Lüftung und Infiltration durch die Gebäudehülle, sowie den Lüftungswärmefluss zwischen einzelnen beheizten Räumen innerhalb des Gebäudes.

Die Norm ÖNORM EN 12831 bietet zwei Verfahren zur Bestimmung der Heizlast an, ein vereinfachtes und ein ausführliches Verfahren. Das vereinfachte Verfahren gilt nur für Wohngebäude mit maximal 3 Wohneinheiten und einer hohen Gebäudedichtheit ($n_{50} \leq 3{,}0\ h^{-1}$)[1].

Es kennzeichnet sich durch die folgenden Eigenschaften:

(i). Verluste an das Erdreich werden vereinfacht berechnet.

(ii). Wärmebrücken der Bauteile werden vereinfacht.

(iii). Temperaturen für unbeheizte Räume werden vereinfacht angenommen.

(iv). Die Lüftungswärmeverluste werden lediglich aufgrund des Mindestluftwechsels errechnet.

Es ist darauf hinzuweisen, dass eine raumweise Berechnung der Heizlast grundlegend für die Möglichkeit einer energieeffizienten Auslegung des Heizungssystems ist. Erst durch eine dokumentierte Heizlastberechnung ist es möglich die Komponenten des Heizungssystems (Heizungspumpe, Radiatoren, Heizkessel etc.) optimal zu dimensionieren und das System hydraulisch abzugleichen.

---

[1] Bei einem Differenzdruck von 50 Pa kommt es zwischen Außen- und Innenseite des Gebäudes zu einer Luftwechselrate ≤ 3,0 pro Stunde.

Auswahl des Wärmeerzeugers

Die Kesselnennleistung und unter Berücksichtigung des Kesselwirkungsgrades die hieraus ermittelte Feuerungsleistung des Wärmeerzeugers wird auf Grund der durchgeführten Heizlastberechnung festgelegt. Dazu ist anzumerken, dass diverse Zuschläge für die benötigte Wiederaufheizleistung[2] (in Absprache mit dem Bauherrn) bereits in die Heizlastberechnung einfließen und daher keine weiteren Angstzuschläge[3] berücksichtigt werden müssen.

Im Falle einer kombinierten Heizung und Warmwasserbereitung durch den Kessel ist, um die Effizienz des Heizungssystems zu gewährleisten, die zusätzliche Installation eines Warmwasserspeichers dringend zu empfehlen. Auch sollte bei der Kesseleinstellung darauf geachtet werden, dass die Speicheraufladung und Wiederaufheizung des Gebäudes nicht zur selben Zeit erfolgen. Die Ladung des Warmwasserspeichers sollte möglichst während der Heizpausen erfolgen.

Im Falle einer kombinierten Heizung und Warmwasserbereitung bestimmt bei Wohnungen oder Gebäuden mit geringer Heizlast oft die notwendige Leistung für die Warmwasserbereitung die Kessel- bzw. die Feuerungsleistung.

Für die Berechnung der benötigten Kesselfeuerungsleistung im Falle einer kombinierten Heizung und Warmwasserbereitung kann grundsätzlich die folgende Formel herangezogen werden:

$$\dot{Q}_f = (\dot{Q}_{HL} + \dot{Q}_{TWW} + \dot{Q}_d) * \frac{1}{\eta_K}$$

$\dot{Q}_f$........Kesselfeuerungsleistung [kW]

$\dot{Q}_{HL}$......Heizlast des Gebäudes [kW]

$\dot{Q}_d$.......Rohrleitungsverluste [kW]

$\dot{Q}_{TWW}$...Wärmeleistung für die Warmwasserbereitung [kW]

η_K ....Wirkungsgrad des Kessels

Um eine optimale Effizienz des Heizungssystems zu gewährleisten ist ein Kessel mit geringen Bereitschaftsverlusten und hohem Kesselwirkungsgrad zu wählen (z.B. Brennwertgerät).

Auch sollte der Kessel ohne Anforderungen an einen Mindestumlauf bzw. mit großem Wasserinhalt gewählt werden. Dadurch können sowohl die Vorlauftemperatur konstanter und die Kesselrücklauftemperatur bei kleinen Volumenströmen und großen Spreizungen niedrig gehalten werden, als auch auf ein Überstromventil verzichtet werden, was sich positiv auf den Brennwertnutzen sowie auf die benötigte Pumpenleistung auswirkt.

Um die Förderhöhe der Heizungspumpe bestmöglich an die Gebäudeanforderungen sowie an den durchgeführten hydraulischen Abgleich anpassen zu können, sollte – wenn möglich – ein Kessel mit externer oder austauschbarer Heizungspumpe gewählt werden.

Die angeführten Punkte der Checkliste „Heizkessel und Heizungsregelung" sollten vom ausgewählten Kessel erfüllt werden, um eine optimale Funktion des Heizungssystems sowie eine größtmögliche Effizienz des Kessels zu ermöglichen.

Dimensionierung der Umwälzpumpe

Die korrekte Auslegung der Warmwasserverteilung ist eine wesentliche Grundlage für eine effiziente Funktion des Gesamtsystems. Nur bei genauer Dimensionierung der einzelnen Rohrstrecken, Pumpen, Regelarmaturen kann ein kostengünstiger und komfortabler Betrieb des Heizungssystems garantiert werden.

Nur durch die korrekte Dimensionierung von Rohrleitungen und der Umwälzpumpe in Verbindung mit der Durchführung eines hydraulischen Abgleichs ist es möglich, dass Thermostatventile an den Heizkörpern genau regeln können und damit eine gleichmäßige Beheizung der Räume und eine Vermeidung unerwünscht hoher Raumtemperaturen oder Ablüftverluste möglich wird. Auch kann der maximale Nutzungsgrad des Kessels nur bei einer optimalen Wärmeverteilung im System erreicht werden. Das gilt besonders für Brennwertgeräte die zur Brennwertnutzung besonders niedrige Rücklauftemperatur des Heizungswassers benötigen.

Förder- bzw. Volumenstrom

Der Förderstrom (auch Volumenstrom), den eine Heizungspumpe zu fördern hat, beschreibt die Wassermenge, die jeweils gepumpt werden muss, um eine bestimmte Wärmemenge in die Räume zu transportieren. Dieser ist somit abhängig vom Wärmebedarf des zu beheizenden Gebäudes. Er wird in Kubikmeter pro Stunde [m^3/h] oder Liter pro Stunde [l/h] angegeben und kann nach folgender Formel berechnet werden:

$$\dot{V} = \frac{\dot{Q}_N}{c_p * \Delta T}\left[m^3 / h\right]$$

V´..........Förderstrom der Pumpe im Auslegungspunkt in [m3/h]

Q´$_N$........Wärmebedarf der zu beheizenden Flächen in [kW]

c_P ....spez. Wärmekapazität von Wasser (= 1,163 [Wh/kgK])

Δ T........Temperaturdifferenz (Spreizung) zwischen Heizungsvor- und -rücklauf in [K]

[2] Im Falle einer vom Bauherrn gewünschten Nachtabsenkung der Wohnraumtemperatur muss zwischen dem Installateur und dem Bauherrn ein Zeitrahmen für die zulässige Wiederaufheizzeit des Gebäudes festgesetzt werden. Auf Basis dieser Vereinbarungen ist vom Installateur die benötigte Wiederaufheizleistung zu berechnen, durch welche die Heizlast des Gebäudes erhöht wird.

[3] Angstzuschläge sind vom Installateur individuell gesetzte Zuschläge zur berechneten Heizlast des Gebäudes, wodurch der Komfort des Kunden unter allen Umständen gewährleistet werden soll.

Förderhöhe

Die Förderhöhe (auch Differenzdruck) in Meter Wassersäule [m Ws] oder Millibar [mbar] beschreibt die Widerstände im Heizsystem und hat nichts mit der Gebäudehöhe zu tun. Der notwendige Differenzdruck der Pumpe entspricht den Druckverlusten, die innerhalb des Heizsystems durch Strömungsverluste hervorgerufen werden. Hauptsächlich fließen Länge und Durchmesser der Rohrleitungen sowie Einbauten wie Kessel, Mischer, Wärmemengenzähler und Thermostatventile in die Berechnung der Förderhöhe ein. Um das Fördermedium an jeden Punkt des Heizungssystems transportieren zu können, muss durch die Pumpenleistung die Summe aller Widerstände in der Rohrleitung und im Heizkessel überwunden werden können.

Da im Falle einer Heizungssanierung der genaue Weg der Rohrführung sowie die verlegten Nennweiten schwer feststellbar sind, kann die folgende Formel als vereinfachtes Verfahren für die überschlägige Berechnung der Förderhöhe herangezogen werden:

$$H_{PU} = \frac{R * L * ZF}{10.000} [m]$$

H_{PU} …Förderhöhe der Pumpe [m]

R ……Rohrreibungsverluste im geraden Rohr [Pa/m]

L……..Länge des ungünstigsten Heizstranges [m] für Vor - und Rücklauf

ZF……Zuschlagsfaktor für Formstücke, Armaturen, Thermostatventile, Mischer, Schwerkraftbremse, Wärmemengenzähler etc.

Für Standardanlagen im Ein- und Mehrfamilienhaus kann R mit 30 Pa/m bis 100 Pa/m angesetzt werden (abhängig vom Baujahr des Hauses, ältere Häuser haben auf Grund der verwendeten größeren Nennweiten einen kleineren Druckverlust 30 – 50 Pa/m).

Für die Länge des ungünstigsten Heizungsstranges kann zur Abschätzung die folgende Faustformel herangezogen werden:

L = (Länge des Hauses + Breite des Hauses + Höhe des Hauses) x 2

Wenn Förderhöhe und Förderstrom bekannt sind, kann die hydraulische Leistung ermittelt werden. Dies ist jene Leistung, welche die Umwälzpumpe bereitstellen muss. Die Berechnung erfolgt nach folgender Formel:

$$P_{Hy} = \frac{\rho * \dot{V} * H_{PU} * g}{3{,}6}$$

P_{Hy}...hydraulische Leistung [W]

ρ …..Dichte des Wärmeübertragungsmediums in [kg/dm3]

g …..Erdgravitation, (g) = 9,80665 m/s²

Schließlich kann die erforderliche elektrische Leistung der Pumpe nach folgender Formel ermittelt werden:

$$P_{el} = \frac{P_{Hy}}{\eta}$$

P_{el}….elektrische Leistung [W]

η……Wirkungsgrad der Pumpe [-]

Hierbei ist anzumerken, dass bei herkömmlichen Pumpen von einem Wirkungsgrad von 10 bis 15 %, bei hocheffizienten Pumpen von 25 bis 35 % ausgegangen werden kann. Für die Anwendung im Einfamilienhaus kann davon ausgegangen werden, dass grundsätzlich die kleinsten am Markt erhältlichen hocheffizienten Pumpen (Leistungsbereich 10 bis 30 W) zur Versorgung des Objekts ausreichen.

Auswahl der Pumpe

Wenn der Volumenstrom $\dot{V}$ und der Differenzdruck HPU berechnet worden sind, kann die benötigte Pumpe mittels des Pumpendiagramms ausgewählt werden. Die beiden Koordinatenpunkte HPU und $\dot{V}$ ergeben den Auslegungspunkt der Pumpe. Die passende Pumpe wird so gewählt, dass der Auslegungspunkt im Bereich unterhalb der Maximalkurve des Diagramms liegt.

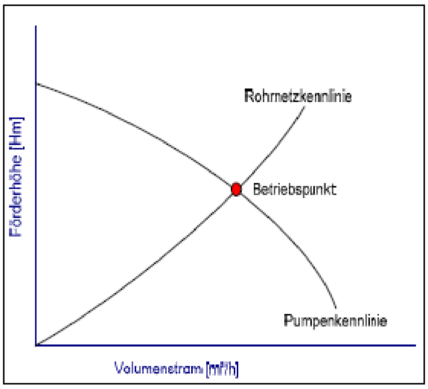

Abbildung 1: Betriebspunkt abhängig von Volumenstrom [m³/h] und Förderhöhe [Hm] [Quelle: Österreichische Energieagentur]

Es ist anzumerken, dass so genannte „Angstzuschläge" für die Pumpendimensionierung grundsätzlich nicht erforderlich sind, da sich bei einer Verringerung des Volumenstroms die Wärmeabgabe der Heizkörper nur geringfügig verändert und diese dann, falls erforderlich, durch eine geringe Anhebung der Vorlauftemperatur korrigiert werden kann.

Die in der Checkliste „Umwälzpumpe" angeführten Punkte sind für Dimensionierung und Auswahl der Heizungspumpe zu erfüllen, um eine optimale Funktion sowie eine größtmögliche Effizienz des Heizungssystems zu gewährleisten.

Dimensionierung des Warmwasser-systems

Der Bedarf an Warmwasser ist von Objekt zu Objekt sehr verschieden. Bei Wohnungen hängt der Bedarf nicht nur von der Größe der Wohnung und der Anzahl der Personen, sondern auch vom Lebensstandard, dem

Alter der Personen, dem Beruf der Bewohner, der Jahrszeit und anderen Umständen ab.

Auch erlangt die Warmwasserbereitung, bedingt durch die erhöhten Anforderungen an die Wärmedämmung von Gebäuden, immer größere Bedeutung. Das führt so weit, dass der Anteil der Warmwasserbereitung bis zu 50% der gesamten Nutzwärmemenge betragen kann. Auch haben Feldtests gezeigt, dass der Jahresnutzungsgrad des Heizungssystems mit steigendem Warmwasseranteil abnimmt.

Als Begründung für die Abnahme des Jahresnutzungsgrads können die folgenden Ursachen in Frage kommen:

(i). Für die Warmwasserbereitung werden Vorlauftemperaturen von ca. 65 – 70 °C benötigt, woraus sich Rücklauftemperaturen über dem Abgastaupunkt einstellen können, wodurch eine Brennwertnutzung nicht mehr möglich ist.

(ii). Bei den meisten Brennwertgeräten wird die gleiche Umwälzpumpe für die Heizungsanlage und die Warmwasserbereitung genutzt. Diese verfügt in den meisten Fällen über eine zu große Förderhöhe. Dies führt zu sehr kleinen Temperaturspreizungen und damit zu einer zu hohen Rücklauftemperatur, die der Brennwertnutzung entgegenwirkt.

(iii). Der Kessel muss im Sommer nur für die Warmwasserbereitstellung in Bereitschaft gehalten werden, was zu anteilsmäßig hohen Bereitschaftsverlusten des Kessels führt.

(iv). Der Kessel fährt im Falle einer geringen Heizlast des Gebäudes immer im Teillastbetrieb, was sich im Teillastbereich kleiner 10 – 20% durchaus negativ auf den Jahresnutzungsgrad auswirken kann.

Aus diesen Gründen ist es besonders wichtig Angstzuschläge bei der Bemessung des Warmwasserbedarfs und der Auslegung des Warmwasserspeichers zu vermeiden.

Für die Planung von Warmwasser-Heizungsanlagen ist auf die ÖNORM EN 12828 sowie auf die ÖNORM H 5056 zur Berechnung des Heizenergiebedarfs zu verweisen. Auch können der ÖNORM H 5056 Defaultwerte für den Verlust von Warmwasserspeichern bei Prüfbedingungen, sowie für den Nenninhalt von Warmwasserspeichern entnommen werden.

Abschließend ist darauf hinzuweisen, dass alle in der Checkliste „Warmwassersystem“ angeführten Punkte erfüllt werden sollten, um eine optimale Funktion sowie eine größtmögliche Effizienz des kombinierten Warmwasser- und Heizungssystems zu gewährleisten.

Verteilnetz/Wärmeabgabe

Für die Ausführung und Dimensionierung des Wärmeverteilnetzes für Ein- und Mehrfamilienhäuser sowie von einzelnen Wohnungen sind grundsätzlich die geltenden Richtlinien, Normen und hygienischen Vorschriften zu beachten.

Flächenheizungen (Wand- und Fußbodenheizungen) haben gegenüber Radiatorenheizungen den Vorteil einer sehr niedrigen Vorlauftemperatur, wodurch die Funktion von Brennwertkesseln und Solaranlagen bestmöglich unterstützt wird. Außerdem führen Flächenheizungen zu einer gleichmäßigeren Wärmeverteilung im Raum sowie zu einer Platzeinsparung, da kein Platzbedarf von Raumheizkörpern eingenommen wird.

Als Nachteil gegenüber den konventionellen Raumheizkörpern sind jedoch die größere Trägheit der Heizflächen (schlechtere Regelfähigkeit) und die höheren Investitionskosten anzuführen.

Anforderungen an Leitungs- und Armaturendämmungen

Basierend auf der OIB-Richtlinie „Energieeinsparung und Wärmeschutz“ sind die Leitungen und Armaturen des Wärmeverteil- sowie des Warmwasserleitungssystems durch die in der folgenden Tabelle angeführten Maßnahmen zu begrenzen:

Art der Leitungen bzw. Armaturen	Mindestdämmstärke bezogen auf eine Wärmeleitfähigkeit von 0,035 W/(mK)[4]
Leitungen/Armaturen in nicht beheizten Räumen	2/3 des Rohrdurchmessers, jedoch höchstens 100 mm
Leitungen/Armaturen in Wand und Deckendurchbrüchen, im Kreuzbereich von Leitungen, zentrale Leitungsnetzverteiler	1/3 des Rohrdurchmessers, jedoch höchstens 50 mm
Leitungen/Armaturen in beheizten Räumen	1/3 des Rohrdurchmessers, jedoch höchstens 50 mm
Leitungen im Fußbodenaufbau	6 mm (kann entfallen bei Verlegung in der Trittschalldämmung bei Decken gegen beheizte Räume)
Stichleitungen	Keine Anforderungen

Tabelle 1 Mindestanforderungen an Leitungs- und Armaturendämmungen

Alle in der Checkliste „Verteilnetz/Wärmeabgabe“ angeführten Qualitätskriterien sollten erfüllt werden, um eine optimale Funktion sowie eine größtmögliche Effizienz des Heizungssystems zu gewährleisten.

[4] Bei Isoliermaterialien mit anderen Wärmeleitfähigkeiten als 0,035 W/(mK) sind die Mindestdämmdicken mit Hilfe von in den Regeln der Technik enthaltenen Rechenverfahren umzurechnen.

Abgasführung

Die Abgasanlage ist ein wesentlicher Bestandteil des Heizsystems und muss vielfältige Anforderungen erfüllen. Grundsätzlich muss sie standsicher und widerstandfähig gegen Wärme, Abgas und Russbrände sein.

Verbrennungsabgase haben eine höhere Temperatur als die Außenluft. In der Abgasanlage und in ansteigenden Teilen des Verbindungsstücks entsteht daher eine Auftriebskraft (Kamineffekt),

die den Transport der Abgase bewirkt. Der notwendige Auftrieb wird durch entsprechende Dimensionierung der Abgasanlage und des Verbindungsstücks, sowie durch exakte Abstimmung auf die Gegebenheiten des Wärmeerzeugers sichergestellt. Die geometrischen Parameter Höhe und lichte Weite der Abgasanlage müssen daher genauestens auf die zu fördernde Gasmenge und ihre Temperatur abgestimmt sein.

Durch den Einsatz verschiedener Brennstoffe (Gas, Öl, Holz) sowie durch die Weiterentwicklung der Feuerungsanlagen hat sich auch hier die Abgasanlagentechnik weiterentwickelt.

Die einschalige, gemauerte Abgasanlage war lange Zeit die gebräuchlichste Ausführung im Kaminbau, da er eine einfache und schnellere Montage gewährleistete. Mit dem zunehmenden Einsatz von Ölfeuerungsanlagen war zusätzlich zur Stand- und Brandsicherheit auch die Säurebeständigkeit gefordert. Dies führte zur zweischaligen Abgasanlage. Das Innenrohr aus Schamotte ist säurebeständig, während der Außenmantel die Standsicherheit gewährleistet. Beide Bauteile gemeinsam brachten die Brandsicherheit.

Die dreischalige Abgasanlage stellt derzeit den Stand der Technik dar. Hauptgrund dafür war die Entwicklung von Feuerungsanlagen mit niedrigeren Abgastemperaturen. Das Innenrohr, welches aus säurebeständigem Schamotte besteht, ist mit einer speziellen Wärmedämmschicht umgeben. Die Außenschale besteht aus Formstücken (aus mineralischen oder metallischen Baustoffen) und gewährleistet die Standsicherheit. Mit der Wärmedämmung wird verhindert, dass die gering temperierten Abgase in der Abgasanlage zu stark abkühlen. Außerdem muss die Wärmedämmschicht Wärmedehnungen der Innenschale kompensieren.

Die derzeit letzte Stufe der Entwicklung stellt die feuchtigkeitsunempfindliche Abgasanlage mit integrierter Verbrennungsluftzuführung dar. Das dünnwandige Innenrohr ist von einem Ringspalt umgeben, in dem die Verbrennungsluft geführt und vorgewärmt wird. Die Außenschale besteht aus einem wärmegedämmten Mantelstein bzw. Edelstahlrohr. Mit diesem System ist die Verbrennungsluftzuführung auch bei dichter Bauausführung bzw. bei Einsatz raumluftunabhängiger Feuerungsanlagen sichergestellt.

Im Fall einer Sanierung des Heizsystems und dem damit verbundenen Umstieg auf Holz oder ein hocheffizientes, mit Öl oder Gas betriebenes Brennwertgerät sind der Zustand und die Ausführung der Abgasanlage unbedingt genau zu prüfen!

Für die Beurteilung des Zustands und die Planung von Sanierungsmaßnahmen ist es unabdingbar, den zuständigen Rauchfangkehrer zu Rate zu ziehen. In der Regel wird eine Sanierung (zusätzliche Wärmedämmung, Querschnittsverengung, Einzug von feuchtigkeits-unempfindlichen Rohren) erforderlich sein. Damit kann die für Feuerungen mit niedrigen Abgastemperaturen nötige Feuchtigkeitsunempfindlichkeit der Abgasanlage gewährleistet werden.

Die ÖNORM EN 13384-1 und 2 gibt die strömungsmechanische Berechnung von Abgasanlagen nach Bauart, eingesetztem Brennstoff, Heizleistung in kW, Höhe der Abgasanlage und Abgastemperatur vor.

Abschließend ist zu erwähnen, dass in Österreich aufgrund des Bauproduktengesetzes nur mehr CE-gekennzeichnete Produkte und in seltenen Fällen auch jene, die das ÜA-Zeichen besitzen, zur Verwendung kommen dürfen. Aus sicherheitstechnischen Gründen und den früher in Österreich gültigen Qualitätsstandards (ÖNORMen und Bauordnungen) sind nicht alle CE-gekennzeichneten Abgasanlagen für die Verwendung in Österreich erlaubt. Spezifische Informationen können der vom OIB (Österreichisches Institut für Bautechnik) herausgegebenen ÖE-Liste entnommen werden.

Aufgrund dieser komplexen Rechtslage ist bei der Auswahl der Abgasanlage für den Neubau dringend eine Rücksprache mit dem zuständigen Rauchfangkehrermeister anzuraten!

Es ist darauf hinzuweisen, dass alle in der Checkliste „Abgasführung“ angeführten Punkte erfüllt werden sollten, um eine optimale Funktion sowie eine größtmögliche Effizienz des Heizungssystems zu gewährleisten.

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Qualitätsprotokoll
Checklisten

Die folgenden Checklisten beinhalten die im Rahmen des Projekts erarbeiteten Qualitätskriterien, welche von einem optimal installierten und damit effizient also- Kosten und Energiesparenden Heizungssystem zu erfüllen sind.

Es ist darauf hinzuweisen, dass aufgrund der unterschiedlichen spezifischen Anforderungen einzelner Objekte und Nutzer an das Heizungssystem nicht immer alle angeführten Qualitätskriterien erfüllt werden können bzw. müssen. Der Installateur sollte jedoch in der Lage sein für jeden mit Nein angekreuzten Punkt der Checkliste eine plausible Begründung anzuführen. Im Zweifelsfall ist es dem Kunden überlassen sich durch Mitbewerber oder unabhängige Organisationen diese Begründung bestätigen zu lassen.

Checkliste – Heizungskessel und Heizungsregelung

	Ja	Nein
Für die Auslegung des Kessels wird eine Heizlastberechnung des Gebäudes basierend auf ÖNORM EN 12831 und dem nationalen Anhang H 7500 durchgeführt.	☐	☐
Die Feuerungsleistung des Kessels wird optimal an Gebäude- und Nutzungsanforderungen angepasst.	☐	☐
Ein Kessel mit geringen Bereitschaftsverlusten und hoher Effizienz bei der Umwandlung wird ausgewählt (z.B. Brennwertgerät).	☐	☐
Ein Kessel ohne Mindestumlauf bzw. mit großem Wasserinhalt wird gewählt (kein Überstromventil wird benötigt).	☐	☐
Ein Kessel mit externer oder austauschbarer Heizungspumpe wird gewählt.	☐	☐
Die regeltechnischen Parameter werden gemäß den Anlagen- und Nutzeranforderungen optimiert und eingestellt (z.B. Vorlauftemperatur und Heizkurve werden optimal an die Heizkörper und das Gebäude angepasst).	☐	☐
Die zentrale Kesselsteuerung erfolgt witterungsgeführt anhand der Außentemperatur.	☐	☐
Die Regelung der Heizung verfügt über ein Tages-, Wochen- und Ferienprogramm. Das Niveau der Absenktemperatur bei reduziertem Betrieb ist auch vom Nicht-Fachmann einstellbar.	☐	☐
Zur einfachen Kontrolle wird jeder hydraulische Kreis am Vor- und Rücklauf mit Bezeichnungsschildern und Temperaturanzeigen ausgerüstet.	☐	☐
Die Verbrennungsluftzufuhr des Kessels erfolgt indirekt (raumluftunabhängig). Der Rohrquerschnitt der Luftzufuhr wird optimal an den Kessel angepasst.	☐	☐
Die Qualität des Heizwassers ist auf das Heizungssystem bzw. die installierten Komponenten angepasst.	☐	☐

Anmerkungen des Installateurs:

Checkliste - Umwälzpumpe

	Ja	Nein
Für die Dimensionierung des Heizverteilsystems (z.B. Radiatoren) und der Umwälzpumpen wird eine Rohrnetzberechnung durchgeführt.	☐	☐
Ein dokumentierter hydraulischer Abgleich des Heizungssystems wird durchgeführt.	☐	☐
Im Falle einer externen oder austauschbaren Pumpe wird eine drehzahlgeregelte energieeffiziente Pumpe installiert.	☐	☐
Die Förderhöhe sowie die vorgesehene Regelungsart der Pumpe wird gemäß der Rohrnetzberechnung sowie den Gebäudeanforderungen vom Fachmann eingestellt.	☐	☐
Die Pumpensteuerung wird mit der Kesselsteuerung gekoppelt und abgestimmt.	☐	☐

Anmerkungen des Installateurs:

Checkliste - Warmwassersystem

	Ja	Nein
Die Warmwasserleitungen werden gemäß den Anforderungen an die Leitungsdämmung basierend auf der OIB Richtlinie "Energieeinsparung und Wärmeschutz" gedämmt.	☐	☐
Für die Warmwasserspeicherung wird ein sehr gut gedämmter Warmwasserspeicher gewählt.	☐	☐
Der gewählte Warmwasserspeicher ist für die Integration einer solarthermischen Anlage zur Warmwasserbereitung geeignet.	☐	☐
Die Temperaturen im Warmwasserspeicher stimmen mit den geltenden hygienischen Vorschriften für die Warmwassererwärmung überein.	☐	☐
Im Falle einer Zirkulationsleitung ist die tägliche Zirkulationsdauer unter Beachtung der geltenden hygienischen Vorschriften begrenzt.	☐	☐
Die Ladezeiten des Warmwasserspeichers werden vom Fachmann gemäß der spezifisch vorgesehenen Ladestrategie eingestellt.	☐	☐
Das Leitungsnetz wird vom Fachmann berechnet und hydraulisch abgeglichen.	☐	☐
Für die Berechnung des TWW -Bedarfs und des benötigten TWW-Speichervolumens werden die derzeit gültigen Normen herangezogen.	☐	☐
Das Temperaturniveau des gespeicherten Warmwassers kann am Warmwasserspeicher durch ein Thermometer abgelesen werden.	☐	☐
An den Zapfstellen werden wassersparende Armaturen installiert.	☐	☐

Anmerkungen des Installateurs:

Checkliste – Verteilnetz/Wärmeabgabe

	Ja	Nein
Alle Rohrleitungen, Armaturen sowie Heizkessel, Warmwasserspeicher und Um-wälzpumpe(n) werden gemäß den Anforderungen an Leitungs- und Armaturen-dämmung der OIB-Richtlinie "Energieeinsparung und Wärmeschutz" gedämmt.		
Es wird ein dokumentierter hydraulischer Abgleich des Heizungssystems durchge-führt.		
Die Heizflächen (z.B. Radiatoren) werden anhand einer raumweisen Heizlastbe-rechnung dimensioniert.		
Alle Räume bzw. Radiatoren werden mit einer selbstständigen Raumtemperaturre-gelung (z.B. Thermostatventilen) ausgerüstet.		
Für die Durchführung des hydraulischen Abgleichs werden die Radiatoren mit voreinstellbaren Thermostatventilen (einstellbarer Kv-Wert) ausgerüstet.		
Der Kv-Wert der Thermostatventile wird vom Fachmann im Zuge des hydraulischen Abgleichs eingestellt und dokumentiert.		

Anmerkungen des Installateurs:

Checkliste - Abgasführung

	Ja	Nein
Die Abgasführung wird auf die eingesetzte Feuerungsanlage und den Brennstoff angepasst.	☐	☐
Es wird eine strömungsmechanische Berechnung der Abgasanlage auf Basis der ÖNORM EN 13384-1 und 2 durchgeführt.	☐	☐
Die installierte Abgasanlage besitzt das ÜA -Kennzeichen bzw. eine CE-Kennzeichnung.	☐	☐
Für die Beurteilung des Zustandes und die Planung der Sanierungsmaßnahmen wird der zuständige Rauchfangkehrermeister einbezogen.	☐	☐

Anmerkungen des Installateurs:

Checkliste – Inbetriebnahme und Einregulierung

Bei der Anlage werden unter dem Fokus Energieoptimierung	Ja	Nein
Sämtliche Leistungsdaten kontrolliert und dokumentiert,	☐	☐
sämtliche Einstellungen (Zeiten, Temperaturen, Stufen) nach der Auslegungsberechnung eingestellt und dokumentiert,	☐	☐
die Einstellungen der Raumtemperatur und der Kv-Werte an den Thermostatventilen vorgenommen und dokumentiert,	☐	☐
ein dokumentierter hydraulischer Abgleich der Wärmeverteilung und Wärmeabgabe durchgeführt,	☐	☐
sowie die Anlage entlüftet.	☐	☐
Alle Einstellungen werden im Inbetriebnahmeprotokoll festgehalten.	☐	☐
Der Kunde wird instruiert bezüglich:		
Funktion von Brennstoffzufuhr, Heizkessel, Brenner, Umwälzpumpe, Regelung, TWW-Speicher und Wärmeabgabe,	☐	☐
der sicherheitstechnischen Einrichtungen (Sicherheitsventil, Füllmenge/Manometer, Ausdehnungsgefäß),	☐	☐
Betriebsoptimierung, Laufzeiten, Temperaturniveaus, Stufen und Energiebuchhaltung,	☐	☐
vorgeschriebener Wartungsintervalle der Anlage bzw. der vorgeschriebenen Überprüfungen der Anlage gemäß der Art. 15a B-VG- Vereinbarung der Länder,	☐	☐
sowie des Verhaltens bei Störungen.	☐	☐

Anmerkungen des Installateurs:

Mit der Unterzeichnung bestätigt der Installateur dem Kunden die mit **Ja** markierten Punkte nach bestem Wissen und Gewissen bei der Installation des Heizungssystems durchzuführen. Nicht vorgesehene Punkte wurden vom Installateur mit **Nein** gekennzeichnet und begründet, sowie mit dem Nutzer/Auftraggeber abgestimmt (d.h. der Kunde wurde durch den Installateur auf die möglichen daraus resultierenden Effizienz- oder gegebenenfalls sich einstellenden Funktionseinbußen des Heizungssystems hingewiesen).

Objekt (inkl. Adresse und Ort, PLZ)

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Auftraggeber/Nutzer | Ort/Datum | Installateur/Unternehmer (Unterschrift/Stempel)

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9.3 GPQU – national versions

9.3.1 Spain

Logo empresa instaladora participante

CREVER

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BOIL EFF

Contrato de Garantía de Eficiencia en el Funcionamiento

La presente instalación de calefacción cumple con los estándares técnicos y de calidad más elevados. Se garantiza una instalación, dimensionado y ajuste del sistema que permite conseguir unas prestaciones por encima de la media y por tanto una elevada eficiencia.

Por estos motivos está garantizada durante dos años bajo las siguientes condiciones:

1) La garantía se refiere al nuevo sistema de calefacción. Se garantiza un rendimiento anual estandarizado mínimo del sistema de calefacción (η_a) superior al 85%.

2) Se controlará el consumo de energía primaria.

3) Si el sistema no cumple con el **rendimiento** prometido, se reparará o ajustará sin coste alguno para el usuario. El periodo de garantía no se verá afectado por estas medidas.

4) La garantía no cubre aquellos casos en que la instalación:
- Haya sido objeto de un trato u operación incorrecto
- Haya sido reparado, mantenido o manipulado por personal no autorizado por el proyecto Boileff o de manera deficiente.
- Haya sido reparado o mantenido con piezas no originales.

Hay que tener presente que no se otorga ninguna garantía respecto del normal desgaste por uso u obsolescencia del producto.
En caso de reconstrucción o modificaciones del edificio se necesita una nueva revisión.

Fecha y lugar:

Empresa:
Nombre:

9.3.2 Hungary

innoterm
Energetikai és Környezetvédelmi Fejlesztő Kft.
Environment Protection and Development Ltd.

BOIL EFF

EGYÜTTMŰKÖDÉSI MEGÁLLAPODÁS

az INNOTERM Energetikai és Környezetvédelmi Fejlesztő Kft. (1071 Budapest, Városligeti fasor 47-49.) a továbbiakban: INNOTERM Kft., valamint

Név:

Cím:

mint lakástulajdonos/lakáshasználó, a továbbiakban Partner között.

1. Preambulum.
   Az energiahatékonyság növelésének egyik lehetséges módja a kazánok szakszerű beépítése, mivel ezzel az éves hatásfok növelhető. Az éves hatásfok értékről nem állnak rendelkezésre megbízható információk, ezért az EU a BOILEFF projekt keretében (EIE/061134/SI2.448721) az EU öt országában programot indított az éves hatásfok méréssel való meghatározásra.
   Magyarországon az INNOTERM Kft. a program végrehajtója, amelyet a lakástulajdonos/lakáshasználó Partnereivel együttműködve valósít meg.

2. Az együttműködés keretében az INNOTERM Kft. vállalja, hogy a partner részére:
   Térítésmentesen rendelkezésre bocsát 1 db hőmennyiségmérőt és 1 db villamosenergia mérőt.
   Szerelési utasítást a szakszerű beépítéshez
   Tájékoztatót a kazán szakszerű beépítéséhez
   Ellenőrzi az üzembehelyezést és kazánbeépítés minőségét
   A számított éves hatásfokot a Partner rendelkezésére bocsátja.

3. Az együttműködés keretében a Partner vállalja, hogy:
   Szakszerűen beépíti a mérőket és legalább 2009. 12. 31-ig használja (működteti)
   Havi rendszerességgel feljegyzi a mérőállásokat és megadja az INNOTERM Kft.-nek.
   Hozzájárul, hogy az INNOTERM Kft. megbízottai a helyszínen is ellenőrizzék a használatot.
   Az átadott mérőket nem szereli le, nem adja el, és a meghibásodás esetét kivéve nem helyezi üzemen kívül.
   Tájékoztatja környezetét a BOILEFF projekt céljáról és állásáról.

4. Partner a megállapodás aláírásával igazolja, hogy a mérőket: hőmennyiségmérő: Supercal 539 1,5 m^3/h, villanymérő: Nr. 740.168., és a szerelési utasításokat használatra átvette.

5. A program lezárása után, amely az éves kazánhatásfok meghatározásával végződik, a használatba adott mérők a Partner tulajdonába kerülnek.

Dátum:

____________________ **INNOTERM Kft.**

____________________ **Partner**

Intelligent Energy Europe

9.3.3 Germany

Garantieerklärung

Die von uns vertriebenen und installierten Heizanlagen sowie deren Zubehör entsprechen höchstem technischen- und qualitativen Standard. Insbesondere garantieren wir für eine Installation, Dimensionierung und Einstellung des Heizsystem, die zu einer überdurchschnittlich guten und damit sehr effizienten Betriebsweise führt.

Dies garantieren wir mit einer eigenständigen Garantie von zwei Jahren ab Installationsdatum nach Maßgabe folgender Bestimmungen:

1) Unsere Garantiezusage bezieht sich auf die Effizienz der neuern Heizungsanlage. Es wird garantiert, dass der mittlere normierte Jahresnutzungsgrad, bezogen auf den oberen Heizwert, mindestens den nach der folgenden Formel zu berechnenden Wert erreicht:

$$\eta_a(\beta=0,1) = 0,9\ (1 - O\ \%) * (1 + I\ \%) * (1 - V\ \%) * (1 + F\ \%)$$

mit
O = 3 für Öl- und O = 0 für Gasbrennwertkessel,
I = 4 für Kessel innerhalb und I = 0 für Kessel außerhalb des beheizten Bereichs,
V = 3 bei Vorhandensein und V = 0 für das Nichtvorhandensein eines Überstromventils im Heizkreis und
F = 2 für eine Fußbodenheizung, F = 0 für eine Radiatorheizung.

2) Wärmemengen- und Brennstoffzähler werden installiert, um den garantierten Wert für den mittleren normierten Jahresnutzungsgrad des Heizsystems zu überprüfen.

3) Zeigt sich innerhalb der Garantiezeit ein Mangel, der die Nichteinhaltung des zugesicherten Jahresnutzungsgrads zur Folge hat, bessern wir kostenfrei nach. Der Garantiezeitraum wird hierdurch nicht beeinflusst, also weder verkürzt noch verlängert. Sollte es sich um einen nicht behebbaren Mangel handeln, wird die Differenz der Energiekosten für eine Heizungsperiode rückerstattet. Diese Kosten werden aus der Differenz des garantierten und des erreichten Jahresnutzungsgrads proportional bestimmt.

4) Der Garantiefall tritt jedoch nicht ein, wenn der Mangel unter folgenden Umständen verursacht wurde:

-) Umbauten oder Umnutzung von Gebäudeteilen (hier kann eine Neuberechnung erfolgen),
-) Bei unsachgemäßer oder zweckentfremdeter Anwendung des Produkts,
-) Wenn das Produkt Fehlanwendung, Unterlassung, Unfall, Gewaltanwendung, oder Missbrauch ausgesetzt war
-) Wenn das Produkt unsachgemäß verändert oder abgeändert wurde
-) Bei unzureichender Wartung und normaler Abnutzung

Ort und Datum

Betrieb
Name

9.3.4 Austria

Garantieerklärung
Information

BOIL EFF

AUSTRIAN ENERGY AGENCY

Garantierte Effizienz durch optimale Installation

Derzeit entscheidet primär der Preis und nicht die Qualität über die Wahl des Installateurs. Qualitativ hochwertige Angebote können vom Kunden nicht von Billigstangeboten unterschieden werden. Daher haben Installateure, die auf Qualität setzten, keine Möglichkeit sich am Markt gegenüber Billigstanbietern durchzusetzen.

Um diese Problematik zu überwinden wurde von der Österreichischen Energieagentur ein Qualitätsprotokoll und eine Garantieerklärung zur Forcierung von qualitativ hochwertigen Heizungsinstallationen entwickelt.

Das Qualitätsprotokoll enthält die wichtigsten Qualitätskriterien für eine optimale Sanierung oder Neuinstallation einer Heizungsanlage. Die Einhaltung dieser Qualitätskriterien soll zu einem Teil des Angebots des Installateurs werden. Dadurch wird es für den Installateur möglich sich von „Billigstanbietern" zu differenzieren und für den Kunden möglich zwischen Best- und Billigstangebot zu unterscheiden.

Zusätzlich zum Qualitätsprotokoll wird es für den Installateur durch die Garantieerklärung möglich dem Kunden die hohe Effizienz seiner optimalen Installation durch einen garantierten Jahresnutzungsgrad zu gewährleisten.

Vorteile für den Kunden:

- höhere Jahresnutzungsgrade
- geringerer Brennstoffverbrauch und somit geringere Brennstoffkosten
- höherer Komfort durch optimale Wärmeverteilung
- niedrigere Kosten für nachträgliche Änderungen, Reparaturen und Wartungsarbeiten
- hochwertigere Ausführungsqualität und garantierte Effizienz

Vorteile für den Installateur.

- höhere Kundenzufriedenheit durch Kompetenz- und Informationstransfer
- Marktbelebung durch vermehrte Heizungsmodernisierung
- höherer Komfort für den Kunden
- Reduktion nachträglicher Nachbesserungen
- griffigere Argumentationsgrundlagen für eine qualitativ hochwertige Installation
- deutlichere Abgrenzung zu Billigstangeboten

Ziel des Qualitätsprotokolls und der Garantieerklärung ist es die möglichen Kosten-, Energie- und CO2-Einsparungen von neuen hocheffizienten Kesseln (z.B. Brennwerttechnologie) durch qualitativ hochwertige Installationen optimal auszuschöpfen. Optimale Heizungsinstallationen sollen Standard werden!

Berechnung der garantierten Effizienz

Das Hauptelement der Garantieerklärung ist eine empirische Formel zur Prognostizierung des Jahresnutzungsgrads eines optimal installierten Gas- oder Öl- Brennwertkessels. Diese Berechnungsmethode wurde im Rahmen des EU-Projekts „BOILeff" vom Wuppertal Institut und der Österreichischen Energieagentur entwickelt und durch europaweite Feldtests verifiziert.

Die folgenden vier Merkmale des Heizungssystems wurden als entscheidend für die Prognostizierung des Jahresnutzungsgrads identifiziert:

(i)Befindet sich der Heizkessel innerhalb oder außerhalb der beheizten Gebäudehülle?

(ii)Besitzt der Heizkessel ein integriertes Überströmventil?

(iii)Bedient der Heizkessel eine Radiatoren oder eine Flächenheizungen?

(iv)Handelt es sich um einen Gas- oder Öl-Kessel?

Durch die folgende Formel ist es für den Installateur möglich einen Mindestnutzungsgrad eines optimal installierten[1] Gas- oder Öl-Brennwertkessels zu prognostizieren und diesen mit einem Sicherheitsband von 3% zu garantieren.

$$\eta_a = 89\% * (1 - 3\%*O) * (1 + 4\%*I) * (1 - 3\%*V) * (1 - 1{,}5\%*W)$$ [2]

Die vier Parameter (O, I, V und W) sind vom Installateur entsprechend dem installierten Heizungssystem zu variieren:

Öl-Brennwertkessel		O =1	Gas-Brennwertkessel		O = 0
Kessel innerhalb der beheizten Gebäudehülle		I = 1	Kessel außerhalb der beheizten Gebäudehülle		I = 0
Kessel mit integriertem Überstromventil		V = 1	Kessel ohne Überstromventil		V = 0
Radiatorheizung	W = 1	Flächenheizung	W = –1	Radiator- und Flächenheizung	W = 0

1 Optimale Installation bedeutet, dass alle für das spezifische System zulässigen Qualitätskriterien des erarbeiteten Qualitätsprotokolls bei der Installation erfüllt werden.
2 Die erarbeitete Formel kann nur für Gas- und Öl-Brennwertkessel herangezogen werden, die folgend dem erarbeiteten Qualitätsprotokoll installiert wurden. Der berechnete Jahresnutzungsgrad ist auf den Brennwert des eingesetzten Heizmaterials bezogen.

Garantieerklärung
Vereinbarung

AUSTRIAN ENERGY AGENCY

Garantieerklärung

Die von uns vertriebene und installierte Heizungsanlage sowie deren Zubehör entsprechen höchstem technischem und qualitativem Standard. Deshalb übernehmen wir hiermit eine eigenständige Garantie von zwei Jahren ab Installationsdatum nach Maßgabe folgender Bestimmungen:

1) Es wird garantiert, dass basierend auf den nachfolgenden Voraussetzungen, der installierte Heizkessel bei gleich bleibender Beheizung des Gebäudes[3] einen Jahresnutzungsgrad von mindestens **.........%** erreicht.
2) Wärmemengen- und Brennstoffzähler sind oder werden vor Inbetriebnahme der Heizungsanlage installiert, um die Überprüfung des garantierten Jahresnutzungsgrad des Heizkessels zu ermöglichen.
3) Zeigt sich innerhalb der Garantiezeit ein Mangel, der die Nichteinhaltung des zugesicherten Jahresnutzungsgrads zur Folge hat, wird kostenfrei nachgebessert. Der Garantiezeitraum wird dadurch nicht beeinflusst, also weder verkürzt noch verlängert.
4) Der Garantiefall tritt jedoch nicht ein, wenn der Mangel unter folgenden Umständen verursacht wurde:
   - ✓ Unzureichende Wartung der Heizungsanlage
   - ✓ Fehlanwendung, Gewaltanwendung oder Missbrauch der Heizungsanlage
   - ✓ Umbauten oder Umnutzung des Gebäudes oder von Gebäudeteilen
   - ✓ Unsachgemäße Veränderung der Heizungsanlage

Objektadresse

--- --
Ort, Datum Installateur/Unternehmer (Unterschrift/Stempel)

Kontakt
Österreichische Energie Agentur
Mariahilfer Straße 136
1150 Wien (Austria)
www.energyagency.at

Projekt Management
Günter Simader I guenter.simader@energyagency.at
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In Kooperation mit

innoterm
Wuppertal Institut für Klima, Umwelt, Energie GmbH
PAE RAE
CREVER
Universitat Rovira i Virgili

Gefördert von

Intelligent Energy Europe

Erstellt im Auftrag des Lebensministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Projektleitung Abteilung V/10.

3 Die beheizten Räume werden auf die zwischen Installateur und Kunden festgelegte Innentemperatur beheizt. Im Falle einer starken Verringerung der benötigten durchschnittlichen Rauminnentempertur durch den Kunden verfällt die Garantiezusage.

9.4 Questionnaires for customers and installers

9.4.1 Questionnaire for customers

Project No. EIE/06/134/sI2.448721

Raising the Efficiency of Boiler Installations

Questionnaire for Customers

Date: 11.05.09

Authors: Gerhard Wohlauf, Dr. Claus Barthel, Dr. Stefan Thomas

Wuppertal Institute for Climate, Environment and Energy
Döppersberg 19
42103 Wuppertal
Germany

Part A: General part / Introduction - questions about the project and the customer, motivation and experiences/assessment regarding the participation in the project, further desires and suggestions

A 1a: Information about the object: kind of flat or house

(please underline the respective appropriate distinctive feature!)

o	Flat in a multiple family house with up to 4 / 8 /12 / more than 12 flats
o	Detached one-family house
o	One-family house as semidetached house, as terraced house (mid/end)
o	Detached two-family house
o	Other building:.. (please specify!)

A 1b: How many persons permanently live in the object under test: flat or house

o	Up to 2
o	2-4
o	5-10
o	11-20
o	More than 20

A 2: In which Boileff sub-project are you especially interested, did you take part or will you possibly take part? (please tick one box per line)

	interested (without participation)	future partici-pation possible	interested, participa-ting in the project
high quality installation according to the „Declaration of high quality installation (DHQUI standard)“	o	o	o
high quality installation with Performance Quality Guarantee (GPQU-standard)	o	o	o

A 3: Which kind of heating do you use (before and after modernisation) (multiple answers are permitted) - note: persons who are interested in the Boileff project should tick the box „before modernisation“

before modernisa tion	after modernisa tion	notice: concerning the differentiation of the details: fuels: gas / fuel oil or with / without integrated water heating! please underline the respective distinctive feature!
o	o	Gas / fuel oil heating with a floor standing boiler with / without domestic hot water
o	o	Gas-heating with a wall mounted boiler with / without domestic hot water
o	o	Gas / fuel oil heating – with additional use of renewables – if yes, please specify the kind of energy source
o	o	Gas / fuel oil heating with a floor standing condensing boiler with / without domestic hot water
o	o	Gas-heating with a wall mounted condensing boiler with / without domestic hot water
o	o	solar heat for domestic hot water; collector size in m^2: ....m^2 (...before/after modernisation!)
o	o	solar heat for domestic hot water and support of heating system; collector size m^2: ....m^2
o	o	split logs boiler: with / without buffer storage
o	o	wood pellets boiler: with / without buffer storage

O	O	Other, (please complete if so):..

A 4: Do you think that the Boileff-objective with standards for the two services „Declaration of high quality installation" and „Guaranteed performance quality" is realistic and practicable? (please tick one box per line)			
	yes	partly	no
The high quality installation according to the „Declaration of high quality installation (DHQUI standard)"	o	o	o
The high quality installation with Performance Quality Guarantee (GPQU-standard)	o	o	o

A 5: : Which were/are the main motifs for your interest in the Declaration of high quality installation? (please tick one box per line)			
	fully applicable	partially applicable	not applicable
Interest in a guaranteed quality of installation including durable high quality components (boiler, fitting material, valves etc.)	O	O	O
Ensuring an energy optimized operation of the heating system as well as largely eliminating technical dysfunctions	O	O	O
Contributing considerably to climate protection due to energy reduction to be additionally achieved by an efficient operation of the heating system	O	O	O
other:.. (please complete if so)	O	O	O

A 6 Which were the main motifs for your participation in the „Guaranteed performance quality"? (please tick one box per line)			
	fully applicable	less applicable	not applicable
Interest in a guaranteed quality of installation including durable high quality components (boiler, fitting material, valves etc.)	O	O	O
Ensuring a guaranteed performance efficiency	O	O	O
Contributing considerably to climate protection due to energy reduction to be additionally achieved by an efficient operation of the heating system	O	O	O
other:.. (please complete if so)	O	O	O

Part B: Your expectations regarding your project participation, the guaranteed quality ensured by an independent institute and the qualifications of the performing installer

B1: : Which heat savings (in percentage) do you expect for the modernised heating system in case of the „guaranteed installation quality" or the „guaranteed performance quality" ? (old boiler: 30 kW max, older than 20 years, new condensing boiler) (please tick one box per line)				
	up to 10%	**up to 15%**	**up to 20%**	**up to 30%**
Boiler old (fuel oil/gas), new gas condensing boiler	O	O	O	O
Boiler old (fuel oil/gas), new fuel oil condensing boiler	O	O	O	O

B 2a: : Which maximum additional costs per heating system are you willing to pay for the installation according to the standards of a „guaranteed installation quality" or a „guaranteed performance quality" compared to a normal installation? (please tick one box per line)				
Note: *each case applies to the necessary installation of new thermic valves with preadjustment – only the additional costs for the above mentioned services are considered*	**up to 150 Eur**	**up to 250 Eur**	**up to 400 Eur**	**up to 500 Eur**
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed installation quality	O	O	O	O
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed performance quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed installation quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed performance quality	O	O	O	O

B 2b: Which maximum additional costs (in percentage) per heating system are you willing to pay for the installation according to the standards of a „guaranteed installation quality" or a „guaranteed performance quality") compared to normal installation? (please tick one box per line)				
Note: *each case applies to the necessary installation of new thermic valves with preadjustment – only the additional costs for the above mentioned services are considered*	**up to 5%**	**up to 7,5%**	**up to10%**	**up to 15%**
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed installation quality	O	O	O	O
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed performance quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed installation quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed performance quality	O	O	O	O

B3: Which further costs per heating system are you willing to pay for the installation of the following additional components to achieve even more efficiency? (please tick one box per line)				
Note: *The additional costs include the following individual high quality components – per line and per dwelling unit in a multiple family house or per one-family house. Circulation pumps certified as A-class pumps are primarily installed, whenever possible (subject to boiler, distribution tubes)*	**Up to 50 Eur**	**Up to 100 Eur**	**Up to 150 Eur**	**up to 250 Eur**
a) additional installation of water saving valves and components (flow restrictor)	o	o	o	o
b) installation of high efficient regulating components (thermostatic valves with 1 K-proportionality range, time-controlled thermostatic valves with central control panel by means of radio control etc.)	o	o	o	o
c) installation of regulating components for a more efficient domestic hot water supply in case of central water heating (circulation control, A-class circulation pumps etc.)	o	o	o	o
d) other services: namely:... (please complete if so)	o	o	o	o

<u>Previous notions to the following questions: B4–B5</u>

Reasoning: With regard to the guaranteed installation quality according to the „Declaration of high quality installation“ or „Guaranteed Performance Quality“ the individual installer will not be able to supervise his own work. In case there will be conflicts regarding the project's success, an independent institution acting as an arbitrator for both parties (installer and customer) should be appointed.

In order to establish market transparency and to ensure the necessary quality standards, the installing companies should produce a recognized certificate of professional training or a quality-label, thus offering orientation and decision guidance to the interested customer.

B4: Is it necessary to establish an independent arbitrator and which institutions will be suitable for this purpose? (please tick one box per line)			
	yes	**I do not know**	**no**
Do you think that an independent arbitrator is necessary in case of conflicts between installer and user? If you say **yes**: to your opinion, which of the following institutions should fulfil this task?	O	O	O
	suitable	**Less suitable**	**Not suitable**
A local / regional expert board (representing the professional body, the chamber of crafts, the association of engineers, etc)	O	O	O
A scientific institute (university, university of applied science) in cooperation with a recognized expert	O	O	O
other, namely:.. (please complete if so)	O	O	O

B 5: Do you think that a special certificate for a professional training or the product label „Guaranteed installation quality" will be useful? (please tick one box per line)			
	approval	**partly approval**	**no approval**
Certificate of participation in a professional training in combination with a successfully terminated project	O	O	O
Product label on the basis of the successful participation in a one-day professional training in a recognized institute	O	O	O

We thank you for your assistance!

Please send the filled in questionnaire in the enclosed, addressed and stamped reply envelope back to the given address as soon as possible until …. (requested date).

9.4.2 Questionnaire for installers

Intelligent Energy Europe

BOIL EFF

Project No. EIE/06/134/sI2.448721

Raising the Efficiency of Boiler Installations

Questionnaire for Installers

Date: 11.05.09

Authors: Gerhard Wohlauf, Dr. Claus Barthel, Dr. Stefan Thomas

Wuppertal Institute for Climate, Environment and Energy
Döppersberg 19
42103 Wuppertal
Germany

Part A: General part / Introduction – Questions about the company's structure and activities as well as about the motivation to take part in this project.

A 1: Which are the typical activities /business fields of your company? (multiple answers are permitted)	
O	Sanitary installation (water and waste water)
O	Heating installation (service inclusive) – heating units for fossil fuels
O	solar heat for domestic hot water and support of heating system
O	biomass-split logs
O	biomass-wood pellets
O	other – if so please specify

A 2: What is the total number of employees in your company?	
O	less than 3
O	4-10
O	11-20
O	more than 20
O	more than 30

A 3: How did you learn about the Boileff-project? (multiple answers are permitted)	
O	Participation in this project was recommended by the national Boileff-organisation (business partner/staff etc)
O	Participation in this project was recommended by a business partner/employee
O	Participation in this project was recommended by an interested customer
O	I learned about the project on internet
O	other sources of information (trade journals etc.)
O	I do not remember

A 4: In which Boileff sub-project are you especially interested, did you take part or do you intend to take part (please tick one box per line)

	interested (without participation)	**interested, participa-ting in the project**	**future partici-pation possible**
high quality installation according to the „Declaration of high quality installation (DHQUI standard)“	O	O	O
high quality installation with Performance Quality Guarantee (GPQU-standard)	O	O	O

A 5: Do you think that the Boileff-objective with standards for the two services „Declaration of high quality installation" and „Guaranteed performance quality" is realistic and practicable? (please tick one box per line)			
	yes	**partly**	**no**
The high quality installation according to the „Declaration of high quality installation (DHQUI standard)"	o	o	o
The high quality installation with Performance Quality Guarantee (GPQU-standard)	o	o	o

A 6: Which were/are the main motifs for your interest in the Declaration of high quality installation? (please tick one box per line)			
	fully applicable	**partially applicable**	**not applicable**
Diversification of the own business activities with the objectives: energy efficiency and guaranteed quality for the customer	O	O	O
Improvement of expertise and reputation in the field of energy efficiency and higher customer satisfaction	O	O	O
Expectation of a higher sales volume due to high quality components and additional installation services	O	O	O
Other, namely:.. (please complete if so)	O	O	O

A 7: Which were the decisive motifs for your participation in the field test „Guaranteed performance quality"? (please tick one box per line)			
	fully applicable	**less applicable**	**not applicable**
Diversification of the own business activities with the objectives: energy efficiency and guaranteed quality for the customer	O	O	O
Improvement of expertise and reputation in the field of energy efficiency and higher customer satisfaction	O	O	O
Expectation of a higher sales volume due to high quality components and additional installation services	O	O	O
Other, namely:.. (please complete if so)	O	O	O

Part B: Success factors and barriers, indications about the additional costs for the services: „Declaration of high quality installation" and „Guaranteed performance quality" and reasoning on the necessary quality control (professional training etc.)

B 1: In how many objects under test you / your company took directly part?	
o	In no one
o	In one
o	In two
o	In three or more

B 2: From your point of view, which preconditions are important for establishing the „Declaration of high quality installation" and the „Guaranteed performance quality (please tick one box per line	fully applicable	less applicable	not applicable
openness to new challenges and high expertise of the management and the participating staff	o	o	o
your own regular clientele contains a growing number of open-minded and solvent customers for the topics energy saving and climate protection	o	o	o
Motivation of the staff by professional training with relevant training contents (hydraulic balance etc.)	o	o	o
Other, namely.. (please complete if so)	o	o	o

B3: Which typical heat savings (in percentage) do you expect in case you carry out the modernisation of a heating system according to the standards for the „guaranteed installation quality" or the „guaranteed performance quality"? (old boiler: 30 kW max, older than 20 years, new condensing boiler) (please tick one box per line)	up to 10%	up to 15%	up to 20%	up to 30%
Boiler old (fuel oil/gas), new gas condensing boiler – guaranteed installation quality	o	o	o	o
Boiler old (fuel oil/gas), new fuel oilcondensing boiler – guaranteed installation quality	o	o	o	o
Boiler old (fuel oil/gas), new gas condensing boiler – guaranteed performance quality	o	o	o	o
Boiler old (fuel oil/gas), new fuel oil condensing boiler – guaranteed performance quality	o	o	o	o

B 4: Where do you see obstacles and barriers for the success of the „Declaration of high quality installation“ and the „Guaranteed performance quality“ (please tick one box per line)	fully applicable	partly applicable	not applicable
Insufficient transparency of quality: for the customer it is very difficult to differentiate between a good and long-lasting installation and a less good!	O	O	O
Is it possible to eliminate this lack of transparency or this dilemma by means of the „Declaration of high quality installation“ and the „Guaranteed performance quality“?	O	O	O
More personal efforts for the acquisition (advertising and dialogues with customers) and an additional inspection of the unit (heating system and distribution) for the „guaranteed performance quality“	O	O	O
More efforts to prepare offers (pre-calculation), for the installation and the guaranteed quality (controlling)	O	O	O
Significantly higher efforts for the initial setup and the subsequent maintenance (follow-up optimisation and customer dialogue)	O	O	O
Other, namely:.. (please complete if so)	O	O	O

B 5: What are the typical additional costs per heating system (including exchange of the boiler) for the „guaranteed installation quality“ or „guaranteed performance quality“) in the following examples, according to your present experience? (please tick one box per line)

Note: *each case applies to the necessary installation of new thermic valves with pre-adjustment – only the additional costs for the above mentioned services are considered*	up to 150 Eur	up to 250 Eur	up to 400 Eur	up to 500 Eur
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed installation quality	O	O	O	O
Self-contained central heating for a flat with 3 or 4 rooms with about 7-9 radiators – guaranteed performance quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed installation quality	O	O	O	O
One-family house with 13 – 14 radiators - guaranteed performance quality	O	O	O	O

B 6: How do you judge the proposals of some experts to generally integrate a heat and electric meter into the heating system in order to substantiate the efficiency of the installation? (please tick one box per line)	yes	no
I fully agree – independently from the additional costs	O	O
I agree, if the additional costs do not exceed 5% per customer for a typical boiler exchange (6000 – 10000 euro)	O	O
I disapprove, because heating systems will get more complicated and thus possibly more susceptible to error	O	O
I disapprove, because the already delicate customer relations will get more complicated, dealing with the customer will be more challenging and exhausting	O	O
f) other reason, namely:... (please complete if so)	O	O

B 7: Necessary efforts as to time and costs for carrying out the following steps for the „Guaranteed installation quality" (a-h) and the „Guaranteed Performance quality" (a-l)			
Notes: OFH= one-family house of about 130 m^2 MFH= multiple-family house with about 8 flats à 80 m^2 note: the prices indicated are the customers gross prices (VAT incl.) - Prices: 01.01.2009	**OFH**	**MFH**	**unit**
a) survey of the building's particulars (physics of construction) and the central specifications of the heating system for the calculation of heat load			**h / house**
b) survey of the heating network and rooms for the calculation of heat load and subsequently the tube system			**h / room**
c) evaluation of heat load according to a valid standard (i.e. DIN EN 12831, ÖNORM EN 12831)			**h / house**
d) calculation of the tube system and identification of the values for the pre-adjustment of the thermic valves			**h / ThV**
e) assembly time for fitting a pre-adjustable thermostatic valve, diameter 15 (1/2 ")			**min / ThV**
f) time for exectuing the hydraulic balance per thermostatic valve or other differential pressure regulators			**min / piece**
g) optional: expenses for material and wage costs in case of the supplementary insulation of tubing (central distribution tubes and ascending tubes) in unheated rooms according to valid standards (OFH: diam. 20; MFH: diam. 25/32) - g1) necessary assembly time for this work			**Euro / continuous tube meter (tm)** **min / continuous tm**
h) optional: expenses for material and wage costs in case of the supplementary insulation of tubing (radiator tubes) in unheated rooms according to valid standards (OFH/MFH: each with diam. 15)			**Euro/ continuous tube meter (tm)**
i) pump parameterisation and adjusting of the central heating control (heating grades etc.)			**h / system**
j) handing over and instructing the customer on the functioning of the system and an energy-efficient operating of the system (start-up protocol incl.)			**h / system**
k) one-time average assembly time for the installation of 1 piece heat meter (hm) and 1 piece electric meter (em) respectively for the electric auxiliary energy – in case of service: guaranteed performance quality			**h/hm** **h/em**
l) annual costs for the monitoring of the system (Declaration of high quality installation incl) – guaranteed performance quality			**Euro / house**

Previous notions to the following questions: B8–B9

Reasoning: With regard to the guaranteed installation quality according to the „Declaration of high quality installation“ or „Guaranteed Performance Quality“ the individual installer will not be able, if required, to supervise his own work independently. In case there will be conflicts regarding the project's success, an independent institution acting as an arbitrator for both parties (installer and customer) should to be appointed.
If required, this institution could offer professional training for the interested installing companies in order to achieve the necessary expert knowledge. In this context, introducing of a certificate or a quality label should be discussed, for those companies that have successfully finished a training. Subsequently, these companies could use this certificate or label for marketing purposes.

B 8: Which kind of institution will be suitable to act as independent arbitrator (in case of conflicts and disputes? (please tick one box per line)			
	suitable	**less suitable**	**not suitable**
A committee consisting of one representative of the own professional body (craft guild etc.) and one representative for the consumers' interest (i.e. consumer protection agency)	O	O	O
A local/regional expert board (representing the professional body, the chamber of crafts, the association of engineers, of house owners, other independent inistutions or a university institute)	O	O	O
Other (no.1), namely:.. (please complete if so)	O	O	O
Other (no.2), namely:.. (please complete if so)	O	O	O

B 9: Do you think that a special certificate for a professional training or the product label „Guaranteed installation quality“ will be useful? (please tick one box per line)			
	approval	**partly approval**	**no approval**
Certificate of participation in a recognized professional training (minimum period: 1 to 2 days), offered by an admitted expert institute or the professional body, possibly in cooperation with an admitted and recognized modernisation project	O	O	O
Product label on the basis of the successful participation in a recognized professional training (minimum period: 1 to 2 days, including a test) and a successfully executed modernisation project including the calculation of heat load and tube system, evaluation of the pre-adjustment values and the pump capacity)	O	O	O

We thank you for your assistance!

Please send the filled in questionnaire in the enclosed, addressed and stamped reply envelope back to the given address as soon as possible until …. (requested date).

Versorgungssicherheit
Wettbewerbsfähigkeit
Nachhaltigkeit
Perspektiven

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