# *SDHplus*

# Solar District Heating in Europe

*WP2 – SDH enabling buildings with high energy performance*
*Task 2.1 – Survey and horizontal review of the existing models*

## D2.2 – Information sheet on building legislation and district heating

### Format for reporting (language: national)

Intelligent Energy Europe Programme
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# INTRODUCTION

**Reminder – Aim of the deliverable**

*This information sheet must describe clearly how DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to solar district heating. It should report in a clear and concise way: the legal background, an exemplary calculation referring also to the standard methods and software tools usually used for such normative calculations, a discussion of limits and opportunities referring to an improved use of SDH for national energy performance of buildings laws and codes. These sheets further aim at acting as a very simple but practical guide not only for DH companies but also for companies dealing with energy renovation of buildings in general.*

**Country: Germany**

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## 1. Consideration of solar district heating in building energy standards

The Energy Saving Ordinance (EnEV) and the Renewable Energy Heat Law (EEWärmeG) define requirements on the ecologic and energetic quality of buildings in Germany. In order to check if a district heating supplied new building complies with these requirements, three criteria must be taken into account: the primary energy demand and insulation level (EnEV) and the share of renewables (EEWärmeG).
In case of building refurbishment, the EnEV defines a maximum primary energy demand Qp and a maximum heat losses transmission factor HT' for the building. The HT' value depends on the insulation of the building's envelope. The Qp value depends on the remaining heat demand, the heating system and the primary energy supply. The EnEV has been updated and enacted by the German Government in October 2013.
Regarding further refurbishment or new buildings, the KfW building energy standards 'KfW-Effizienzhaus' are established in Germany. They are optional, but subsidies and cheap financing possibilities depend on their compliance.
This means following:

- There is a minimum to fulfil regarding insulation of the building's envelope in order to not exceed HT'
- The primary energy demand needed to get incentives can be achieved by insulating even more the envelope or by an efficient heat supply with low primary energy factor.

District heating or cooling represent a good opportunity to fulfil the requirements, because they often have a relatively low primary energy factor. EnEV refers to the calculation rules from the DIN norms DIN V 4701-10 and DIN V 18599-1, in which district heating systems primary energy factor calculations are described as well as heat demand calculations. Solar thermal energy is one of the environmental energies for which the non renewable share of the primary energy factor is zero.

Finally, for new buildings the EEWärmeG (Erneuerbare Energien Wärmegesetz) requirements need to be fulfilled: a new building must have a minimum share of its heating and cooling energy consumption covered by renewable energies. The heating and cooling consumption calculation method is the one defined by EnEV. The minimum share depends on the energy source, for solar heat it is 15%.

*Note: the recent negotiations about the German government coalition concluded about EEWärmeG: it will be further developed based on field reports and European legislation and adjusted to EnEV requirements. The use of renewable energies in existing buildings should stay optional.*

## *2.* Practical calculation example

Refurbishment of buildings from a residential area built in the 50's.

The multi-family buildings have been built in 1957 and count each 3 floors, 12 apartments and 829 m² living area. In the initial state, the primary energy demand of one building is more than 3 times the EnEV level. The residential area will be supplied by district heat and the buildings are oriented south. Values before refurbishment: HT'= 1,4 W/($m^2_{wall\ area}$.K), Qp = 336 kWh/($m^2_{living\ area}$.a).

The following table shows the reference maximal values for each standard:

| Standard | Qp kWh(m²a) | HT' W/(m²a) | Remaining final heat demand for heating and domestic hot water Qh kWh/($m^2_{living\ area}$.a) |
|---|---|---|---|
| EnEV 2009 reference | $Qp_{ref}$ = 80 | $HT'_{ref}$ = 0,41 | 90 |
| KfW-Effizienzhaus 85 | 85% * $Qp_{ref}$ = 68 | 100% * $HT'_{ref}$ = 0,41 | 90 |
| KfW-Effizienzhaus 70 | 70% * $Qp_{ref}$ = 56 | 85% * $HT'_{ref}$ = 0,35 | 81 |
| KfW-Effizienzhaus 55 | 55% * $Qp_{ref}$ = 44 | 70% * $HT'_{ref}$ = 0,29 | 73 |
| KfW-Effizienzhaus 40 | 40% * $Qp_{ref}$ = 32 | 55% * $HT'_{ref}$ = 0,23 | 66 |

**Fulfilment of HT'**

The measures taken for energetic refurbishment of the building's envelope are for example:

- Insulation of the walls with a thermal insulation composite system
- Insulation of the roof
- Insulation of the basement's ceiling
- Replacement of the windows

A corresponding insulation thickness and good quality windows enable reaching the required HT' value. The resulting lowered heat demand is calculated according to DIN V 4701-10 and presented in the table.

**Fulfilment of Qp**

**Case 1:** The building will be supplied by the local district heating net only. The maximum district heating primary energy factor in order to fulfil the standards will be calculated.

The primary energy factor fp of a district heating net is to be calculated according to the method described in AGFW 309-1, based on DIN V 4701-10. Qp = Qh * fp .

If the district heating has a primary energy factor from 0, Qp is fulfilled in all standards. The following table shows the maximal primary energy factor needed for complying with each KfW building standard (if no further measure on the building's envelope beyond the above reported HT values are performed). It is calculated to $fp_{max} = Qp_{ref} / Qp_{KfW}$.

| Standard | Qp kWh(m²a) | $fp_{max}$ |
|---|---|---|
| EnEV 2009 reference | $Qp_{ref}$ = 80 | 0,89 |
| KfW-Effizienzhaus 85 | 85% * $Qp_{ref}$ = 68 | 0,75 |
| KfW-Effizienzhaus 70 | 70% * $Qp_{ref}$ = 56 | 0,67 |
| KfW-Effizienzhaus 55 | 55% * $Qp_{ref}$ = 44 | 0,56 |
| KfW-Effizienzhaus 40 | 40% * $Qp_{ref}$ = 32 | 0,43 |

**Case 2:** The building is supplied with a district heating with a primary energy factor of 0,7. It will be calculated what solar share it would be necessary to add to the district heating energy mix to fulfil the standards.

From the table above it can be seen that the EnEV 2009 reference and first KfW standard can be fulfilled with the district heating net as it is (fp = 0,7). However, to fulfil the three best KfW standards, a renewable energy share in the district heating is needed.
The new $fp = CHP_{share} * fp_{CHP} + Solar_{share} * fp_{solar}$. Solar is considered to have a primary energy factor of 0.

For example, KfW-Effizienzhaus 55: $Solar_{min\ share} = 1 – CHP_{share} = 1- fp_{max} / fp_{CHP} = 20\%$

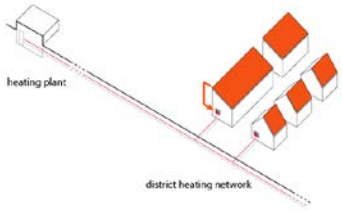
**Case 3:** The building is supplied with a local district heating net. Heat is produced by a gas boiler. It will be calculated what solar share it would be necessary to add to the district heating energy mix to fulfil the standards.

The primary energy factor is assumed to be 1,3. Following the same calculation as for case 2, the following table shows the share of solar heat needed to achieve the required fp for each standard:

| Standard | $fp_{max}$ | Minimum solar share |
|---|---|---|
| EnEV 2009 reference | 0,89 | 32% |
| KfW-Effizienzhaus 85 | 0,75 | 42% |
| KfW-Effizienzhaus 70 | 0,67 | 48% |
| KfW-Effizienzhaus 55 | 0,56 | 57% |
| KfW-Effizienzhaus 40 | 0,43 | 67% |

**Case 4:** The building is supplied with a district heating with a primary energy factor of 0,7. The owner wants to reach KfW-Effizienzhaus 55.

If the district heating (DH) supplying the building does not have a low enough fp to reach the standard aimed at, the owner can compensate, for example with a local solar thermal plant (ST).
$Qp = Qh * (DH_{share} * 0,7 + ST_{share} * 0)$.
In order to reach KfW-Effizienzhaus 55, the owner will have to produce 20% of his own heat demand with his solar plant.




**Fulfilment of EEWärmeG**

If a new building should be supplied by a district heating net, there are two possibilities: either the district heating fulfils the EEWärmeG requirements, or the owner of the building must compensate for it: more energy saving measures, or a local solar heating plant. Therefore district heating operators should be careful to match the law's requirements in term of renewable or recycled heat share.

The heat from district heating nets must be produced with a defined part of renewable energies, waste heat or high efficient combined heat and power plants. The 'degree of fulfilment' $EG_{FW}$ must be calculated and be higher than 1.
This can be achieved if the solar thermal share in the heat production is equal or higher than 15%, or if another energy is used at equal or higher share than required (biogas-CHP 30%, Biomass and geothermal 50%, waste or CHP 50%), or by a combination of these energies. Usually in a DH system several generation devices and different energy carriers are combined. So even a small share of solar thermal can contribute to fulfil the requirements.

## 3. Standard methods and software tools

Several software tools are available. They enable the user to enter data about the building and the HVAC system, check if it matches the law's requirements.
No software is available to calculate the primary energy factor of a district heating net, the calculation by the experts is adapted to the net configuration.

## 4. Limits and opportunities for SDH according to the current methodology

Solar thermal energy, due to its primary energy factor zero helps reducing efficiently the primary energy factor of a district heating net. A relatively low primary energy factor is important for district heating operators, as it is needed to fulfil the requirements of EnEV by refurbishment or new construction. It is even more important in order to reach the optional but subsidized KfW building standards.
However, the generally low primary energy factors of district heating systems with CHP imply that already a high share of the German existing district heating systems reach compliance with the standards as they are. The specific calculation shows nonetheless that the combination of solar thermal and CHP is needed in order to achieve the better KfW standards. Depending on the system set-up solar thermal can contribute to a lower primary energy factor.

## 5. Possible improvements for the methodology and the current legislation

Any possible improvements are under discussion.