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

D2.1 - Survey of national frameworks

Summary report

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TABLE OF CONTENTS

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1. EXECUTIVE SUMMARY

Energy performance requirements for new buildings and renovations are continuously increasing in EU countries, thanks to two EC Directives: the recast of the European Building Performance Directive and the Directive for the promotion of renewables. Both law provisions foresee a key role also for renewable energy sources (RES) heat obligations, requiring minimum shares of renewable energy to be set for heating and cooling of buildings.
District heating (DH) is one effective way to satisfy these performance requirements. Moreover, DH is an effective energy measure not only for new buildings or settlements, but also in case of renovation of larger residential areas (e.g. social housing or urban districts), where the direct improvement of the energy performance of the buildings, through e.g. improved insulation, can be sometimes difficult and costly.
This document reports information on how the two EC Directives have been implemented at national level in 12 EU countries, which are the ones participating in the "SDHplus" project, and on the consequences, in terms of opportunities and barriers, for district heating, with a specific focus, when available, on solar district heating.
Part I of the document analyses, for all 12 countries, the transposition of the Directives at national level, highlighting local differences due to regional laws within the same country. This analysis is done looking at the concept of "Nearly Zero Energy Building" and at how the energy efficiency standard in buildings are set and calculated in the different countries. Furthermore, details about renewable heat obligation laws, if operating in the specific country, are reported.
In Part II, then, the effects of these national laws on the current and future development of district heating, with a specific focus on solar, are discussed and analysed, by presenting the main opportunities and the toughest barriers, by describing the relevant regulations and subsidy schemes and, finally, by showing the technologies which are strongly competing with solar thermal.
More in detail, this second part describes how, in the partner countries of the SDHplus project, solar district heating can be accounted for in the legislation on energy standards in buildings, in particular in the calculation of the energy performance factor.
Limits and opportunities are shown country by country, as well as potential improvements and suggestions for modifications are reported. In spite of the national differences, one general remark that should be done is that, most of the times, the energy and environmental benefits of using solar thermal, especially in a district heating system, are not adequately taken into account in the calculation method.
A detailed description of the calculation method used in the different countries ("*Relevant national building and DH legislation per country*") is available on the SDHplus website (http://www.solar-district-heating.eu/Documents.aspx).
Moreover, from the analysis of the different national legislative framework, several general conclusions can be drawn regarding both opportunities and barriers for district heating and, in some cases, with a specific focus on solar thermal for district heating.

The opportunities can be summarized as follows:

- DH is very often included in the laws on energy efficiency in buildings, because it is considered as an energy efficiency measure; therefore it is eligible to meet the nearly-zero energy requirements.
- Local energy and climate policies tend to consider RES DH development as a powerful mean to tackle greenhouse gas emissions.
- A DH network which is dimensioned for the present demand may be oversized in the future if the heat demand decreases due to energy efficiency measures. However, this surplus capacity allows to extend the DH network to additional areas without the need to upgrade neither the pipes or the production power. Therefore, in countries where DH

has a low heat market share, their densification and development can, despite lower heat demand per building, lead to a need for new plants.
- DH grids could also be used as heat storages, at least on a daily basis.
- To reduce DH additional infrastructure cost, it should be included in the general building cost or, even stricter, include RES DH as an essential building service and therefore have on obligation to build it.

The main barriers which must be highlighted are:
- General competition between DH and low energy houses, also due to high connection costs.
- Lack of specific incentives for developing new DH grids or for renovating existing ones.
- Regulated price for DH in some countries.
- Negative image for DH, sometimes associated with the concept of large industrial polluting infrastructure on the territory.
- Market saturation in some countries.
- “Unfair” competition with electric heat (e.g. by heat pumps) and too low electricity price..
- Specific barriers for SDH:
    - competing technologies are often cheaper (also because more supported) and more well-known and therefore more easily bankable;
    - not many potential installation sites show both high solar radiation and existing DH grids.

Regarding the competing technologies, within the DH sector, solar energy faces a continuous and tough competition with several technologies. Some general considerations can be underlined from the analysis carried out at national level are:
- Main competing technologies, depending on local resource availability, price and subsidies, are:
    - biomass;
    - natural gas;
    - geothermal (trough heat pump technology);
    - coal;
    - waste incineration;
    - industrial excess heat;
    - heat recovery from CHP.
- Solar is often considered one of the less viable solutions due to:
    - high investment cost;
    - zero or low subsidies;
    - not well-known and therefore not bankable;
    - sometimes considered as technologically complicated;
    - cheaper in operation but not that much (it could be competing even with electric boilers in some countries);
    - it cannot cogenerate;

low fraction compared to biomass meaning a low influence on CO2 emission (e.g : 50 g CO2 emission / kWh ⇔ 79% solar fraction) and more difficult to get benefit.

2. PART I – TOWARDS NEARLY ZERO ENERGY BUILDINGS

2.1. Energy efficiency standards in buildings

2.1.1. AT – Austria

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
Buildings´ energy efficiency requirements and their basis calculations are defined within the OIB (Österreichisches Institut für Bauordnung - Austrian Institute for Construction Regulations) guideline 6. Within this guideline, district heating systems are an alternative option for any other type of energy saving measures at a building. The energy efficiency calculations´ results are based on various key data. One central key data is the gross area primary energy demand rate. This rate´s calculation is defined in the OIB-code of practice "„Energietechnisches Verhalten von Gebäuden - Buildings´ Energy characteristics" and is based on the application of conversion factors. District heating networks in Austria have a very good primary energy factor as they are mainly driven by energy from combined heat-power (CHP) systems or waste heat.
Renewable energy or solar thermal driven district heating systems are evaluated based on an alternative assessment within the Energy Performance of Building Directive (EPBD). This assessment is an expertise and is not related to legal regulations or norms. The system´s economic performance is a very critical factor within the assessment.

A practical example of calculation.
At first, the building is classified: new building,/old building, residential building/commercial building. Afterwards, the buildings´ heating demand and energy demand are calculated (including electricity etc.)

Energy Source	f_{PE} [-]	$f_{PE,n.ern.}$ [-]	$f_{PE,ern.}$ [-]	f_{CO2} [g/kWh]
Coal	1,46	1,46	0,00	337
Fuel Oil	1,23	1,23	0,00	311
Natural gas	1,17	1,17	0,00	236
Biomass	1,08	0,06	1,02	4
Electricity (Austrian-Mix)	2,62	2,15	0,47	417
District heating from heat plant (renewable)	1,60	0,28	1,32	51
District heating from heat plant (non-renewable)	1,52	1,38	0,14	291
District heating from high efficiency KWK[1] (Default data)	0,92	0,20	0,72	73
District heating from high efficiency KWK[1] (Best data)	≥ 0,30	Based on an itemization[2]		
Waste heat (Default data)	1,00	1,00	0,00	20
Waste heat (Best data)	≥ 0,30	Based on an itemization		

1) High efficient Combined Heat-and-Power (CHP) systems are defined in the 2004/8/EG

2) For an itemization based on EN 15316-4-5, no values lower than the waste heat (best data) value are allowed. Side calculations are defined in the document "Comments"

Conversion factors based on the OIB-Guidelines 6, October 2011

The total energy factor is based on several calculations, defined within the OIB-Guidelines RL6, October 2011, revision in December 2011:
The total energy efficiency factor is calculated in relation to the energy demand EEB_{IST} and the reference value EEB_{Ref}:
The energy demand EEB_{IST} is equal to the energy demand EEB_{BGF} regarding the conditioned gross area. The basis calculation is:

- $EEB_{IST} = EEB_{BGF}$
- An alternative calculation is optional:
- For WG: $EEB_{IST} = HWB_{IST} + WWWB_{Def} + HTEB_{IST} + HHSB_{Def}$
- For NWG: $EEB_{IST} = HWB_{IST} + WWWB_{Def} + HTEB_{IST} + KEB_{IST} + BelEB_{Def} + BSB_{Def}$

Basically, the $HHSB_{Def}$, the $BelEB_{Def}$ and the $_{BSB}Def$ can be substituted by the $HHSB_{IST}$, $BelEB_{IST}$ and the BSB_{IST}, where (NPVE … Netto-Photovoltaic-Revenue):

- $HHSB_{IST} = HHSB_{Def}$ - NPVE
- $BelEB_{IST} = BelEB_{Def}$ - NPVE
- $BSB_{IST} = BSB_{Def}$ - NPVE

It is further possible to calculate the $BelEB_{IST}$ based on the EN 15193. Therefore, the $BelEB_{IST}$ can be different from the $BelEB_{Def}$.
As well, the NPVE - Netto-Photovoltaic-Revenue can be calculated based on the EN 15316-4-6. Here, the calculated value per month has to be below the per month calculated and balanced NPVE.
Further detailed calculations can be found in a „Leitfaden Energietechnisches Verhalten von Gebäuden - Guideline for buildings´ energy performance“ Appendix OIB-6.

Standard methods and software tools usually used for such normative calculations.
A lot of companies are calculating a buildings´ energy performance and are qualified to do so. Therefore, various company-specific tools exist. As an example, the city of Vienna uses a tool developed by Christian Pöhn and other partners. For further information, the following link is provided:
http://www.google.at/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CEEQFjAC&url=http%3A%2F%2Fwww.oib.or.at%2FEA-WGv-2012-01-01-V10b2.xls&ei=yZCwUdOmLoj54QTv_4CICg&usg=AFQjCNFjgx-c74sPNDLbFMYssjhl5VnEOg&sig2=rCA1XkwMHGDafX4nbWXPGQ&bvm=bv.47534661,d.bGE

Limits and opportunities for SDH according to the existing methodology.
Within the current calculation schemes, the primary energy factor is very central. The primary energy factor from district heating systems is advantageous due to the district heating´s connection with CHP and waste heat plants. Many biomass plants can also be found within the existing district heating systems. Therefore, solar thermal energy feed-in systems only slightly influence a building´s total energy efficiency.

Possible improvements for the methodology and for the current legislation.
Conversion factors for CHP plants and waste heat are currently very low. This has positive effects on building´s total energy efficiency. If these conversion factors increased, plant operators would have incentives to realize more solar thermal feed-in systems to increase a district heating network´s advantage within building´s total energy efficiency. Another conversion factor for district heating systems which includes solar thermal plants would be beneficial.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
EBPD (Energy Building Performance Directive) was mainly implemented in regional building codes, not in national legislation. But many of the nine Austrian regions cooperate in order to harmonize their building codes and new inputs like from the EBPD.
An "energy performance action plan for Austria" exists, which focuses also on implementing the EU directives 2009/28/EG. Goals and measures are defined.
http://www.energiestrategie.at/images/stories/pdf/06_bmwa_07_eeaktionsplan.pdf
Following the EU Directive 2002/91/EG and 2010/31/EU, (Energy Performance of Buildings Directive) the "energy pass" was introduced in Austria. Since January 1, 2009 building sellers and renters have to submit an energy pass. The idea of the pass is to provide profound and comparable information about the thermal quality of buildings. The practical implementation of the directive is primarily within the authority of provinces in Austria.
Directive for the promotion of renewable:

Name and date of the law
Climate and Energy Fund Law (KLI.EN FondsG, BGBl. I No 40/2007)
An "energy performance action plan for Austria" exists, which focuses also on implementing the EU directives 2009/28/EG.
http://www.energiestrategie.at/images/stories/pdf/06_bmwa_07_eeaktionsplan.pdf

Main contents of the law, with focus on: energy efficiency in buildings and support measures for DH and solar thermal.
To fulfill the EU Directive 2006/32/EG, a Governmental Programm 2007 - 2010 for energy savings was developed, including following aspects:
Disconnecting economic growth from increase of energy consumption. Coordination of an energy efficiency action plan is realized by the Austrian Energy Agency. Main goals are:
- National Energy Efficiency Program
- Improving energy intensity of 5% until 2010 and 20% until 2020
- Energy check at all Austrian households until 2010
- Increasing cleansing rate of buildings to improve buildings´ thermal performance
- National and regional governments force the construction of low or passive energy housing
- 50% of all new buildings reach a klima:aktiv Standard
- From 2015 onwards, only buildings fulfilling the „Climate active passive house standard" are subsidized
- Subsidies for DH grid installation
- Check of pump efficiency and optimization potential of DH pumps
- Subsidies for connection to DH on customer side
- Systematic urban development along the DH grid and public transport routes
- enforced waste heat use:
Free access to for heat suppliers to existing DH grids

Point 12.5 specially focuses on DH and the connection of DH and RE.
Also different kinds of subsidy programs for energy efficiency and renewable energy exist, depending on region and intended purpose.

For houses which are located in areas with DH supply there is an obligation to connect to DH, like e.g. in Graz, in Styria or in Upper Austria.
For energy efficiency, the national law “Energieausweis-Vorlage-Gesetz“ (Energy pass draft law), BGBl. I Nr. 137/2006 exists. It will probably be changed in December 2012 and is conform to the 2010/31/EU law. The energy pass identifies a building´s energy performance, focusing on energy efficiency and long term improvements like energy savings.
http://www.justiz.gv.at/internet/file/2c94848525f84a630131a971ea184fc3.de.0/gesetzesentwurf.pdf;jsessionid=4D7422621B4D4069A7CEB5C3E1A8DDDA
Other examples for buildings ‘energy improvements are minimum construction requirements for new buildings or restorations and the consideration of renewable energies within these processes.
EU Directive 2006/32/EG will be succeeded by 2012/27/EU but is not yet implemented in national Austrian law. (note: An exchange of information within the SDHplus consortium about national implementations of 2012/27/EU in different countries would be very interesting.)

Are there different laws at regional or local level?
Yes, there are different laws, e.g, the compulsory DH connection in Graz.
Different regional laws are:
-Burgenländisches Energiekonzept 2003 (Energy Concept of Burgenland)
-Kärntner Landesenergieleitlinien 2007–2015 (Regional Energy Guidelines of Carinthia)
-NÖ Klimaschutzprogramm 2000, NÖ Klimaprogramm 2004–2008, sowie NÖ Klimabericht 2005 und NÖ Energiebericht 2005 (Low Austrian Climate protection law)
-Energiekonzept OÖ 1993, Energieeffizienzprogramm OÖ (Energie Star 2010), sowie 2. Phase des OÖ Energiekonzeptes (Energy 21) (Energy Concept of Upper Austria, Energy Efficiency Programm of Upper Austria, 2.nd Phase of the Upper Austrian Energy Concept)
-Energieleitbild des Bundeslandes Salzburg und dessen Umsetzungsprogramm Energie Aktiv, (Evaluierungsbericht zum) Kyoto Optionenbericht Salzburg 2006 (Energy concept of Salzburg, Kyoto Statement of Salzburg)
-Energieplan 2005–2015 des Landes Steiermark (Energy Plan Styria)
-Energieleitbild Tirol 2000–2020 (Energy Guideline of Tyrol)
-Energiekonzept Vorarlberg 2010, Verkehrskonzept Vorarlberg 2006 (Energy Concept of Vorarlberg)
-Städtisches Energieeffizienzprogramm der Stadt Wien (Data and Concept 2006), Masterplan Verkehr Wien 2003 (Energy efficiency Programs of Vienna)

An Ö-NORM also exists, the standard “ÖNORM EN 15316-4-5“ for heating systems in buildings - A Method for calculation of system energy requirements and system efficiencies - Part 4-5: Space heating generation systems, the performance and quality of district heating and large volume systems, valid at national level.

A kind of subsidy which improves the energy situation for buildings in Austria is the „Umweltförderung“ (Environmental Subsidy) UFG, BGBl Nr. 185/1993.

Differences at local level
There are different restrictions and laws in the field of DH and renewable energies or building requirements depending on the location/region or topic. Vienna has most DH connections, followed by Styria and Upper Austria.
One local law is the compulsory DH connection in Graz. It is also obliged for certain subsidies in Styria (Wohnbauförderung im Neubau) either to include a solar thermal plant into a new building, or to be connected to DH. This is also valid for Upper Austria.

On regional and local level different subsidies for solar thermal energy exist which can also be combined. Highest rates can be found in Vorarlberg or Tyrol, but also Upper Austria, Burgenland or Vienna. Lowest rates are in Styria and Carinthia.

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings
Information about the energy efficiency of buildings can be found in the 2012 – EAVG 2012 law, based on the EU directive 2010/31/EU EPBD (Energy Performance of Buildings Directive), ABl. Nr. L 153 from the 18th of June 2010.
The indicator for a buildings whole energy efficiency is calculated by the buildings energy cumulted energy demand.

Current energy efficiency standard for new buildings
The following term has to be fulfilled for a new residential facility heating energy demand:
EEBBGF,WG < HWBBGF,WG,max,Standort + WWWBBGF + fHT * HTEBBGF,WG,Ref
Explanation:

EEBBGF,WG	Specific energy demand of new residential buildings
HWBBGF,WG,max, Standort	Maximum permitted annual heating demand per m² konditioned brutto- ground area at a facility location
WWWBBGF	Warm water demand focusing on brutto ground area
fHT	Factor for increase specific technical heating demand of a comparable application
HTEBBGF,WG,Ref	Specific technical heating energy demand of a comparable application following OIBL guidline based on conditioned brutto ground area

Current energy efficiency standard for renovated buildings
The following term has to be fulfilled:
EEBBGF,WGsan < HWBBGF,Wgsan,max,Standort + WWWBBGF + fHT * HTEBBGF,WGsan,Ref
Explanation:

EEBBGF,WGsan	Specific energy demand of renovated residential buildings
HWBBGF,Wgsan,max ,Standort	Maximum permitted annual heating demand per m² konditioned brutto- ground area at a renovated facility location
WWWBBGF	Warm water demand focusing on brutto ground area
fHT	Factor for increase specific technical heating demand of a comparable application
HTEBBGF,WGsan,Ref	Specific technical heating energy demand of a comparable renovated application following OIBL guidline based on conditioned brutto ground area

Renovation included in the scope of the law
It focuses on the renovated conditioned brutto ground area. A thermal-energetic improvement should be reached which is reasonable from an ecological and economic perspective.

Time steps foreseen

There have been stricter requirements which have already been implemented since 2010. It can be predicted that requirements will become stricter, based on the EU plans to increase the number of passive or plus energy buildings.

2.1.2. CZ – Czech Republic

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
European directive 2013/31/EU was implemented by an amendment of the energy management act No. 406/2000 Coll. Terms of reducing the energy consumption of buildings are set out in § 7 of the above Act. Duties for owners and builders of buildings on energy performance certificates are provided in section § 7a.
Implementing regulation of the Act, which is Decree No. 78/2013 Coll. on energy performance of buildings determines:
a) cost-optimal levels of energy performance requirements for new buildings, major renewals of buildings, other than major changes on completed buildings and buildings with nearly zero energy
b) methodology of the energy performance of buildings calculation
c) model assessment of technical, economic and environmental feasibility of alternative energy supply systems (including DH)
d) model set of recommended measures for improving the energy performance of the building,
e) template and contents of the certificate and way of its placement in the building,

The Decree also defines indicators of energy performance of the building and their determination. Indicators are:
a) total annual primary energy consumption
b) total annual non-renewable energy consumption
c) total annual energy consumption
d) partial annual energy consumption of technical systems for heating, cooling, ventilation, humidification, hot water preparation and lighting
e) average heat transfer coefficient
f) heat transfer coefficients of individual constructions
g) energy efficiency of technical systems

Values of indicators of energy performance assessment of buildings and the reference buildings are determined by calculation on the basis of the documentation. For calculation of the energy performance indicators of the reference building, the values set in the Decree Annex 1 are used for building parameters, building components, structures and building systems.
Due to the general unavailability of material parameters of technical building systems, typical use and climate data for the evaluation of EPB was created TNI 73 0331 - Energy performance of buildings - Typical values for the calculation. TNI 73 0331 is non-binding tool in a form containing a single processing methods and commensurate values of representative parameters used in calculation of the energy performance of buildings, which includes:
- Typical values and range of inputs for efficiency parameters of technical systems
- Typical profiles of building usage (operating time, the demand for ventilation, lighting and hot water, internal heat loads from the equipment etc.) for different types of buildings
- Monthly climate data for calculation

The calculation of the average heat transfer coefficient and heat transfer coefficients of each structure at system limit is made according to Czech standards for the calculation method of thermal protection of buildings (CSN 73 0540-4 Thermal protection of buildings - Part 4: Calculation method).
The calculation of energy efficiency of heating, cooling, ventilation, humidification, hot water system and lighting is done according to the relevant Czech technical standards. Total energy

consumption is the sum of the calculated energy consumption and auxiliary energy. Calculation of the total energy supplied and the energy supplied by the partial computation is performed by calculation method with the maximum interval of one month and for each zone of the building. The total energy delivered to the building is determined by the sum of partial energy delivered and expressed also by individual energy carriers. Partial delivery of heating energy is the sum of the calculated energy consumption for heating and auxiliary energy for the operation of the technical system for heating by the Czech technical standards for the calculation of the energy needs for heating and cooling (DIN EN ISO 13790 - Calculation of energy use for heating and cooling) and Czech technical standards for thermal systems in buildings (EN 15316 - heating systems in buildings) using values of typical use of buildings.
Total primary energy and non-renewable primary energy consumption of assessed building is calculated as the sum of the energy supplied in the building, distinguished by energy carriers multiplied by relevant primary energy factors listed in Annex 3 of the Decree. Energy delivered outside of the building is included in the calculation by the same procedure.
District heating systems are included in § 7 Assessment of technical, economic and environmental feasibility of alternative energy supply systems. Solar systems as a heat source for DH systems are not specifically listed in the Decree. Possible use a solar system in DH may affect a primary energy factor and primary energy consumption according to the Table 1. The primary energy factor for solar heat is 1.0).

A practical example of calculation.
COMPARISON OF EPBC INDICATORS FOR A SINGLE FAMILY HOUSE (NATURAL GAS BOILER/DH HEATING WITH 50% SHARE OF RES)
A calculation of a simple model single family house was made. Different was only in the usage of heat source for heating and DHW (natural gas boiler/dh heating with 50% share of res). The fundamental difference within the evaluated indicators can be found essentially only in the case of non-renewable primary energy consumption.

Standard methods and software tools usually used for such normative calculations.
National kalkulační nástroj (NKN) - Development of the NKN calculation tool was performed at the Department of Building Services, Faculty of Civil Engineering of CTU in Prague based on support through grants from Czech Energy Agency (CEA). Development of the tool has been supported due to the need of instrument for calculating the energy performance of the building in accordance with act 406/2000 Sb.NKN was created as a tool for calculating the energy performance of buildings including output as a protocol and its graphical representation. Computational tool is designed as an open with option to display all links and the source code. The current version of NKN reflecting changes resulting from Decree 78/2013 Coll. will be available during the year 2014.
Stavební fyzika (Energie 2013) – Commercial software - Software Energie 2013 is designed for comprehensive evaluation of energy performance of buildings. It enables the calculation of the average heat transfer coefficient of the building, specific heat flows, demand for heating, partial delivered energy (heating, cooling, forced ventilation, humidification, domestic hot water, lighting), energy production (solar collectors, photovoltaics, cogeneration) total delivered energy, primary energy (total and non-renewable) and CO2 emissions. The calculation takes into account the procedures and requirements of ČSN 730540, 730329 TNI, TNI 730330, STN 730540, EN ISO 13790, EN ISO 13370, EN ISO 13789 and other European standards. The program processes the certificate of energy performance of the building by Decree No. 78/2013 Coll. and a label according to ČSN 730540-2 (2011).
PROTECH (Průkaz 2013) – Commercial software –

Module Průkaz 2013 is designed to handle EPBC under the Decree No. 78/2013 Coll., on the energy performance of buildings. Detection module 2013 is connected to other modules of the software and it is possible to load them to prepared calculations.

Limits and opportunities for SDH according to the existing methodology.

- annex with factors of primary energy does not distinguish between RES. Solar systems generally are included among the renewable sources of energy in district heating systems.
- Inclusion of solar systems in the RES group allows their use in the DH systems to reduce primary energy factor for the EPBC calculation
- §7 imposes an obligation to assess the technical, economic and environmental feasibility of alternative energy supply systems. Solar systems are included in subparagraph a) local energy supply system using energy from renewable sources and also indirectly in point c) thermal energy supply system where the solar system is part of the source mix
- the existing legislation sets minimum efficiency requirements for energy systems including solar systems

Possible improvements for the methodology and for the current legislation.

The current set of requirements in the context of European and national legislation appears appropriate from the perspective of deploying solar systems in DH.

Zdroje:

[1] Decree No. 78/2013 Sb. on energy performance of buildings.
[2] Urban M., Kabele K., Adamovský D., Kabrhel M., Musil R.: Výpočetní nástroj pro stanovení energetické náročnosti budov podle vyhlášky 148/2007 Sb.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?

EC Directive 2010/31/EC is implemented by Act 318/2012 Coll. – Energy management Act. (Zákon o hospodaření energií)
http://aplikace.mvcr.cz/sbirka-zakonu/SearchResult.aspx?q=318/2012&typeLaw=zakon&what=Cislo_zakona_smlouvy
Not available in English.
Act is focused on the rules for creating energy documents – Energy concepts, Energy audits, EPB certificates.
Maximum values of “non-renewable” primary energy use in buildings are set by Decree to increase energy efficiency and use of RES.

EC Directive 2009/28/EC is implemented by Act 165/2012 Coll. – Act on promotion of RES.
http://aplikace.mvcr.cz/sbirka-zakonu/SearchResult.aspx?q=165/2012&typeLaw=zakon&what=Cislo_zakona_smlouvy
Not available in English.
Act specifies types of RES chosen for investment and/or operation support. DH is included in both support types. Solar thermal is suitable only for the investment support.
Investment support will be realised by specific subsidy programs that will be announced according to the availability of financial sources.

Different laws at regional or local level

There is a small number of municipalities with their own support programs on RES. Also other municipalities have special requirements on energy efficiency in their buildings.

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings
Owner/builder is obligated to abide values of referential building or better in both cases. Monitored parameters are:
Total energy consumption
Non-renewable primary energy consumption
Average heat transfer coefficient
Heat transfer coefficient of construction
Efficiency of building systems

Renovation included in the scope of the law
Larger renovations of buildings – covers more than 25 % of building envelope.
Recommended values of heat transfer coefficient of renovated constructions must be kept during small changes.

Time steps foreseen
There are several dates for different types of buildings depended on its use, its size and owner.
e.g. All new buildings should be built as Nearly-Zero after 1. January 2020.

2.1.3. DE – Germany

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
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 building complies with these requirements, three criteria must be taken into account: the primary energy demand and insulation level (EnEV) and the degree of performance (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.

A practical example of calculation
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 to provide for each KfW building standard, if no further measure is taken on the building's envelope. $fp_{max} = Qp_{ref} / Qp_{KfW}$

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%

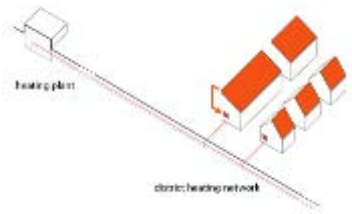
Case 3: The building is supplied with a local district heating net. Heat is produced by a gas boiler. It will be calculated what solar share it would be necessary to add to the district heating energy mix to fulfil the standards.

Since the primary energy factor from gas fp_{gas}= 1,1, 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.

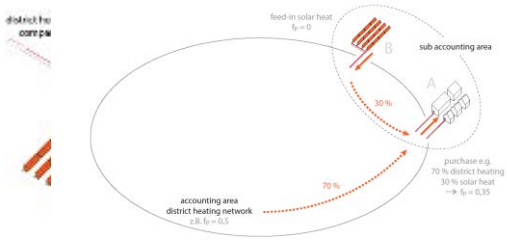
Standard	fp_{max}	Minimum solar share
EnEV 2009 reference	0,89	19%
KfW-Effizienzhaus 85	0,75	32%
KfW-Effizienzhaus 70	0,67	39%
KfW-Effizienzhaus 55	0,56	49%
KfW-Effizienzhaus 40	0,43	61%

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.



Case 5: Same case as 4 but instead of the roofs of the buildings, the solar plant is now built somewhere else and feeds in the net. The idea would be to allocate the solar heat to a particular customer. At the moment this kind of sub-accounting areas are possible according to AGFW FW309 but is however not an available option in EnEV certificates, and therefore neither in KfW standards.



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 30%, Biomass and geothermal 50%, waste or CHP 50%), or by a combination of these energies.

Standard methods and software tools usually used for such normative calculations.
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.

Limits and opportunities for SDH according to the existing 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 practical calculation shows nonetheless that the combination of solar thermal and CHP is needed in order to achieve the better KfW standards.

Possible improvements for the methodology and for the current legislation.
At the moment, the limits defined by EnEV for the heat losses transmission factor HT' represent already a rather high requirement and do not allow a lot of choice between taking measures on

the building's envelope or improving the energy supply. As the first must be done anyway, the second is still too often less necessary to fulfil the requirements.
As described in Case 5 there is still improvement potential in allowing and facilitating sub-accounting areas within single district heating systems, or at least achieve clarification on the subject.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
The Act on the Promotion of Renewable Energies in the Heat Sector
The Energy Saving Ordinance (EnEv). Directive 2010/31/EU will be implemented in the EnEv2014.
The Act on the Promotion of Renewable Energies in the Heat Sector (EEWärmeG) aims to facilitate sustainable development of the energy supply and promote the further development of technologies for the generation of heat from renewable energies, especially with a view to climate protection, efficient use of fossil resources and the reduction of import dependence. In order to achieve this goal the basic instrument of the act is an obligation to use energy from renewable energy sources in newly built buildings to cover the heating and cooling demand to a certain extent, depending on the renewable energy source being utilized. District Heating is not considered a renewable energy source per se but if the heat is produced by a substantial share of renewable energy sources, by a share of at least 50 % of CHP or waste heat or a combination thereof District Heating is considered an alternative measure and the obligations to use renewable energy sources deemed to be met.

The Energy Saving Ordinance
The Energy Saving Ordinance (EnEV) aims to reduce the primary energy demand of buildings to reduce use of resources and greenhouse gas emissions and covers newly built buildings as well as buildings undergoing major renovation. The ordinance has a holistic approach on the building envelope, the systems engineering and the energy sources which are being utilised. Balancing the different measures is possible. For instance the obligations can be fulfilled by either using more insulation or more efficient systems engineering or energy sources. The system in general therefore reflects the efficiency benefits of District Heating based on Combined Heat and Power and/or renewable energy sources.
There are no certain eligibility criteria for District Heating, since the ordinance is targeted at building owners. If buildings are connected to a District Heating grid the calculation method for the yearly primary energy demand takes into account the respective attributes of the system the building is connected to.
In order to evaluate the primary energy efficiency of an energy source such as District Heating, primary energy factors are being utilized. Primary energy factors take into account the losses occurring during extraction, conversion and distribution of the energy being utilized. The primary energy factors utilized express the amount of primary energy needed to provide energy to the building. There are standard primary energy factors which can be used but primary energy factors for District Heating may also be calculated using the appropriate rules and standards.

Different laws at regional or local level
The federal states are empowered to extent the scope of the Act on the Promotion of Renewable Energies in the Heat Sector to cover existing buildings as well.

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings
Criteria that need to be fulfilled for new buildings:

- primary energy demand for heating, hot water, air conditioning and cooling shall not be higher than primary energy demand of the reference building that technical specifications are to be found in Annex I, Table I of the EnEv
- the maximum value of specific heat transfer coefficient related to the heat transmitting surface area (building envelope)
- requirement on the protection against summer overheating

Criteria that need to be fulfilled for renovated buildings

- heat transfer coefficient of the replaced building component

Renovation included in the scope of the law

- modification, extension and expansion of the buildings
- replacement of the technical installations in the buildings

Time steps foreseen

- policy stricter in two-time-steps: 2014 and 2016:
- Primary energy demand (=maximal allowed value) shall decrease by factor 0,875 in 2014 and by factor 0,750 for new building from 2016 on.
- The maximum value of specific heat transfer coefficient related to the heat transmitting surface area (building envelope) shall be decreased.

2.1.4. DK – Denmark

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
Denmark has decided to introduce two building classes that already includes describing the requirements for energy performance of buildings that will be applicable to buildings in 2015 and 2020. Buildings can be designed according to these requirements or for a less demanding minimum standards introduced in 2010.

Requirements from year:	*Housing [kWh/m²]*	*Offices [kWh/m²]*
2010	*52,5 + 1650/A*	*71,3 + 1650/A*
2015	*30 + 1000/A*	*41 + 1000/A*
2020	*20*	*25*

Table 1: Limits on energy consumption of buildings depending on the year of construc-
tion. A is the heated floor area in m2.

In 2010 is used a factor of 2.5 for electricity for heat-production. For buildings built as low-energy buildings in 2015, a factor for electricity of 2.5 and for district heating a factor of 0.8. For other types of heat used a factor of 1.0 and the relevant efficiency. For buildings built after building class 2020, a factor for electricity of 1.8 and for heating a factor of 0.6. For other types of heat applied a factor of 1.0 and the appropriate benefit. The factors are summarized in the table below. An example of the use of these factors can be found in section 2

Factor from year		*El*	*District Heat*	*Others (inncluding biomass)*
2010		*2,5*	*1,0*	*1,0*
2015		*2,5*	*0,8*	*1,0*
2020		*1,8*	*0,6*	*1,0*

Table 2: Factors for different types of heating.

The factors are elected political factors and uniform throughout Denmark. It therefore takes no account of the actual primary energy factors for a specific district heating system. Solar implemented in a district heating system (LDS) has also no effect on the calculation of the building's energy performance and there is no political intention that it should have it.
For solar applies incidentally: "The new construction or renovation of buildings outside existing district heating areas where the expected hot water consumption exceeds 2,000 liters per day, must be established solar power systems that can cover an energy demand equivalent to hot water consumption under normal operating conditions ".

A distinction is also made between Common RE plants and Individual RE plants.
For common VE system applies: "If a new settlement is established with a joint renewable energy plants, this is recognized in the energy framework, provided that the owners of the buildings contribute financially to the establishment thereof. The calculation takes into account all losses. Examples from a solar heating system can be heat loss from the storage tank, pipeline losses to the individual building, as well as electricity for pumps and automatics. For solar thermal systems is the possibility of recognition.
In the energy frame for facilities to be established as part of a new settlement outside a district heating area. This limitation includes not, for example solar or wind turbines. "Common solar thermal plants can not enter into the calculation of the district heating areas".

For individual plants, it's different - it says the following: "RE plants on the building or in connection with the building included in the energy frame of the building." Where solar included in the calculation with a factor of 1.0.

A practical example of calculation.
Based on the DTI test house EnergyFlexHouse is carried out calculations of the energy performance of different types of installations with heating or air-water heat pump and in combination with solar heating or solar cells. EnergyFlexHouse has a heated floor area of 216 m^2 and is built to be energy neutral. The building envelope is roughly equivalent to what would be the requirement in 2020. The table below shows installation solutions and the calculated energy performance.

		2010	2015	2020
	Installation Solution	kWh/m^2	kWh/m^2	kWh/m^2
0	**Requirements of the Building Regulations**	**60,1**	**34,6**	**20,0**
1	District heating unit and hot water tank, 100 liters *	36,3	30,8	22,8
2	District heating unit + 200 liter solar tank for domestic hot water + 5.1 m2 solar panels *	28,3	24,7	18,2
3	Block Heating supply system to 10 houses + 62.5 m2 solvarmetag on 1 house + water heater and hot water tank, 100 liters in 10 houses + 4000 liter storage tank	(30,7)	(26,5)	(19,6)
4	District heating unit and hot water tank, 100 liters + 3.8 m2 solar cells *	30,1	24,5	18,3
5	Air / water heat pump and hot water tank, 200 liters	27,8	27,8	20,0
6	Air / water heat pump + 200 liter solar tank for domestic hot water + 5.1 m2 of solar panels	22,3	22,3	16,0
7	Air / water heat pump + 1000 liters solar cylinder for both domestic hot water and space heating + 12.5 m2 of solar panels	20,2	20,2	14,7

Table 3: Examples of experimental house *EnergyFlexHouse's* calculated energy performance.
Installation Option 3 is a common green plant that supply 10 houses and where the facility apart from contributing to the hot water, is designed to produce so much heat that can compensate for cable loss, losses in acc. tank etc. and in

the network between the 10 houses. The results are shown in brackets, as it referred to above it is not a permissible solution in DK for the moment.

Standard methods and software tools usually used for such normative calculations.
There are used the Danish standard tool for calculating the energy performance Be06/Be10, developed by the Danish Building Research Institute (SBI).

Limits and opportunities for SDH according to the existing methodology.
There are no immediate opportunities to take the SDH in the calculations. However requires a factor of 0.6 for district heating in 2020 further expansion of renewable energy in the network, so you could say that the many Danish SDH initiatives indirectly are included in the calculations.

Possible improvements for the methodology and for the current legislation.
There are also other legislative initiatives that are helping to promote SDH - instance "Agreement of 13 November 2012 on energy companies' energy saving efforts ", where District Heating Supply Companies have the possibility of – in the required energy savings activities – to include the establishment of large-scale solar in the period from 2013 to 2015.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
Name and date of the law: Lov om fremme af energibesparelser i bygninger. No 636, 16th June 2012 (Law about energy labeling and energy savings in buildings)
Link to the full documentation: https://www.retsinformation.dk/Forms/R0710.aspx?id=142572
Name and date of the law: The Danish Building Regulations. 28th August 2011
Link to the full documentation:
http://www.bygningsreglementet.dk/br10_02/0/42

Main contents of the law, with focus on: energy efficiency in buildings and support measures for DH and solar thermal.
Rules for energy labelling of all kind of buildings, certification of labellers, possibility to certificate plumbers etc. Setting up small energy plants for single houses (Lov om fremme af energibesparelser i bygninger)
Maximum heat consumption for new and renovated buildings and rules for including renewable energy and district heating in the energy frame (additions to the Danish Building Regulations)

Different laws at regional or local level
Municipalities can use the planning law to decide further restrictions in areas for new buildings (For instance 2015 standards or 2020 standards for buildings built already now)

Current energy efficiency standard for new buildings
52.5 kWh/m2 + 1,650 kWh/m2/A, where A is the heated floor area

Current energy efficiency standard for renovated buildings
The same as for new buildings, but calculated for single parts (new windows etc). If single activities are feasible the standards must be followed. Calculation rules for feasibility is part of the

regulation. If implementation is not economical feasible or will cause moisture problems single the standards must not be followed.

Renovation included in the scope of the law
Insulation of outer walls, floors, ceilings, walls to neighbours, change of windows and doors

Time steps foreseen
Time steps are in 2015 and 2020. The standards are:
30 kWh/m2 + 1000 kWh/m2/A in 2015 and 20 kWh/m2 in 2020 (i.e. does not depend on the floor area).

2.1.5. ES – Spain

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.

Energy Certification of Buildings is a derivative requirement of the 2002/91/EC Directive regarding energy certification. This Directive and 2010/31/EU Directive of 19th May, on energy efficiency of buildings partially transposes into Spanish law by 235/2013 Royal Decree of 5th April, by which **the basic procedure for energy efficiency certification is approved, for both new and existing buildings.**

The standard programs that have been developed for energy certification of buildings (Calener for new buildings and CE3 and CE3X for existing buildings) do not include the possibility of analyzing buildings connected to District heating and cooling (DHC) systems. Parallel to these general tools, ADHAC (the Spanish District Heating and Cooling Association) has developed a new tool (currently recognized by the Ministry) for the correct energy rating of buildings connected to DHC systems. The tool, called Post-Calener, is useful only for new buildings so far. Soon there will be published the version for existing buildings.

It should finally be noted that since Calener was published (tool for energy certification of buildings) in 2009, until having the PostCalener tool in 2011 (for buildings connected to district heating and cooling), has not been possible to carry out energy certifications of buildings connected to DHC systems This is just an example of the current situation of these systems in Spain: DHC is not still a very common alternative.

The tool allows considering all kind of heat sources, but there is no a specific calculation methodology for solar thermal plants.

PostCalener can be downloaded from the website of the Ministry of Industry, Tourism and Commerce.

http://www.mityc.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/ProgramaCalener/Paginas/DocumentosReconocidos.aspx

A practical example of calculation.

The rating process of DHC systems consists of making a simulation with Calener (including conventional equipment) and then modify it with Post-Calener program (replacing conventional systems by the heating and cooling network to which the building is connected); parameters that quantify the efficiency of the DHC system will be considered.

Considering a building with following demands:

	Demand (kWh/year)
Heating	22.575
DHW	817,3
Air conditioning	13.280

And these are the features of the heating and cooling network to which the building is connected:

Concept	**Specific consumption in heating per MWh**	**Specific consumption in cooling per MWh**
Biomass	1,23	0,54
Natural gas	0,07	-
Electricity	0,01	0,19

This means that for each MWh of heat delivered to the users from this network, the operator has used 1,23 MWh of biomass, 0,08 MWh of natural gas and 0,01 MWh of electricity.

Therefore, the specific energy consumption for each network operator will be:

Concept	Specific consumption per MWh	Building consumption (kWh)
Heating		
Heat supplied		**22.575**
Biomass	1,23	27.658,69
Natural gas	0,07	1.556,49
Electricity	0,01	321,19
DHW		
Heat supplied		**817**
Biomass	1,23	1.000,98
Natural gas	0,07	56,33
Electricity	0,01	11,62
Air conditioning		
Cold supplied		**13.280**
Biomass	0,54	7.116,51
Natural gas	-	-
Electricity	0,19	2.549,98

Once these values are introduced into the program, it is possible to carry out the simulation. Below are the obtained results:

Conventional systems for heat and cold production		Connected to the DHC system indicated above	
KgCO2/m2·year	Energy rating	KgCO2/m2·year	Energy rating
99,83	E	55,14	C

As seen, the network connection considered as example, entails improving the energy rating of the building from Category E to Category C.

Standard methods and software tools usually used for such normative calculations.
In this section, the official tools for energy certification of buildings are briefly explained:

- Calener: This Software is a computer tool to obtain the energy efficiency certification of a new building, both in its planning stage and the finished building.
  - Calener-GT: for large terciary buildings
  - Calener-VYP: for residential and small and medium tertiary buildings
- CE3 and CE3X: These are software tools to obtain the energy efficiency certification of an existing building.
- Simplified procedures:
  - CERMA software: Computer tool to obtain, in a simplified way, the energy efficiency rating of residential buildings.
  - Prescriptive Simplified Procedures: these are technical documents to obtain the energy efficiency rating of buildings in a simplified way.

Limits and opportunities for SDH according to the existing methodology.
The legislative framework reflects the present situation in Spain regarding heating and cooling networks and SDH: Although it is possible to evaluate a solar thermal plant, the established

methodology for energy efficiency in buildings does not do a special emphasis on SDH. The reason is that there are some centralized solar thermal plants in Spain, but unlike other countries there are not large plants connected to a thermal network.
The most important barrier for the evolution of SDH is that the presence of heating and cooling networks is still very low. As the most remarkable opportunity, in addition to solar availability, should be emphasized that the heating and cooling networks are increasing and a significant rise in the coming years is expected. In conclusion, it could be said that is not expected a substantial increase in new SDH systems in the short term, but could be in medium to long term.

Possible improvements for the methodology and for the current legislation.
The potential for improvements concerning SDH is high, considering that:

- Until recently there was not an official tool for the evaluation of buildings connected to DHC systems..
- The existing tool is very generic, and a special calculation methodology for solar thermal plants does not exist.
- Nowadays, the large solar thermal plants are not the priority for the companies in the field.

However, it is difficult to establish or propose improves on a technology (SDH) which is still novel and there is no experience about it.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
Name and date of the law: RITE (Regulation of Thermal Installations in Buildings) RD1027/2007 (July 2007).
Link to the full documentation
http://www.idae.es/index.php/mod.pags/mem.detalle/relcategoria.1030/id.27/relmenu.53
This Royal Decree has been introduced in a national transposes the Directive 2002/91/EC on the energy performance of building related to the energy efficiency of thermal installations in buildings. It has been written with the necessity of transpose the Directive 2002/91/EC and the appearance of the RD-47/2007. This Decree transposes the Regulation of Thermal Installations in building before (dated in 1988).
The regulation of Thermal Installations in Building emphasizes the convenience of the use of centralized production systems, by building or group of buildings, and even network connections from urban central. The purpose of this legislation is on one hand the contribution to improvement of the air quality in the cities and on the other hand add the elements to fight against climate change. And also to foment the instalation of low emission boilers which permit the reduction of nitrogen oxides and other pollutions.
This legislation includes the basic exigencies of saving energy referrenced to the efficiency of thermal installations setting the minimun requirements of efficency that had to achieve these installations in new buildings and conditions of inspection procedures.
This regulation has no real impact in DH because the recommendation it does about of DH network is only a comment with no kind of link with any obligation.
For solar thermal, indicates that thermal installations must be designed and constructed, implemented, maintained and operated in such a way as to reduce the power consumption of conventional heating systems and, therefore, emissions of greenhouse gases and other air pollutants by the use of energy efficient systems, systems that allow energy recovery and utilization of renewable energy and energy waste
Both technologies are mentioned only to enforce the law, do not have any implications.

Name and date of the law: Technical Construction Code CTE (September 2006).

Link to the full documentation
http://www.codigotecnico.org/web/recursos/documentos/
The main purpose of this legislation is establish the basic procedure that must satisfy the methodology to calculate the efficiency rating energy of buildings, with which the certification process begins, considering those factors that most impact have in energy consumption of new buildings or reform or rehabilitate ina particular extension. It also sets the same technical and administrative conditions for certificates of energy efficiency projects and completed buildings.
This measure aims to promote a high efficiency building forcing architects and constructors to make good enclosures, and establishing a minimum quality of buildings.
This legislation includes a section of minimum solar contribution in DHW.
"HE4: minimum solar contribution in DHW: For those buildings with a DHW demand or heated swimming pool,establishes a minimum annual solar contribution between 30% and 70% depending on the climate zone, there are 5 classifications for this purpose. Percentage can be overcome by the promote or due to regulations issued by the competent authorities. The facilities must meet certain requirements that are foressen possible damage from overheating, freezing, burning, pressure and in case of exceeding the actual contribution in certain areas is expected to divert surplus energy to other existing applications."
The Technical Building Code (CTE) provides that all new buildings or rehabilitation must take account of solar thermal energy in its design.
But this measure has no mention about DHC systems because of the absence of it in Spain but in the specifications for the software to certificate and qualify which include DHC systems.

Name and date of the law: National Strategic Plan 2011-2020 (June 2010).
Link to the full documentation
http://www.minetur.gob.es/energia/desarrollo/EnergiaRenovable/Paginas/paner.aspx
This plan has been introduced in a national transposes the Directive 2009/28/EC on the promotion of the uses of energy from renewable sources and mending and subsequently repealing Directive 2001/77/EC and 2003/30/EC.
The objectives are 20% target for the overall share of energy from renewable sources and a 10% target for energy from renewable sources in transport.
To achieve the challenges the National Strategic Plan is based on the development of strategies that simultaneously allow progress along: energy policy a priority has toward liberation and promotion of transparency in the market, the development of energy infrastructure and the promotion of renewable energy and energy efficiency and saving.
This regulation foments a large use of solar thermal energy:
”Measures dissemination, promotion and regulatory adaptation of solar (photovoltaic, thermal and thermoelectric) to promote their horizontal penetration in all sectors (construction, agriculture, industry and services).”
“Development of mechanisms to promote desalination plants based on solar technologies (low temperature thermal, photovoltaic and thermal)”
“Leadership of projects to optimize solar thermal systems that include integrated solutions (DHW, heating and cooling)”.
“Measures for the professionalization of the sector and to promoting change in perception of the users by spreading the benefits of solar energy as well as the rights and obligations of its users.”
PANER includes some measures thermal use of renewable energies that are referring to DH:
“Inclusion of RES heating and district heating systems in the energy certification of buildings.”
“Introduction of RES heating and district heating systems through Municipal ordinances.”
Furthermore, it is estimated that from 2015 could be entering several projects underway geothermal district heating, currently in exploration and research phases and processed the necessary administrative authorizations.

Different laws at regional or local level
At present more than 50 municipalities, of the more than 8,000 existing, provide specific support to the installation of solar thermal systems. Among the municipalities that have ordinances approved are the capital of Barcelona, Madrid, Seville, Granada, Burgos, Ceuta and recently Valencia, which about 8 million citizens can enjoy bonuses such locally.
The province of Barcelona is a particularly evident example, by having more than 25 municipalities that have opted for this route to solar incentives.
Municipalities, have the possibility to give a bonus to neighbors to make solar thermal systems, consisting of:

- Reduction of up to 50% of the business tax.
- Reduction of up to 50% on goods and property tax.
- Reduction of up to 95% Tax on Construction, Installations and Works.

For instance, the General Environmental Ordinance of Barcelona: Solar
Applies to:

- New buildings
- Comprehensive rehabilitation of buildings

For those buildings with a DHW demand or heated swimming pool establishes a minimum annual solar contribution.

For DHW:
general: assuming that the energy source support is diesel, propane, natural gas, or other;

Total daily DHW of the building at 60°C, in litres	% solar contribution
0-10000	60
10000-12500	65
>12500	70

b) Joule effect: assuming that the energy source is electricity support by Joule.

Total daily DHW of the building at 60°C, in litres	% solar contribution
0-1000	60
1000-2000	63
2000-3000	66
3000-4000	69
>4000	70

For indoor heated swimming pools:30% of solar contribution.
For outdoor heated pools, only allow solar thermal energy systems.

http://www.barcelonaenergia.cat/document/actualitat/060225_aprobacion_OST_cas.pdf

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings
The main purpose of these bonuses is to foment a large use of Renewable Energies and to improve the energy efficiency in buildings reducing the energy consumption.
Figure 1 shows the foreseeable impact of the ordinance on solar thermal energy surface in Barcelona.

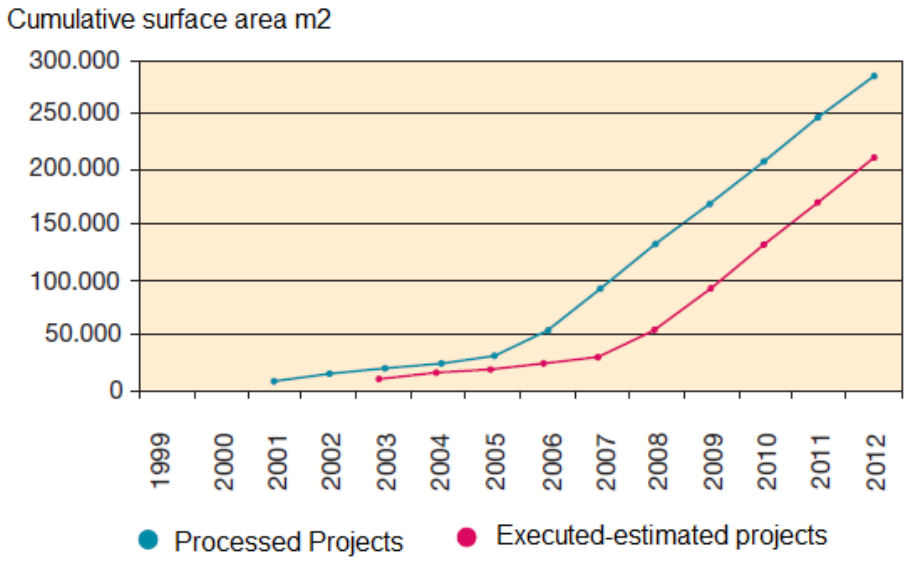
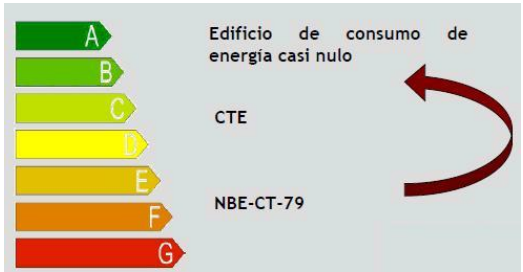


Figure 1 Foreseeable impact of ordinance on solar thermal energy surface in Barcelona. Source: Aplicación de la Ordenanza Solar Térmica: un balance positivo http://www.bcn.cat/publicacions/b_mm/ebmm67/37_AmieiroQCcas.pdf

Current energy efficiency standard for new buildings
RITE RD1027/2007 and CTE RD314/2006.
"HE4: minimum solar contribution in DHW: For those buildings with a DHW demand or heated swimming pool,establishes a minimum annual solar contribution between 30% and 70% depending on the climate zone, there are 5 classifications for this purpose. Percentage can be overcome by the promote or due to regulations issued by the competent authorities. The facilities must meet certain requirements that are foressen possible damage from overheating, freezing, burning, pressure and in case of exceeding the actual contribution in certain areas is expected to divert surplus energy to other existing applications."
RD 47/2007, Basic Procedure for New Building Energy Certification is aimed at new buildings and existing buildings that are subject to modifications, alterations or renovations and having a surface area greater than 1,000 m2 and is renewed in more than 25 percent of their total closings.
The new Directive 2010/31/EC is not yet implemented in Spain but it seems that those buildings which have an A in the energy rating will be nearly-zero energy buildings. For instance, in Madrid a building with these consumptions and emissions will be a nearly-zero energy building.
Heating 15.8 kWh/m2 y and 5.1 kgCO2/m2 y
Cooling: 4.9 kWh/m2 y and 1.2kg CO2/m2 y



Current energy efficiency standard for renovated buildings
RITE RD1027/2007 and CTE RD314/2006.
"HE4: minimum solar contribution in DHW: For those buildings with a DHW demand or heated swimming pool,establishes a minimum annual solar contribution between 30% and 70% depending on the climate zone, there are 5 classifications for this purpose. Percentage can be overcome by the promote or due to regulations issued by the competent authorities. The facilities must meet certain requirements that are foressen possible damage from overheating, freezing, burning, pressure and in case of exceeding the actual contribution in certain areas is expected to divert surplus energy to other existing applications."
Nowadays only renovated buildings with a surface area greater than 1000m2 and renewing more than 25% are force to carry out the RD 47/2007. But from 1st January of 2013 the new royal decree will run and it will affect to all existing buildings.
All existing buildings when they will be sold or leased, they will have an energy performance certificate.

Renovation included in the scope of the law
Bonuses to use solar thermal energy and stricter requirements (regional laws).

Time steps foreseen
In a near future stricter energy requirements will be operating, in a new or modified CTE.
A new Royal Decree will introduce in a national transposes partially the Directive 2010/21/EC on the energy performance of building related to energy efficiency of thermal installations in buildings.
http://www.coac-lz.com/sites/default/files/orden_modificacin_db_he.pdf

2.1.6. FR – France

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.

The building code « RT2012 » applied to buildings

RT 2012 (thermal standards to be applied since 2013) establishes the energetic performances and the thermal characteristics for newly construct building. The requirements concerning multi-dwelling housing building are presented below:

- ✓ Bioclimatic loads (Bbio): this criterion describes the minimum building energy efficiency requirement, regardless of its heating system. It ensures that basic Bio-climatic design (orientation, compactedness, natural lightning, efficient insulation, etc…) is taken into account from the start.

- ✓ Summer confort (Tic) : this criterion represents the maximum allowed indoor temperature on a sequence of 5 hot days,

- ✓ Primary energy consumption (Cep) : The primary energy consumption is calculated for the five following loads: heating, DHW, cooling, lighting and ventilation / heating auxiliaries. The objective for all new building is to be lower than an average of 50 kWh_{PE}/m^2.year. This set value is adjusted according to several criteria: application (office, dwelling, etc..), geographical location, altitude, dwelling area. This modulation leads to a requirement of Cep between 40 and 75 kWh_{PE}/m^2.year.
  Another criteria related to the greenhouse gas emission of the heating device leads to a modification of the set value. Then, for a housing building connected to a district heating, the Cep requirement value is increased as follow:
  + 30% for DH with CO2 emission equal or lower than 50 g_{CO2}/kWh
  + 20% for DH with CO2 emission between 50 and 100 g_{CO2}/kWh
  + 10% for DH with CO2 emission between 100 and 150 g_{CO2}/kWh

  DH above 150 grams per kWh sold benefit of no modification in the Cep.

District heating in the « RT2012 »

The Cep modification coefficient (or “bonus”) presented above for “green” district heating has several benefits. First, the builder can save investments costs by reducing measures to reduce the primary energy consumption. The energy consumption is slightly higher, resulting in a better economical efficiency for DH, but without changing the economical and environmental relevancy of RES DH compared to other heating solutions. This incentive measure allows for example to ensure that most buildings in a new Eco district are connected, increasing the economical and environmental advantages of RES DH for stakes holders, and especially decision makers who are in most cases local authorities.

This “green” DH bonus is also a good opportunity for builders to achieve better thermal performances, as it makes it simpler to reach the performance of RT2012 labels (very efficient building label, passive label, etc..) which enables investors to obtain tax advantages.

For new district heating or those which have a deep change in their energetic mix (by replacing an old fossil fuel boiler by a biomass boiler for example), another method is to be used. This method, named “Titre V”, implies for the DH operator to present its project in front of a national committee who decides which CO2 emission is to be taken into account according to the technical specifications of the project (see appendix 1).

Solar energy and solar district heating in the « RT2012 »

In the calculation method of the RT2012, the thermal solar energy is taken into account in deduction of the building consumption (for DHW mainly). According to the average consumption and cover ratio, it increases the maximum allowed primary energy consumption (Cepmax) of about 20%.
If solar energy is integrated to the energetic mix of the district heating, there is not such a deduction. At the utmost, if solar implementation allows the CO2 emissions to descend below 150 grams / kWh, it increases the maximum consumption by only 10%, even if the carbon balance is far better with this solution. In most cases where solar brings only 5 to 10% of the DH heat production, it will make no difference.

Standard methods and software tools usually used for such normative calculations.
The national technic and scientific building committee (CSTB) is in charge of developing the building code calculation method. Several software based upon the method are developed by private companies (Clima-Win ; DISCEPOLO ; CYPECAD MEP ; DesignBuilder ; Lesosai ; Visual TTH ; ArchiWIZARD ; Pleiades+Comfie, module RT2012 ; U22Win RT 2012).

Limits and opportunities for SDH according to the existing methodology.
As shown above, it is more incentive for the builder, on a RT2012 point of view, to implement solar on a building instead of developing SDH.
The necessity to go through the “titre 5” process is also an important difficulty for new DH, and hence new SDH which represent an interesting opportunity in new Eco district. For example, the project presentation in front of the committee must include the list and characteristics of all the buildings that will be connected to the network. This implies for the DH operator to obtain signed agreements for the connections beforehand from all builders, without being able to tell them which “green bonus” they will get by doing so, or even to guarantee if they will get one.

Possible improvements for the methodology and for the current legislation.
AMORCE has asked for an evolution allowing the same benefit for the builder between SDH connection and solar HTW installation, but chances to obtain it are quite low until now. The necessity to adapt the building code to zero energy building by 2020 gives an opportunity to get out of the current approach which takes only the building into account, towards a wider approach including the surrounding buildings and the district, hence giving more opportunities to DH and SDH.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
LOI n° 2005-781 du 13 juillet 2005 de programme fixant les orientations de la politique énergétique
http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=2729572D449BC2916C49B50B0190758A.tpdjo04v_3?cidTexte=JORFTEXT000000813253&categorieLien=id

- → target of 10% RES in total energy consumption (21% for electricity) by 2010
- → target of 200 000 domestic solar water heaters installed per year
- → target of energy intensity decrease of 2% per year by 2015 and 2,5% by 2030
- → implementation of the white certificate scheme (possibility to obtain certificates for connecting a building to a DH, the amount of certificate being proportional to the RES share of the DH)

→ implementation of the building regulation for 2005 (with performance labels which forgot DH and hence discouraged connecting new buildings to existing DH)

LOI n° 2009-967 du 3 août 2009 de programmation relative à la mise en œuvre du Grenelle de l'environnement (« Grenelle 1 »)
And **LOI n° 2010-788 du 12 juillet 2010 portant engagement national pour l'environnement (« Grenelle 2 »)**
http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000020949548&dateTexte=
http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000022470434&dateTexte=
→ target of 80% decrease of greenhouse gases by 2050
→ target of "3x20" by 2020, with 23% RES in total energy consumption
→ implementation of regional and local (compulsory for local authorities with more than 50 000 inhabitants) energy and climate schemes. Regional schemes : SRCAE & local schemes : PCET
→ "Renewable Heat fund" (implemented effectively by the financial Law for 2009 – around 200 M€ per year for 5 years) to help heat RES development, especially in DH (with subsidies for heat production and heat distribution)
→ implementation of the building regulation for 2012 (cf. next page) :

- "bonuses" for DH, allowing, for new buildings connected to a low carbon emission DH, to have a higher energy demand (10 ; 20 or 30% depending upon the amount of carbon emitted per kWh sold by the DH)
- Strong encouragement to use thermal solar on buildings : all the thermal solar production on the building is taken off the energy demand calculation (which allows – roughly- to design a building with 20% more energy consumption).
- Advantage for DH : it is interesting on an economical point of view for the project building owner to connect the building to DH, especially if the RES share of the DH is above 60% (he can for example design a building without thermal solar and with the same heating performance)
- problem for SDH : if the project building owner wants solar, it is more interesting for him to implement solar on the roof for internal hot water needs than to connect the solar to DH. Connected to the internal hot water needs, the solar allow the building to consume the quantity of solar energy produced (for example, if 10 kWh/m2 are consumed directly by the production of solar energy, the building can consume 10 other kWh/m2 of gas with the limit of 50 kWh/m2. With SDH, this is the CO_2 emission of the DH witch give the "bonus" (explained in the chart next page). But the reduction of CO_2 emissions thank to the integration of the solar in the DH could not reach a better section of bonus (for example reach 105 gCO_2 / kWh instead of 140).

In financial laws :
→ Tax credit and zero rate loan for individual solar DHW equipment.
→ Tax credit for connection of a building to a DH (seldom used)
→ Reduced VAT (5,5% instead of 19,6%) for heat sold by DH using more than 50% of RES
→ Public grants for investment in renewable like solar DHW system for professional use and multidwelling residential buildings, distribution part of the DH if they have more than 50% RES for the production part (Fonds Chaleur, regional and FEDER budget)
→ Public grants are possible for demonstration projects; solar energy is eligible but there are no rules to spend the money (ADEME budget)

French thermal regulation for buildings "RT2012" :

- This regulation provides mandatory requirement for the thermal performance of new and existing buildings (offices, health sector, residential)

- The thermal performances are express with 3 indicators :
    - the primary energy consumption for 5 loads (“Cep” – heating, cooling, domestic hot water, lighting, parasitic electricity for heating and ventilation)
    - a coefficient (“Bbio”) taking into account the geometry and insulation of the envelop, solar shadings, etc…
    - the summer indoor temperature (“Tic”)

Those 3 indicators are modulated to take into account: the geographic zone (5 zones), the altitude and the surface of habitations. For the primary energy consumption (Cep) the CO_2 emission are also considered (“bonuses” for low emissions energies).

- The regulation set up minimum requirements for the 3 indicators; for Cep, it is considered to be lower than 50 kWh_{EP}/m^2 (in average)
- The regulation is put in practice with a national and official calculation method, applied by software developers so as to calculate the 3 indicators; the current method is an annual hourly based method.
- The “low consumption building” labels are set up with the RT2012 definition;

➔ District heating are taken into consideration only in the calculation of the primary energy calculation in two ways :

- calculation of the Cep MAX (the limit according the low) : in the coefficient of CO_2 emission
- calculation of the Cep PROJECT (the calculated Cep of the simulated building) : in the primary energy consumption for heating and domestic hot water.

Different laws at regional or local level

All laws are national.

Regions have incentive programs to enhance the building regulation criteria (in the association Effinergie). These programs have provided a feedback which encouraged the government to implement the 2012 building regulation.

Since March 2012, local authorities can classify a DH with 50% of RES at least (with other conditions). In these areas, all new buildings and renovated building have to connect to the classified DH. Today, there is only one classified DH in France, but it would probably increase the use of renewable heat in the next years.

Current energy efficiency standard for new buildings

Target of 50 kWh of primary energy per square meter for 5 loads (heating, cooling, domestic hot water, lighting, parasitic electricity for heating and ventilation).

The target is adjusted according to the building location (geographical climate area and altitude), and the housing surface (the bigger the accommodation, the lower the target), the use of wood energy or DH alimented by RES (see above),

For some DH, the introduction of solar could decrease the CO_2 emissions and reach a better section for the building regulation (more attractive).

CO_2 emission of the energy (of the DH for example)	**Target of primary energy per square meter (on average)**
Up to 150 g CO_2 / kWh	50 kWh
100 to 149 g CO_2 / kWh	50 kWh + 10%
50 to 99 g CO_2 / kWh	50 kWh + 20%
0 to 49 g CO_2 / kWh	50 kWh + 30%

Current energy efficiency standard for renovated buildings
A national efficiency label for renovated building "*BBC renovation*" sets a target of 80 kWh of primary energy per square meter for 5 loads (heating, cooling, domestic hotwater, lighting, parasitic electricity for heating and ventilation). This target is not compulsory : the average renovations tend toward 150 kWh/m2 (which brings about 30% reduction in energy consumption).

Renovation included in the scope of the law
Buildings larger than 1000 m2 and constructed after 1948 have to respect the existing building regulation which gives either performance criteria for each building elements (walls, windows, boiler…) or a global performance target for the building.

Time steps foreseen
The building regulation for 2012 will be fully operative by 2013, except for housing buildings : flats can be constructed with a 15% higher energy demand until 2015.
"positive energy" building regulation planned for 2020.

2.1.7. HR – Croatia

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
Through the *Ordinance on energy audits and energy certification of buildings* from 2012, the required calculations of energy demand of buildings are set to be carried through in compliance with the *Methodology for energy audits of buildings*, issued by the Ministry of Construction and Physical Planning. This methodology is defined as the set of activities for performing of the energy audits, comprising the algorithm for the calculation of building's energy properties.
This *Algorithm for determination of energy requirements and efficiency of thermal engineering systems in buildings* is based on norms stated in the above mentioned ordinance. In these calculations, the district heating systems are also regarded, as the alternative heat sources that should be considered when new buildings are built or existing ones are significantly reconstructed. The norm that relates itself to the district heating is HRN EN 15316-4-5:2008 *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-5: Space heating generation systems, the performance and quality of district heating and large volume systems.* In this norm, the calculation of the primary energy factor is given, i.e. the calculation of the primary fuel needed for one unit of useful heat in a district heating system. For the existing DH systems, the data needed for the primary energy factor calculation are based on the results of operating metering. For the new DH systems, the calculation of the primary energy factor is based on design data.

A practical example of calculation.
The heated area is 647,3 m^2, out of which 165,3 m^2 are in office area (Zone I ground), and 482 m^2 in dwelling area (Zone II, 1.-3. floor).
The primary energy factor is defined in the ordinance related to the energy certification of the buildings; when the used heat is delivered from the fossil-fired cogeneration plant the factor is $f_{p,dh}$= 0,7 while for the renewable sources $f_{p,dh}$ = 0,1.
For a detailed calculation, data on delivered heat, produced power and fuel consumed in cogeneration or heat plant is required.

- Energy requirements for a heating substation:
The installation of a 50 kW compact heating substation is supposed (hot water, low temperature type)
$\theta_{dh,gen,in}$= 105 °C, average temperature of forward primary media,
$\theta_{dh,gen,out}$= 50 °C, average temperature of secondary media, according to the HRN EN 15316-2-3 and to the algorithm for heating and hot water systems
According to the table 2.2, for $\theta_{dh,gen,in}$= 105 °C, $D_{dh,gen}$= 0,6.

Average substation temperature:
$\theta_{dh,gen} = D_{dh,gen}\ \theta_{dh,gen,in}+(1-D_{dh,gen})\ \theta_{dh,gen,out}$= 83 °C
Coefficient $B_{dh,gen}$=4,0 chosen for insulating class 3-4 in table 2.1.
Heat exchange coefficient $H_{dh,gen}$:
$H_{dh,gen}=B_{dh,gen}\ \Phi_{dh,gen}^{1/3}$=14.7361 kWh/Ka

With supposed ambient temperature on substation's location of θ_{amb}=11 °C, annual heat loss of the heating substation is:
$Q_{dh,gen,ls} = H_{dh,gen}\ (\theta_{dh,gen}-\theta_{amb})$=1061 kWh.
Calculated output values, provided that the heating substation is situated in a heated part of building:

	kWh
$Q_{dh,gen,ls}$	1061
$Q_{dh,gen,ls,rbl}$	1061

Standard methods and software tools usually used for such normative calculations.
The issuing of these methods and tools is expected in the near future

Limits and opportunities for SDH according to the existing methodology.
According to the *Technical ordinance for energy savings and energy insulation in buildings* (NN 110/08, 89/09), the carrying out of the study of applicability of alternative systems for buildings with useful area above 1000 m^2 is mandatory, but the implementation of the study results is not obligatory for the investor, just informative.
This study contains the elaborate on technical, ecological and economic feasibility of alternative heat supply systems, particularly regarding decentralized energy supply systems that use renewable sources, cogeneration, district heating, heat pumps or fuel cells.

Possible improvements for the methodology and for the current legislation.
Amendments of the methodology and changes of the regulation, aimed to facilitate the implementation, are ongoing.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
The Act on the Efficient Utilization of Energy in Final Consumption (OG 152/08, 55/12) was adopted on 18th December 2008 and its Amendments on 9th May 2012. It is based on EU Directives (2002/91/EC old & 2010/31/EU new) on the energy performance of buildings (EPBD), Eco-design Directive (2009/125/EC) and EU Directive (2006/32/EC) on energy end use efficiency and energy services (ESD).
Link to the full documentation

- http://narodne-novine.nn.hr/clanci/sluzbeni/379617.html
- http://narodne-novine.nn.hr/clanci/sluzbeni/2012_05_55_1358.html

The law together with its subordinate acts defines energy efficiency measures (especially energy services, energy audits and energy certification of buildings) and obligations of the public sector, energy companies and large consumers. There is no special mention of solar thermal or district heating.
Note: Directive for the promotion of renewables has not yet been implemented in national legislation. The Act on Renewable Energy Sources is currently under preparation and is planned to be adopted during the course of 2013.

Different laws at regional or local level
There are no specific regional or local level acts for the time being. However, some regional/local incentives promoting the use of renewable energy sources for limited periods of time are introduced in some areas. Examples of such initiatives are tenders for introduction of RES projects including solar thermal collectors, heat pumps, small-scale biomass boilers, small wind turbines and photovoltaic household systems. The incentives per installation usually amount to 40% of the investment and installation costs (e.g. max. EUR 1,600 in Karlovac County, tender in 2011).

Current energy efficiency standard for new buildings
70-95 kWh/m2 based on Technical regulation on energy economy and heat retention (OG 110/08, 89/09)

Current energy efficiency standard for renovated buildings
70-95 kWh/m2 when undergoing major renovation

Renovation included in the scope of the law
The article 31 of the Technical Regulation on Energy Economy and Heat Retention in Buildings (OG 110/08, 89/09) defines when building renovation needs to meet the same criteria as construction of new buildings;

- If the surface of net useful heated area (heated to more than 12°C) is increased by more than 50 m2,
- If the reconstruction includes renovation or replacement of at least 75% of the heated building envelope area or at least 25% of the area of any part of heated building envelope (for each geographical orientation of transparent and opaque parts of building envelope),
- If the reconstruction includes renovation of at least 25% of the useful heated area of the building,
- If the reconstruction includes the conversion of non-heated into heated surface area (heated to more than 12°C) of the building, more than 50 m2

Time steps foreseen
Energy audits will be obligatory for all public buildings with net useful area larger than 250 m2 (instead of 500 m2) from 9th July 2015.
Energy certificate will be obligatory when selling/leasing a building or part of building from July 2013. Energy class will be obligatorily advertised in the sell/lease add.

2.1.8. IT – Italy

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
The Italian decree containing the national guidelines for the energy labelling (D.M. 26 giugno 2009 "Linee Guida Nazionali per la Certificazione Energetica degli Edifici") which implements the European directive 2002/91/CE, doesn't define a calculation method for buildings energy performances but it prescribes to refer to UNI/TS 11300 (Standard assessment).
Some Italian regions have elaborated their own calculation method, before the generation of the national one. Lombardia, one of the region with more DH systems, published it's calculation method (D.G.R. VII/8745 del 22 dicembre 2008 e il decreto 5796 del 11 giugno 2009) based on UNI/TS 11300 too, but with the difference that the class assignment of a building is based just on the heating primary energy demand (not considering domestic hot water). Lombardia method is taken here as an example. The presence of the DH connection in a building influences the energy performance calculation in two phases:

- in the modelling of the generation system
- in the calculation of primary energy from the final energy of the building and system.

Calculation method for buildings with DH connection in UNI/TS 11300: Energy performance of buildings - Part 4: Renewable energy and other generation systems for space heating and domestic hot water production)

DH and generation system in the building
The system generation component in a building connected to DH correspond to the substation in the energy performance calculation. The energy supplied in the substation is calculated considering the energy demand of the building and the losses in the substation heat exchanger. The elements used in the calculation are:

- nominal thermal power of the heat exchanger,
- heat loss coefficient Kss [W/K] of the substation heat exchanger,
- average temperature in the heat exchanger.

All these data have to be provided by the DH supplier; if not, the regional regulation presents some estimation methods.

DH and primary energy
The second phase of the calculation influenced by the presence of the DH connection is the use of energy conversion coefficient from final to primary energy.
This coefficient should be provided by the DH company: it depends on the energy sources of the supplier side of the DH network (gas, biomass, waste to energy plant…). If not, regional regulations present some conversion coefficients for primary energy of DH systems depending on the source plant. (Lombardia: f_P = 1,2, Pr. Autonome Trento e Bolzano: f_P =0,8 for biomass, 0,9 for industrial or CHP heat recovery, 1 for fossil fuel, Piemonte : f_P = 1). For what concerns solar thermal energy as a source for the DH, there's no mention in Italian regulation.

Dlgs28/11
This Italian decree implements European directive "RES heating and cooling" and introduces new obligations for buildings in terms of renewable energy.
For new buildings or for important renovations, the thermal energy production systems shall cover at least 50% of the energy needs for DHW and 20% of energy needs for DHW, heating and cooling with renewable energy (20% in 2013 will change in 35% in 2016 and 50% in 2017).

This obligation is completely satisfied if the building is connected to DH which covers the entire demand for heating and DHW. In this context DH gets an important role.

A practical example of calculation.
A building energy performance calculation according to Regione Lombardia regulation is now presented, obtained using Cened+ software, the building energy labeling software. The calculation is made for two buildings: a single family house and a multi-dwelling building with 16 units both with energy efficient envelope with low thermal dispersions, low temperature radiant floors and with DHW daily storages.
The solution with DH is compared with an alternative solution of the the same building but with a traditional system composed by a condensation gas boiler, with same power as the substation, and a solar thermal system which covers 50% of DHW energy demand.

Envelope characteristics

	Exterior walls	*Roof (unheated zone)*	*Floor (unheated zone)*	*Windows*
U [W/m^{2}K]	0,27	0,24	0,3	2

DH data

Primary energy coefficient	Loss coefficient K_{ss}	Average T	Fuel
0,8	10 W/K	70 °C	Waste to energy plant

Primary energy results for heating are:
EP_H [kWh/m^{2}year]

	Condensation gas boiler + ST	DH
Single family house	39,11	37,87
Multi-dwelling building	26,86	26,92

DH, even with low primary energy coefficient (0,8 in this case), doesn't improve energy performance in significant way compared with a condensation gas boiler and solar thermal system.

Standard methods and software tools usually used for such normative calculations.

- CENED+ Regione Lombardia → Regione Lombardia makes a building energy performances calculation software available, which was developed following the regional regulation method. Its name is CENED+ and it's available for download at http://www.cened.it/software
- Edilclima → www.edilclima.it
- Celeste (Liguria)

Limits and opportunities for SDH according to the existing methodology.
DH is now assuming an important role in energy and urban policy in Italy. Dlgs 28/11 decree contains an article that promotes DH, prescribing development plans in cities with more than 50000 inhabitants to promote renewable energy sources for DH and DC. For smaller towns this plans can be developed in a membership form taking advantage of the coordination action of the provinces.
Dlgs 28/11 decree relieves constructors of the obligation on renewable energies thanks to the DH connection, which assumes a particular interest in the building sector.

We should anyway consider that 2012/27/UE European directive for energy efficiency will bring to a greater presence of renewable energy sources. The result will be a shift of obligation from constructors to DH suppliers, at least in urban areas served by DH.
As it can be seen from the calculation example, the connection to DH doesn't imply big changes in the EP_H (Lombardia calculation) value comparing it with the reference case with condensation gas boiler and solar thermal collector for DHW.
For what concerns the juridical mandatory connection of building to DH, at present there's no obligation. The law "legge 10/91", updated by the following Dlgs 28/11, prescribes an obligatory predisposition of a room to host the components of potential DH connection for new buildings that are at a distance of less than 1000 m from the nearest DH network.
Dlgs 28/11 considers DH as a work of primary urbanization (but without tax facilitations, unlike other primary works) and obliges municipalities over 50000 inhabitants to make urban plans that consider this technology.

Possible improvements for the methodology and for the current legislation.
To improve the position of DH in the Italian legislation it would be necessary to include the sub-stations in the group of incentive measures with the mechanism of tax deduction.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
Recast of the European Building Performance Directive 2010/31/UE:

- not yet implemented at national level
- already implemented in Province of Bolzano
- (http://www.anit.it/system/files/legge/Efficienza%20energetica/Regionali/Alto%20Adige/Recepimento%20EPBD-31.PDF)
- partly implemented in Region Liguria
- (http://www.anit.it/system/files/legge/Efficienza%20energetica/Regionali/Liguria/Pagine%20da%202012_burl_n13__parte1.pdf)
- EPBD Recast has not been completely implemented in Italy, which will most probably lead to a fine to be paid by the Italian country.

Directive 2009/28/CE:

- Name and date of the law: dlgs 28/2011
- Link: http://efficienzaenergetica.acs.enea.it/doc/dlgs_28-2011.pdf
- By 2020 17 % of gross final energy consumption must be covered by RES
- Out of such consumption, in the transport branch 10 % will have to be covered by RES

Different laws at regional or local level
Directive 2009/28/CE: no differences at local level

Current energy efficiency standard for new buildings

- 50 % RES of energy need for DHW + 20 % RES of energy need for DHW + space heating + space cooling up to 31/12/2013
- 50 % RES of energy need for DHW + 35 % RES of energy need for DHW + space heating + space cooling 01/01/2014 – 31/12/2016
- 50 % RES of energy need for DHW + 50 % RES of energy need for DHW + space heating + space cooling after 01/01/2017

This approach is supposed to change in the near future, as lots of criticism has been arisen by planners and RES technology manufacturers. For what concerns solar thermal, it is likely that its use for DHW production will be considered as one possible way of fulfilling the law requirements.

Current energy efficiency standard for renovated buildings

- Energy efficiency standards are foreseen for particular cases (see next question).
- Furthermore, standards have to be fulfilled when buildings (or single apartments) are to be sold: energy certification according to EPBD (Directive 2002/91/EC) is in fact linked to the technologies used for producing heat. District heating with high PRF (Primary Resource Factor) have positive effects on energy certificate, thus lead to better opportunities of selling houses and apartments.

Renovation included in the scope of the law

If renovation occurs on building > 1.000 m2 the same rules as for new buildings are applied.

Time steps foreseen

See above

2.1.9. LT – Lithuania

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.

Project „ SDHplus - New Business Opportunities for Solar District Heating and Cooling“ is directed towards solar district heating (SDH) to consumers via towns DH networks. Residential multi-apartment houses, public, commercial and industrial buildings are considered as potential consumers. DH covers approximately 65 % of total heat market in Lithuania. About 72 % of DH is consumed by multi-apartment residential buildings [1]. It is expected that SDH will be directed for preparing hot tap water in DH companies and buildings in Lithuania.

The defining of energy efficiency classes for buildings is regulated by revised Building Regulations of the Republic of Lithuania STR 2.01.09:2012 „Energy Efficiency of Buildings. Energy Efficiency Certification“ [2]. The Annex II of above Regulations [3] describes methodology for estimating of energy consumption in buildings and assessment of energy efficiency class for the building with regard to consumed renewable energy sources (RES).

Energy efficiency class of the building is defined by the values of heating, ventilating, lightening indicator C_1 and hot water consumption C_2 indicator. The buildings of respective energy efficiency class must meet the following requirements of energy efficiency indicators C_1 and C_2 (Table 1):

Table 1. Indicators of energy efficiency classes for buildings

Class of Building	*Indicator*	*The values of indicators for certified buildings**	*Class of Building*	*Indicator*	*The values of indicators for certified buildings**
A++	$C_1 < 0{,}25$ and $C_2 \leq 0{,}70$	No certified	D	$1{,}5 \leq C_1 < 2$	C_1 appr. 130-550 kWh/m^2/m
A+	$0{,}25 \leq C_1 < 0{,}375$ and $C_2 \leq 0{,}80$	C_1 appr. 24 kWh/m^2/m, and summary 49 kWh/m^2/m	E	$2 \leq C_1 < 2{,}5$	C_1 appr. 150-1200 kWh/m^2/m
A	$0{,}375 \leq C_1 < 0{,}5$ and $C_2 \leq 0{,}85$	C_1 appr. 4-24 kWh/m^2/m, and summary 41-60 kWh/m^2/m	F	$2{,}5 \leq C_1 < 3$	C_1 appr. 500-1600 kWh/m^2/m
B	$0{,}5 \leq C_1 < 1$ and $C_2 \leq 0{,}99$;	C_1 appr. 30-130 kWh/m^2/m, and summary 70-140 kWh/m^2/m	G	$C_1 \geq 3$	C_1 appr. 500-2600 kWh/m^2/m
C	$1 \leq C_1 < 1{,}5$ and $C_2 \leq 0{,}99$;	C_1 appr. 80-260 kWh/m^2/m, and summary 120-290 kWh/m^2/m			

* The values of indicator came from practice of energy efficiency certification [7]

Methodology distinguishes indicator K_{ers}, which defined the share of renewable energy consumed by the building of A++ energy efficiency class only. This indicator is not applied for the buildings of lower energy efficiency class. New buildings built after year 2014 must meet the requirements of B energy efficiency class, and renovated buildings – o C class [3].

Indicators C_1 and C_2 define the ration between non-renewable estimated primary energy consumption and standard non-renewable primary energy consumption. Non-renewable estimated primary energy consumption evaluates renewable energy consumption assigned to the building, and standard non-renewable primary energy consumption are all energy consumption in the building [3].

A practical example of calculation.

Heating
Indicator C_1 assesses the ratio between estimated and standard energy consumption required for space heating, ventilation and electricity consumption for lightening, expressed per non-renewable primary energy factor for heat generation or DH system and average electricity generating installations. Standard non-renewable primary energy consumption (all consumption) for heating, ventilation and lightening are estimated based on requirements defined in Construction Technical Regulations [4].
Non-renewable primary energy factor is estimated and presented in the methodology for used fuel and energy types, heat and power generation technologies, separate DH companies and Lithuanian DH average. The value of indicator C_1, which defines energy efficiency class of the building, depends on heat and power energy consumption of the building, on heat and power generation sources, on used ventilation system. The value of indicator C_1 is increased by the following factors: the value of renewable primary energy factor for heat generation source; ventilation with recuperation in the building; the consumed energy is generated by solar, wind and hydro energy plant and is assigned to the building.

Hot water
Indicator C_2 assesses the ratio between estimated and standard energy consumption required by the building for hot water preparing. The value of this indicator is ratio between estimated non-renewable primary energy and standard non-renewable energy consumption estimated according to requirements of Construction Technical Regulations [5, 6]. Standard energy consumption for hot water – all energy consumption for hot water preparing and maintaining of required temperature (recirculation). Standard non-renewable non-renewable primary energy consumption assesses energy consumption for preparing hot water, losses in pipelines, installations and systems of the buildings, expressed per non-renewable Primary Energy Factor of the source. Since most residential multi-apartment houses use DH systems for hot water preparing, the estimate assesses standard non-renewable primary energy factor for this DH system.
Estimated non-renewable primary energy consumption for preparing hot water define the following: heat demand of hot water preparing system; system efficiency; energy volume for hot water preparing assigned to wind, hydro and solar collectors; non-renewable primary energy factor of the source; and non-renewable primary energy factor for preparing hot water assigned to RES.

Standard methods and software tools usually used for such normative calculations.

Currently energy efficiency classes for buildings are defined using software tool „NRG-sert“. Algorithm of this tool was adapted for former methodology of Building Regulations of the Republic of Lithuania and does not distinguish C_1 and C_2 indicators and does not evaluate the use of RES. The tool defines the building under certification as follows: building, certificate and customer information. Every information group has obligatory and additional info fields.

Building info fields:

Obligatory fields:	***Additional fields:***
Unique Building no	Title – title of the building
Municipality	Designed by- author of building design project
Town	Gen. contractor – main contractor of the building
Street	Construction year – year of building construction
House number	Reconstruction year – year of building reconstruction
	Comment – Personal remarks concerning building

Certificate information

Obligatory fields	***Info fields***	***Additional fields***
Building certificate no – the main feature if Your certificate, which is used in Register of Certificates. Number consists of two letters, which are selected automatically according to the purpose of the building; No of Expert Qualification Certificate (selected automatically); and No assigned by Certification Expert (e.g. PE-0001-0003).	Issued – field provides issue date of the Certificate	Registered – feature shows if Certificate is registered
		Application to perform certification of the building – comments on application
	Valid – field shows validation date of the Certificate	Paid – comments on payment for certification
		Other information – Your personal comments on Certificate

Customer information

Additional fields								
Customer – customer data	E-mail	Mobile	Phone	Fax	Municipality	Location	Address	Other information – Your personal comments

The tool provides the estimated results, which define energy efficiency class, based on input data. The tool results field shows: energy efficiency class of the building; heat losses through walls, roof, floors, windows, thermal bridges, internal heat emissions, energy consumption for space heating, hot water, ventilation, and summary energy consumption, etc.

Limits and opportunities for SDH according to the existing methodology.
Described former and still in use software tool for defining energy efficiency class of the building does not assess the use of RES, does not non-renewable primary energy consumption separately for heating and hot water preparing. The main factors, defining higher energy efficiency class of the building are the efficiency of heat generating source and ventilating system with recuperation. Currently updated methodology for Construction Regulations and the updated software tool (based on this methodology) will assess non-renewable and renewable Primary Energy Factors for heat generating source.

References

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2. Building Regulations of the Republic of Lithuania STR 2.01.09:2012 „Energy Efficiency of Buildings. Energy Efficiency Certification", http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=431646
3. Building Regulations of the Republic of Lithuania STR 2.01.09:2012 „Energy Efficiency of Buildings. Energy Efficiency Certification". Annex 2.
4. National Standard LST EN ISO 13790:2008 „Energy Characteristics of Buildings. Estimate of energy consumed for space heating and cooling (ISO 13790:2008)";
5. National Standard LST EN 15316-1:2007 „Space heating systems of buildings. Method for assessment of system energy demand and system efficiency. Part 1. General issues";
6. National Standard LST EN 15316-3-2:2008 „Space heating systems of buildings. Systems energy demand and system".
7. http://www.spsc.lt/cms/index.php?option=com_wrapper&view=wrapper&Itemid=288

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
Directive of the European Buildings Performance was implemented under Law on Construction of the Republic of Lithuania, 19 March 1996, No I-1240, Vilnius. Last updated 26/06/2012;
Lithuanian language: http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=429306
The last version is not available in English language:

Energy performance certification; adoption of a methodology for assessment of energy performance in buildings; setting minimum energy performance requirements; nearly zero-energy buildings is the main contents of the law of buildings performance.

Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources was implemented under Republic of Lithuania Law on Renewable Energy Sources, 12 May 2011, No. XI-1375, Vilnius.
Last updated 17/01/2013;
Lithuanian language:
http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=442549&p_query=&p_tr2=2
The last version is not available in English language:

Ministry of Energy coordinates implementation of development and promotion measures for the use of solar heat for energy generation, carries out monitoring of their implementation, and provides state supervision and control.
The law requires certification for installers of solar heat and power generating equipment using renewable energy.
Support schemes for solar heat installations are applied, in case they are certified in accordance with European Union standards, in case these are defined, including ecological labelling, energy labelling and others technical regulation systems defined by European Union standardisation bodies.
National Renewable Energy Action Plan must submit assessment regarding development of the new district heating and cooling infrastructure with providing conditions for development of biomass, solar and geothermal plants for achieving respective RES indicators till year 2020.
The Government or its' authorized institution shall prepare and adopt programme for the use of roofs for energy generation using solar thermal and solar PV energy.
Solar thermal collectors and heat pumps do not apply to land-use compliance requirements, environmental impact assessment procedure and do not need authorization for construction and impact of vi-societal health assessment;

Different laws at regional or local level
There is no regional or local level legislation in Lithuania.

Current energy efficiency standard for new buildings
All new residential buildings have to meet the requirement of C energy efficiency class after 1 January 2006.

Current energy efficiency standard for renovated buildings
Renovated buildings have to meet the requirement of D energy efficiency class until 1 January 2014.

Renovation included in the scope of the law
Renovation (modernization) program of blocks houses, Resolution of the Republic of Lithuanian Government, 2004 m. September 23 d. Nr. 1213, Vilnius.
Last updated 28/12/2011;
Lithuanian language:
http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=416105&p_query=&p_tr2=2

Renovation/modernization	unit	2010	2015	2020
Implementation of blocks houses renova-tion/modernization projects founded by program and other government funds	unit	430	1 500	4 000
Implementation of energy saving measures, such as substation, in block houses and private initiatives	unit	3 000	6 000	10 000

Implementation about 600 of blocks houses renovation projects at this moment.

Time steps foreseen
All new buildings have to meet the requirement of B energy efficiency class after 1 January 2014.

2.1.10. PL – Poland

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.

The general regulations that apply to construction processes is Construction Law (1994), which normalizes all processes referring to design, construction and deconstruction of buildings. The act also defines the actions that public entities can undertake. Technical standards and norms are defined by specific regulations. In the area of renewable energy technologies in construction process the most important part refers to energy performance of buildings and implementation of EU regulations (directives 2006/32/WE and 2010/31/WE).

The document that implements directive 2010/31/WE regarding energy performance of buildings is act issued by Minister of Transportation, Construction and Maritime Economy on 21st of June 2013, which implements changes the scope and form of construction projects. (Dz.U. 2013 nr 0 poz. 762, 2013). Several new annotations were added to the law regarding the analysis of possibility of implementation of alternative, high efficiency energy and heat supply systems, provided specific technical, environmental and economical conditions are met. Alternative systems are defined as decentralized heat supply systems based on renewable energy technologies, cogeneration, district heating or cooling, especially if it is fully or partially based on renewable energy technologies. The analysis stipulates the requirements based on building energy performance, fuel sources available, conditions of connection to external network, optimization and comparison calculations and system selection. In case when buildings with same purpose and similar technical and utilization parameters are taken into consideration, one analysis may consider all of them. The Energy Efficiency Act from 15th of April, 2013 (Dz.U. 2011 nr 94 poz. 551, 2011) defines the target of energy savings taking into consideration the leading role of public sector and sets mechanisms for support, monitoring and collection of data. The act is an implementation of directive 2006/32/WE on energy use and energy services.

A practical example of calculation.

Heat demand calculations (heated water, heating and ventilation) are conducted accordingly to the methods introduced In the act of Ministry of Infrastructure (see diagram 1), (Dz.U.2008.201.1240, 2008). The act consists also of most reference values, coefficients and factors. For the purpose of projects specific methods and industry standards are used (see literature). The reference values and guidelines that are used for calculations are presented in the supporting programs/documents, which are regularly updated in regard to the current legislative status.

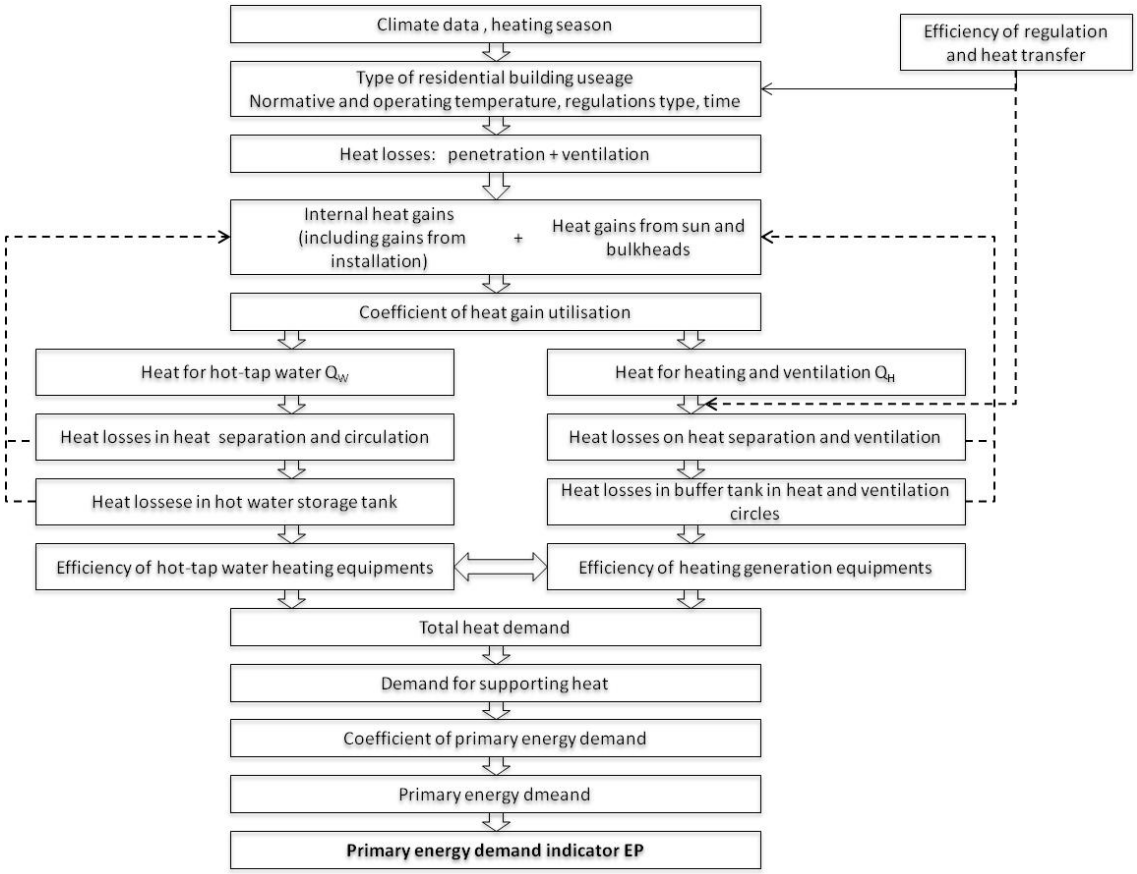

Fig. 1 Diagram illustrating calculation procedure for primary energy demand for heating and tap water (Dz.U.2008.201.1240, 2008, p. 10912)

Standard methods and software tools usually used for such normative calculations.
The reference values and guidelines that are used for calculations are implemented in the supporting software tools, which are regularly updated in regard to the current legislative status.
Sample computer programs are Audytor OZE, Kolektorek 2.0, T*SOL, TRNSYS, CERTO, EXPERT Certyfikat Energetyczny+, BuildDesk Energy Audit.

Limits and opportunities for SDH according to the existing methodology.
The need to develop renewable energy technologies with a particular focus on cogeneration is pointed out as a one of the key challenges of the heating industry. Usage of solar-based systems can be incorporated in this challenge although in Poland, such systems are only used by individuals interested in lowering the costs of energy.
Any energy company that distributes heat is legally obliged to purchase any heat generated by systems based on renewable energy technologies in the amount not exceeding the demand of entities receiving heat from the company (Dz.U. 1997 nr 54 poz. 348, 2012).
Furthermore, a rule derived from the act allows any alternative suppliers, producers and receivers a unblocked access to grid infrastructure by Third Party Agreement.
The reasoning behind investments in solar-based systems are economic criteria, which includes requirements resulting from current climate policy:

- Full investment cost of solar-based system

- Full investment cost of alternative scenarios
- A comparison between scenarios in terms of economical and technical efficiency and selection of the best alternative

Profitability of solar-based investment may be indicated by:

- High demand on heated water during summer periods
- Lack of economic reasoning for using heat generators of higher capacity, when only small part of it output is used
- Long distances to the district heating network and a consideration of creating a separate, local heating network with a closer heating source
- High operating costs connected with i.e. increasing costs of heat

Possible improvements for the methodology and for the current legislation.
The most crucial aspect influencing the possibility of implementation of big-scale solar-based installations with current heat prices and costs is an economic support of said investments. The current regulations pose a possibility of connecting to the heating network and receiving heat. The greatest barrier remains the investment costs, which is also the aspect that should be properly addresses by specific regulations.

Literature

1. Dz. U. z 2006 r. Nr 156, poz. 1118 z późn. zm., 2006. Prawo budowlane.
2. Dz.U. 1997 nr 54 poz. 348, 2012. Ustawa z dn. 10 kwietnia 2007 r. Prawo Energetyczne
3. Dz.U. 2011 nr 94 poz. 551, 2011. Ustawa z dnia 15 kwietnia 2011 r. o efektywności energetycznej
4. Dz.U. 2012 nr 0 poz. 462, 2012. Rozporządzenie Ministra Transportu, Budownictwa i Gospodarki Morskiej z dnia 25 kwietnia 2012 r. w sprawie szczegółowego zakresu i formy projektu budowlanego
5. Dz.U. 2013 nr 0 poz. 762, 2013. Rozporządzenie Ministra Transportu, Budownictwa i Gospodarki Morskiej z dnia 21 czerwca 2013 r. zmieniające rozporządzenie w sprawie szczegółowego zakresu i formy projektu budowlanego
6. Dz.U.2008.201.1240, 2008. Rozporządzenie Ministra Infrastruktury z dnia 6 listopada 2008 r. w sprawie metodologii obliczania charakterystyki energetycznej budynku i lokalu mieszkalnego lub części budynku stanowiącej samodzielną całość techniczno-użytkową oraz sposobu sporządzania.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?

1) The Draft of Renewable Energy Act
2) The Project of Assumptions for the Act for Energy Performance of Buildings
3) The Construction Act from 19th of September 2007
4) Regulation of the Ministry of Infrastructure from 6th of November 2008 on the methodology of calculating energy performance of buildings and dwellings or a part of the building being an independent technical-utility part and the preparation of a template for certificates of energy performance
5) Regulation of the Ministry of Infrastructure from 6th of November 2008 on the technical requirements for buildings and their location

Link to the full documentation:

1) http://legislacja.rcl.gov.pl/lista/2/projekt/19349
2) http://legislacja.rcl.gov.pl/lista/1/projekt/36518
3) http://isap.sejm.gov.pl/DetailsServlet?id=WDU20071911373
4) http://isap.sejm.gov.pl/DetailsServlet?id=WDU20082011240
5) http://isip.sejm.gov.pl/DetailsServlet?id=WDU20082011238

Main contents of the law:.

1) The Directive 2009/28/EC obliges Poland to reach at least 15% share of renewable energy in the final energy consumption by 2020. Poland is supposed to reach intermediate targets in respective years on the following level: 8,76% up to 2012, 9,54% up to 2014, 10,71 up to 2016 and 12,27% up to 2018.
   The provisions of The RES Directive is realized by The RES Act, the first law on the act's level dedicated to the renewable energy. The Ministry of Economy has presented the last draft version of The RES Act in July 2012, after public and inter-ministerial consultations. The next steps are additional inter-ministerial consultations. The RES Act is supposed to be fully implemented in the first half of the year 2013.
2) The implementation of the directive is in progress and in the existing legal system respective provisions are partially in force. The provisions have been, so far, implemented through the two amendments in the Construction Act and changes in the three existing Regulations.
   In March 2012 The Ministry of Transport, Construction and Maritime Economy had published the document "The Project of Assumptions for the Act for Energy Performance of Buildings" which is the very first step in the process of preparing the law. The document has been accepted in July 2012 r and recommended for further work.
3) The Construction Act contains general principles and guidelines for energy efficiency in buildings, e.g. obligation for certification of energy performance but without detailed requirements which are supposed to be in relevant dedicated regulations.
4) The Regulation aims at the defining standardized layout of certificates of energy performance of the building, dwelling or part of a building and the methodology for calculating their energy performance.
5) The Regulation establishes the technical conditions to be met by buildings and related equipment, their location on the construction plot and management of land intended for construction. The rules apply in the design, construction and reconstruction, changes in use of buildings as well as the related construction equipment.

Different laws at regional or local level

There are no regional differences referring to the national legislation system. Outstanding matters in regional level are regulated by administrative decisions, which are not in contradiction but are more detailed referring the specific issues.

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings

The current energy efficiency standards for new buildings are defined in two equivalent ways:

1. **Requirements for thermal insulation**.
   There are defined required values for thermal insulation of building elements, e.g. for the wall surfaces of the building and structural components Umax= 0,3 W/m2K, other values for internal surfaces for the walls, ceilings, windows etc

2. **Primary (and Final) Energy indicator, EP (FP)**, of annual calculation value of non-renewable energy demand for heating, ventilation, cooling and preparing hot water. The law describes the methodology for balancing annual unit demand for energy related to the surface and dependant of the building surface. The limit value of EP and EF indicators for new and renovated buildings [kWh/m2a] is calculated according to given methodology.

The current standard for so called “energy efficient house”, according to professional publications, is 70 kWh/m^{2}a. This standard is a kind of good practice justified by energy costs and enforced by interested investors and users.

Current energy efficiency standard for renovated buildings
Renovated buildings, however the definition of “renovated building” is not comprehensive with this in the directive, have limited values of 15% higher than for new buildings.

Renovation included in the scope of the law
The definition of ‘renovated buildings’ is not fully precise. There is used the same term, namely– reconstructed building, as in the Construction Act, however the scope is not relevant for energy efficiency issues and SDH purposes.
In the Project of Assumptions for the Act for Energy Performance of Buildings, the term “renovation” has been defined according to the original in the directive.

Time steps foreseen
The current legislation system is intermediate in the scope of energy performance of buildings, there are no time steps for gradual implementation of standards.
The foreseen Act for Energy Performance of Buildings is supposed to implement respective strict requirements with time steps.
In the project of assumptions for the Act for Energy Performance of Buildings, the term “renovation” has been defined according to the original in the directive.
In the same document the obligation for having the certificate of energy performance for building will be related to buildings of the surface bigger than 500 m2 and this limit will be lowered to 250 m2 since 2015.
It is also foreseen an amendment in 2013 of the regulation related to the scope of construction projects where it will be introduced an obligation for analysing the feasibility of supplying buildings with energy from alternative sources. This regulation will be implemented for public building and other in 2013.

2.1.11. SE – Sweden

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.
Determining specific energy use of a building is based on the Energy Performance of the Building Directive and is defined in "BBR" (Swedish Building Regulation). According to "BBR" energy performance of a building/ building´s energy use is defined as energy delivered to the building for heating, comfort cooling, domestic hot water, service installations and other electrical energy for building services. The electricity used for the activities/operations carried out in the building and for domestic purposes are not included.
For existing buildings the calculations are based on measured values which are corrected to normal year. For new buildings a theoretical calculation of building´s energy use is done. In order to verify if the requirements stated in the "BBR" are fulfilled it is required to report the measured values within 24 months after the final commissioning.
According to "BBR" specific energy use of a building (bought energy) can be reduced by installing solar collectors or solar cells on the building or on the land connected to the building, in the extent the building can utilize this energy. A number of property owners have therefore installed solar collectors and solar cells on the roof to improve energy performance of their buildings. Installation of solar collectors can for example be considered as an alternative for adding additional insulation on the building envelope, as this is often considered to be costly measure to improve energy performance of a building.

A practical example of calculation.
Calculated specific energy use of the building: 100 kWh/m^2
Calculated annual net solar heat gain: 15 kWh/m^2 (from solar collectors on the roof).
Calculated specific energy use of the building with solar heat: 85 kWh/m^2
Measured specific energy use of the building with solar heat: 85 kWh/m^2

District heating is counted as bought energy and charged 100 % on the building´s energy use even if the energy comes from renewable sources, for example from solar thermal energy. Specific energy use, e.g. 100 kWh/m^2 as in the example above, for a building where heat is supplied via a local or district heating system is not affected by whether district heating is produced by oil- or biofuel fired heating plant, nor if there is a solar thermal system connected to the heating plant.
As mentioned before solar heat can be generated with collectors installed on the building or on the land connected to the building in order to improve building's energy performance and there is a certain interest from the housing companies side, who are connected to the district heating grid, to use solar thermal energy. When the property owner installs solar collector system for domestic hot water (on the secondary side) they will minimize simply the amount of bought energy from district heating network and improve the specific energy performance of the building. There is also a possibility to install solar thermal system connected in the primary district heating system via a sub-station in the building. This means that a contract between the district heating supplier and property owners is be made that regulates how property owner can utilize the solar energy similar way as shown with the example before.

Limits and opportunities for SDH according to the existing methodology.

Solar heat is treated differently if it is supplied in a building or via district heating system. BBR requirements encourage the use of solar heat in buildings connected to district heating, but they do not stimulate the use of solar thermal energy in district heating systems.

Possible improvements for the methodology and for the current legislation.
The current regulations must be reviewed and amended to promote renewable energy in district heating systems. How bought energy is produced should be relevant when evaluating building's energy performance. The use of weighting factors (as mentioned in the EPBD directive) for different energy sources in the assessment of building's energy performance can be a one solution.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?
Implementation of the Energy Performance of the Buildings Directive in Sweden
The EU Directive (2002/91/EC) on the energy performance of buildings has been implemented via [1]:

- implementing a system for energy declaration of buildings [2-5]
- changing the Swedish Building Regulations [6]
- informative work via energy consultants and energy offices

The Swedish system for energy declarations is regulated with the law SFS 2006:985, The Energy Declaration of Buildings Act [2]. This law was issued in June 2006 and came in force from October 2006. A number of amendments have been made to this law: SFS 2009:579 [3], SFS 2012:397 [4], SFS 2012:398 [5].
Additionally, following mandatory documents regulate the energy certification process:

- SFS 2006:1592, The Energy Declaration of Buildings Ordinance [7]
- BFS 2007-4 BED1, Regulations for Energy Certification of Buildings [8]
- BFS 2007-5 CEX1, Regulations for Accrediting Energy Experts [9]
- BFS 2012-9 BED9, Regulations regarding Changes to the Regulations for Energy Certification of buildings [10]

The Energy Declaration of Buildings Act defines the buildings that have to be certified, according to the instructions given in the Directive. According to the law SFS 2006:985 [2] and its amendments [3-5], all buildings being built, sold or rented/leased as well as buildings larger than 500 m2 used for public activities should be declared. In the Swedish Ordinance SFS 2006:1592 [7] the general exceptions can be made for a number of building categories. An energy declaration is valid for 10 years and shall contain the following: energy performance, reference or benchmark values, recommendations for cost effective improvements, information about the obligatory performance testing of the ventilation system, information about Radon measurements. Boilers and heating systems do not have to be inspected in Sweden. Instead, advice is given. The energy declaration of buildings begun in 2008 and the most recent energy declaration must be available in a clearly visible place in the building.
Energy performance of a building is based on the national calculation method. For new buildings a theoretical calculation for the verification of the requirements of the “BBR” (Swedish Building Regulation) is done. For existing buildings the calculations are based on measured, corrected normal values. The use of energy comprises the corrected average yearly amount of bought energy for heating, comfort cooling, domestic hot water, service installations and other electrical energy for building services. The electricity used for the activities/operations carried out in the building and for domestic purposes are not included.
The reference values given in the energy certificate represent the requirements stipulated for new building and benchmarks for similar houses according to the current legal standards.

Boverket (The National Board of Housing, Building and Planning) has set minimum requirements for new buildings, most recently updated in the Swedish Building Regulations 2012 [6]. For existing buildings, the calculation procedure for benchmark/reference values is presented in BFS 2012-9 BED9.
In the amendment SFS 2012:398 [5] for the law SFS 2006:985 it is also stated that for new buildings before the construction work alternative energy supply systems need to be evaluated from the technical, environmental and economical aspect.

Summary: The Swedish building regulations have requirements on and the Swedish building owners need to declare their normalized annual energy use defined as the energy bought (metered and calculated kWh/year of fuels, district heat, electricity) for heating of space, ventilation air and hot water, as well as electrical energy for basic building services (e.g. fans, etc.), and if used energy bought for cooling is also included.

A Swedish standard, which will supplement the European standard EN 15217 for energy certification is now being produced. In this standard, an environmental impact will be assed based on a weighted use of energy in which different factors are used for different energy sources. Consequently, the weighting factor for oil and electricity might be significantly greater than the factor for bio-fuels, although this will be decided based on political decisions.
Swedish Parliament adopted in June 2006 the goal to reduce the use of energy in the building sector by 20% by 2020 and 50% by 2050 compared to the year 1995 [13]. This goal has also lead to a number of measures undertaken in the buildings sector regarding renovation.

Implementation of the Directive for the promotion of renewable energy in Sweden
The EU Directive 2009/28/EG aims to establish a common framework and to define binding national targets for the promotion of energy from renewable sources. Sweden has on a proposal from the Government decided that the share of renewable energy by 2020 should be at least 50 percent of the total energy use and the share of renewable energy in transport in 2020 is at least 10 percent. Sweden today already has a very high share of renewable energy in buildings, both directly and indirectly by including district heating and cooling. The total share of renewable energy in Sweden was 47.8 percent in 2010. The share of renewable energy in the transport sector amounted to 8.0 percent in 2010 [11].
Additionally, the majority of the demands in the EU Directive had already been implemented in the laws before 2010. For implementing articles 15 (Guarantees of origin of electricity, heating and cooling produced from renewable energy sources) and 16 (Access to and operation of the grids) in the EU Directive 2009/28/EG has resulted in changes in the national laws. Changes in the Electricity law [14] has been done, with the latest amendment [15] coming into force in October 2012. Additionally, changes in the Natural gas law [16] has been done, with the latest amendment [17] coming into force in July 2012. The electricity producers can upon a request issue guarantees of origin. Additionally, connecting electricity producers from renewable sources to the grid- system have been made possible.
According to the action plan for implementing the EU Directive 2009/28/EG [18] the buildings netto energy use is better to be regulated by Building Regulations, while a use of renewable energy shall be promoted by other means, e.g. taxation of fossil alternatives, or via support for investing in solar energy or similar. There is also a certification system with quotas for electricity from renewable energy sources (bioenergy, wind power, hydro power, solar power, etc.). A number of investment programs support increase in district heating systems.

Summary: The Swedish share of renewable energy is high, around 50% (EC definition), and the promotion of renewable energy is managed on the national energy supply level, not on the building level.

Different laws at regional or local level
There are no additional laws at regional or local level

Consequence of these national / regional laws on the minimum requirements for energy efficiency in buildings
The law on energy declarations aims at making buildings more energy efficient by implementing the measures proposed in the energy declaration. The energy declaration contains the information about the energy performance of the specific building, reference or benchmark values and recommendations for cost effective improvements. The reference values given in the energy certificate represent the requirements stipulated for new building and benchmarks for similar houses according to the current legal standards. BFS 2012-9 BED9 gives the calculation procedure for benchmark/reference values for energy certificates. It is up to the energy expert who carries out energy audit work for energy certificate to give recommendations for cost efficient energy saving measures in the specific building.
Boverket (The National Board of Housing, Building and Planning) has set minimum requirements for new buildings, most recently updated in the Swedish Building Regulations 2012 [6]. The currently published and updated Swedish Building Regulations 2012 will become in force in 2013 and will be reviewed again in 2015 in order to evaluate if they can be made even stricter. Principally the same requirements as for new building should apply for renovation projects. However, there is a lot of space for interpretation and in practice this requirement is not strictly followed.

2.1.12. SI – Slovenia

How DH is accounted for in the calculation of energy performance of buildings according to national laws, with specific attention to SDH.

The conditions to achieve the building energy efficiency are listed in Energy efficiency building regulations (Official Gazette of RS, no. 52/2010). The articles that are associated to solar district heating systems are:

- Annual primary energy for system operation in residential building Q_p, calculated per unit of heated area of the building A_u ,shall not exceed (Article 7, paragraph 4):

$$\frac{Q_p}{A_u} = 200 + 1{,}1\left(60\, f_0 - 4{,}4 T_L\right)\left[\frac{kWh}{m^2 a}\right]$$

  Factor f_0 is defined as ratio between the building envelope surface and heated building net volume, and T_L is the average annual ambient air temperature.

  Advantage of solar district heating system is the use of non-renewable energy that is taken into account for heat transport and not solar energy which is converted into heat.
- Buildings energy efficiency is achieved if at least 25% of the total final energy consumption for the system operation in the building is ensured by the use of renewable energy (Article 16, paragraph 1).
- Building energy efficiency is also achieved if the building is at least 50 percent supplied by the energy-efficient district heating or cooling system (Article 16, paragraph 2).
- Energy-efficient district heating and cooling systems are systems, where the energy is produced from renewable sources or comes from a CHP plant with high efficiency in accordance to the regulations of electricity production by cogeneration of heat and electricity with high efficiency.
  In the case of solar district heating system supply, the conditions of using renewable energy in buildings are achieved.
- The CO_2 emissions are not limited in regulations but have to be calculated and reported in the Statement of Buildings Energy Performance (EE study, article 17, paragraph 2).
  The use of solar energy does not produce CO_2 emissions to the atmosphere, so the CO_2 emissions caused by the solar district heating system are very low.

A practical example of calculation.

A methodology for calculation of the building energy performance is provided in Technical Guideline TSG-1-004: 2010 in Chapter 9. In the case of providing heat from district heating system, the heat loss of heat substations must be taken into account.

If the building supply by energy-efficient district heating system (solar district heating system) or cooling is at least 50%, the conditions of using renewable energy sources are achieved.

The annual primary energy for the building operation shall be determined by multiplying the annual energy input and conversion factor. Conversion factor for district heating without cogeneration is 1.2 and for district heating with cogeneration 1.0. For renewable energy sources this factor is lower than 1 (0.1 for biomass). Factors for different types of energy are given in Chapter 11 (Table 3) in Technical guideline.

The CO_2 emissions are determined on the base of calculated energy consumption. The specific CO_2 emissions per unit of fuel or energy are given in chapter 11 in Technical guideline. When

the fuel or energy emissions are not given by the supplier, factor 0.33 kg/kWh is used for district heating system.

Standard methods and software tools usually used for such normative calculations.
Standard calculation methods are given in Technical guideline TSG-1-004:2010. Software tools in which these methods are implemented are not prescribed by the legislation.

Limits and opportunities for SDH according to the existing methodology.
Opportunities for solar systems are showing in district heating systems which do not satisfy the conditions of renewable energy share and in which the use of primary energy is excessive. In that case the use of solar collector fields is reasonable.
The growth of solar district heating systems is limited by current legislation which supports the local systems for renewable energy sources without the broader view of energy use in urban areas and on the integration of energy systems.

Possible improvements for the methodology and for the current legislation.
Possible improvements of current legislation for solar district heating systems are mainly seen in the inclusion of a wider and integrated approach in the design of energy supply.

Have the two EC Directives (recast of the European Building Performance Directive and the Directive for the promotion of renewables) been implemented at national level? By which law/s?

- Construction Act and subordinate regulation:
- Rules on efficient use of energy in buildings (2010)

Link to the full documentation

- http://zakonodaja.gov.si/rpsi/r00/predpis_ZAKO3490.html
- http://zakonodaja.gov.si/rpsi/r00/predpis_PRAV7050.html

Main contents of the law, with focus on: energy efficiency in buildings and support measures for DH and solar thermal.
It sets out the technical requirements that must be met for energy efficiency in buildings in thermal insulation, heating, cooling, ventilation, or a combination of hot water and lighting in buildings, providing their own renewable energy systems to operate in the building and methodology for calculating the energy performance of buildings.

Different laws at regional or local level
Only laws on national level are operating.

Current energy efficiency standard for new buildings

1. residential buildings:
   - Q(NH)/A(u) ≤ 56 + 60 f(0) - 4,5 T(L) (kWh/m2a)
   - Q(NC)/A(u) ≤ 70 kWh/(m2a)
   - Q(p)/A(u) = 275 +1,1 (60 f(0) - 4,4 T(l)) kWh/(m2a)

   non-residential buildings:
   - Q(NH)/V(e) ≤ 0,32 (56 + 60 f(0) - 4,5 T(L)) (kWh/m3a)

   public buildings:
   - Q(NH)/V(e) ≤ 0,29 (56 + 60 f(0) - 4,5 T(L)) (kWh/m3a)

2. $H_T' \leq 0{,}28 + \frac{T_L}{300} + \frac{0{,}04}{f_0} + \frac{z}{4}$;
3. limited thermal conductivity of elements

Current energy efficiency standard for renovated buildings
If more than 25% of building envelope is renovating, energy efficiency standard are the same. Otherwise only thermal conductivities of elements are limited.

Renovation included in the scope of the law
If more than 25% of building envelope is renovating.

Time steps foreseen
After 31.12.2014 energy requirements are stricter.

1. residential buildings:
   - Q(NH)/A(u) ≤ 45 + 60 f(0) - 4,4 T(L) (kWh/(m2a))
   - Q(NC)/A(u) ≤ 50 kWh/(m2a)
   - Q(p)/A(u) = 200 +1,1 (60 f(0) - 4,4 T(L)) kWh/(m2a)

   non-residential buildings:
   - Q(NH)/V(e) ≤ 0,32 (45 + 60 f(0) - 4,4 T(L)) (kWh/(m3a))

   public buildings:
   - Q(NH)/V(e) ≤ 0,29 (45 + 60 f(0) - 4,4 T(L)) (kWh/(m3a))
2. $H_T' \leq 0{,}28 + \frac{T_L}{300} + \frac{0{,}04}{f_0} + \frac{z}{4}$, (requirement is the same)
3. limited thermal conductivity of elements (requirement is the same)
4. 25% of useful energy from RES

2.2. Renewable heat obligation

2.2.1. AT – Austria

Article 13(3) of Directive 2009/28/EC describes the existing legislation and measures for the use of renewable energy sources in buildings at federal and state level. At federal level, RE measures in buildings are implemented and promoted through the following legislation:
-Austria's Environmental Aid Act (UFG, BV: BGBl. No 185/1993)
-Agreement pursuant to Article 15a B-VG (2009) between the federal government and states on measures in the building sector for the purpose of reducing the emission of greenhouse gases

In the Austrian Energy Strategy it is recommended – as part of the further development of the Article 15a B-VG Agreement – that a given share of renewable energy sources to supplying heat in buildings should be specified. Concrete minimum values have not yet been determined, but it is planned to gradually increase the minimum share of renewable energies.
The mandatory use of solar installations for water heating in residential and commercial buildings is being considered.The implementation of these plans will happen in stages by the federal and state governments, starting from 2010.

Minimum share of renewables foreseen
There are no minimum values for the use of renewable energy sources in the building regulations of federal states. In the part of the building code that includes the technical rules, there are however general requirements on the issue of energy savings and
thermal Insolation.

Share of renewables (%)	2005	2010	2015	2020
Residential building	24	25	26	26
Commercial building	8	9	10	10
Industrial building	1	2	2	2
Public building	1	1	2	2
All buildings	33	35	38	38

Source: National Renewable Energy action plan Austria

Which buildings fall under the scope of this law?
Private, public and commercial buildings.

Which renewables are included in the law?
- Biomass
- Waste heat
- Heat pumps
- Solar installations

Specific provisions for district heating
Within the scope of the 'Environment Assistance in Austria' subprogram, some schemes to encourage the use of district heating from renewable energy sources are in place.

The Austria's Heating and Cooling Network Expansion Act (WKLG, BGBl. I No 113/2008) includes sections of possible support.
Under § 1(2), district heating plants and grids are outside the scope of this federal act where they are operated on the basis of renewable energy sources.
The most substantial form of support of small-scale heating and cooling from renewable energy sources exists at federal state level. Special investment incentives are awarded for solar heat, heat pumps and biomass heating systems in the building sector within the scope of housing promotion.

Specific provisions for solar
Solar installations for hot water supply or part solar space heating including casing, heat accumulators and distribution grids with a maximum collector area of 100m² are supported.
The support is calculated with a flat rate of € 100 per m² for standard collectors or € 150 per m² for vacuum collectors, but a maximum of 30 % of environment-relevant investment costs (as de minimis aid). An award of € 300 for external energy consultation is possible. A requirement is that the request be submitted after implementation, however not exceeding six months after accounting.
Solar installations from a collector area of 100 m² for hot water supply or part solar space heating including casing, heat accumulators and the provision of process heat;
solar installations (smaller than 100 m²) for thermal propulsion for cooling
installations. The support amounts to a maximum of 20% of the environment-relevant investment costs.
Source: national_renewable_energy_action_plan_austria_en

2.2.2. CZ – Czech Republic

Savings of non-renewable energy can be provided by better parameters of a building envelope or by RES.

Minimum share of renewables foreseen
Decree is not published yet, that is why accurate values are not known, but:

- 3 % Renovated buildings
- 10 % New buildings
- 25 % Nearly-Zero buildings

at the end of implementation are expected.

Which buildings fall under the scope of this law?
All new or renovated buildings.

Which renewables are included in the law?
All renewable and alternative energy sources.

Specific provisions for district heating
It is included as an alternative and should be assessed during the process.

Specific provisions for solar
It is included as an alternative and should be assessed during the process.

2.2.3. DE – Germany

The purpose of Act on the Promotion of Renewable Energies in the heat Sectors: to increase the share of renewables in the total final heat and cool consumption to 14 % in 2020. There are extra goals for renovated public buildings.
Buildings under the scope of the law: all buildings with the minimal floor space 50 square meters and more.
According to the Act of the law, renewable energy includes:

1. geothermal energy
2. heat withdrawn from air or water and technically usable
3. solar energy
4. heat energy from biomass
5. heat withdrawn from ground or water and technically usable for heating or cooling purposes

Specific provisions for district heating
District heat produced by a substantial share of renewable energy sources, by a share of at least 50 % of CHP or waste heat or a combination thereof is considered an alternative measure to fulfil the obligation for using renewable energy.

Specific provisions for solar
When using solar thermal energy, at least 15% of the total heating demand must come from solar energy. In the case of detached and semi-detached houses a collector area of 4 % of the usable floor area is sufficient. In case of houses with three apartments a collector area of 3 % is enough.

2.2.4. DK – Denmark

Denmark does not have a renewable heat obligation for new or renovated buildings. However, two points should be mentioned:

- District heating has energy factor 0.8 where fossil fuels have 1 and electricity 2.5 when calculating heat consumption
- Production from solar thermal plants can be subtracted when calculating the energy consumption if the plant is placed at the building site.

2.2.5. ES – Spain

The Technical Building Code (CTE) provides that all new buildings or rehabilitation must take account of solar thermal energy in its design.
For those buildings with a DHW demand or heated swimming pool,establishes a minimum annual solar contribution between 30% and 70% depending on the climate zone, there are 5 classifications for this purpose. Percentage can be overcome by the promote or due to regulations issued by the competent authorities. The facilities must meet certain requirements that are foressen possible damage from overheating, freezing, burning, pressure and in case of exceeding the actual contribution in certain areas is expected to divert surplus energy to other existing applications."

DHW buiding total demand (l/day)	Minimum solar contribution % General Case Climate Zone I	II	III	IV	V
50-5.000	30	30	50	60	70
5.000-6.000	30	30	55	65	70
6.000-7.000	30	35	61	70	70
7.000-8.000	30	45	63	70	70
8.000-9.000	30	52	65	70	70
9.000-10.000	30	55	70	70	70
10.000-12.500	30	65	70	70	70
12.500-15.000	30	70	70	70	70
15.000-17.500	35	70	70	70	70
17.500-20.000	45	70	70	70	70
> 20.000	52	70	70	70	70

Table 1 Minimum solar contribution % general case for different climate zones

DHW buiding total demand (l/day)	Minimum solar contribution % Joule Efect Climate Zone I	II	III	IV	V
50-1.000	50	60	70	70	70
1.000-2.000	50	63	70	70	70
2.000-3.000	50	66	70	70	70
3.000-4.000	51	69	70	70	70
4.000-5.000	58	70	70	70	70
5.000-6.000	62	70	70	70	70
> 6.000	70	70	70	70	70

Table 2 Minimum solar contribution % Joule Effect case for different climate zones

	Minimum solar contribution % Pool heating case Climate Zone I	II	III	IV	V
Indoor-pool	30	30	50	60	70

Table 3 Minimum solar contribution %, pool heating case for different climate zones

Renewables included in the law are solar thermal and photovoltaic.
There are no specific provisions neither for district heating nor for solar but there are specific local or regional laws for solar (see Barcelona's example).

2.2.6. FR – France

There is nothing compulsory for renovated buildings.
For new individual houses, the use of one RES is compulsory: solar thermal water heater, connection to a DH with more than 50% RES, other RES

Which renewables are included in the law?
RES sources : wind, solar, geothermal, ground source and air heat pumps, biomass, heat gradient from water, hydropower, gas from waste and sewage, biogas, ocean energy. (Article 29 de la loi n° 2005-781 du 13 juillet 2005)

Specific provisions for district heating
The specific provisions for DH depend on the local authorities policy.

Specific provisions for solar
Solar thermal technologies are in competition with other RES and faced with important investment costs. There is a tax credit on solar thermal technologies for households.

2.2.7. HR – Croatia

In the near future, the primary energy requirement/consumption of buildings shall be determined. The ordinance on methodology for calculation of the primary energy requirement/consumption is in the preparation phase, including the appropriate software. It will provide help in calculation of a RES share. Additionally, there are initiatives for inclusion of the minimum levels of renewable energy in building regulations. The promotion of RES usage in buildings will be a part of forthcoming Law on renewable energy sources that is still in the preparation phase. Any new building or the existing building substantially renovated should be designed, constructed or renovated in such a way to allow a significant use of RES leading to nearly zero energy building standards.
Within the scope of this sub law, it's obligatory for all new or existing buildings undergoing major renovation larger than 1000m^2 to include analysis of technical, ecology and economy feasibility of application of decentralized RES, cogeneration, district heating and cooling, heat pumps or fuel cells. The investor is requested to revise alternative systems and technical solutions, but application of these systems is not obligatory.

Which renewables are included in the sub law?
Decentralized RES systems, cogeneration, district heating and cooling, heat pumps or fuel cells for application in buildings are included.

Specific provisions for district heating
District heating/cooling systems should be included in physical planning documents in order to foresee required infrastructure.

Specific provisions for solar
None in the existing legislative acts, however there are other provisions as follows.
The Environmental Protection and Energy Efficiency Fund exists in Croatia. It is an extra-budgetary fund that finances projects, programmes and measures for the purpose of environmental protection, increase of energy efficiency and the usage of renewable energy sources in Croatia. The Fund supports the implementation of EE/RES projects by occasional tenders. The Fund is mostly oriented towards private companies, local/regional self-governments and other institutions.
The support of natural persons in financing implementation of RES installations has started to develop in 2008, on regional/local level. Typical tender in 2011 covered installations of solar thermal collectors, solar PV systems, geothermal heat pumps and small-scale biomass boilers in residential sector. All RES technologies are eligible to receive the same level of support (max. 40% of the investment and installation costs or max. approx. 1600 EUR). Incentives are received upon installation and audit by the county committee.
Feed-in tariffs for electricity production are higher for PV systems integrated on buildings than PVs on other locations. PV plants on ground, with installed capacity up to 1 MW are eligible for a fixed value of feed-in tariff equal to cca 15 c€/kWh. PV plants installed on buildings are eligible for higher feed-in tariffs, and an additional bonus is added if a building uses RES system for heating (solar thermal system or heat pump).
Additionally, financial institutions (commercial banks in Croatia, Croatian Bank for Reconstruction and Development, European Bank for Reconstruction and Development, World Bank, KfW etc) have started to offer soft *green* credit lines for projects based on the introduction of RES and energy efficiency increase. Within this, the construction of low-energy buildings or recon-

struction of existing buildings in an energy efficient way, using RES technologies, is supported. Some cities (e.g. Samobor and Koprivnica) had terminated communal charges for the construction of buildings ranked in classes: A+ and A, where are energy demand for space heating less than 25 kWh/(m^2a).

2.2.8. IT – Italy

The renewable heat law is included in the legislation on energy efficiency and, therefore, has been already described in the previous sections.

2.2.9. LT – Lithuania

Buildings meet energy requirements of A++ energy efficiency class if ration between renewable and non-renewable energy consumption in the building must be more then one. All new buildings have to meet energy requirements of A++ energy efficiency class after 1 January 2016.

Which buildings fall under the scope of this law?
Modernization of public, industrial buildings and residential houses should consider the possibility to use installations for electricity, heat and cooling generation of renewable sources.
Renewable Energy Law of Republic of Lithuania, 2012 m. May 12d. Nr. XI-1375, Vilnius.

Which renewables are included in the law?
Not specified.

Specific provisions for district heating
Up to 50 % district heating share to achieve from renewable energy sources until 2020.

Specific provisions for solar
None.

2.2.10. PL – Poland

There are any strict regulations about required minimum share of renewable so far. However the specific share of solar heat is foreseen in NREAP (National Renewable Energy Action Plan), as well as the increasing role of DC in heat supplying. In the draft RES Act there are only light recommendations referring to renovated public buildings and linked with energy efficiency.

	2010	2015	2020
Residential buildings	11%	14%	16%
Public buildings	10%	13%	15%
Commercial and industrial buildings	9%	12%	14%
Total	**10%**	**13%**	**15%**

2.2.11. SE – Sweden

There is currently no renewable heat obligation for new or renovated buildings in Sweden. According to Swedish Building Regulations 2012 [6] the specific energy use of a new building can be reduced by the amount of energy provided by solar collectors or solar panels locating on the main building, on the house or the land connected to the building. This means that some building owners install solar heating systems and/or solar PV systems on the buildings to reduce the specific energy use.

2.2.12. SI – Slovenia

The minimum share of renewables foreseen is 25% of RES in useful energy.

Which buildings fall under the scope of this law?
All new buildings and renovated if more than 25% of building envelope is renovating.

Which renewables are included in the law?
- 25% of solar energy used or
- 30% of biogas or
- 50% of solid biomass or
- 70% of geothermal energy or
- 50% of energy from the environment or
- 50% of energy from cogeneration or
- 50% from energy efficient DH or district cooling

Specific provisions for district heating
None.

Specific provisions for solar
- Regulation on the promotion of efficient energy use and use of renewable energy sources
- Rules on feasibility study of alternative energy systems for energy supply in buildings
- Regulation on supports for the electricity generated from renewable energy sources

3. PART II – CONSEQUENCES FOR SOLAR DISTRICT HEATING

3.1. Opportunities and barriers

From the analysis of the above described national legislative framework, several general conclusions can be drawn regarding both opportunities and barriers for district heating and, in some cases, with a specific focus on solar thermal for district heating.

The opportunities can be summarized as follows:

- DH is very often included in the laws on energy efficiency in buildings, because it is considered as an energy efficiency measure; therefore it is eligible to meet the nearly-zero energy requirements.
- Local energy and climate policies tend to consider RES DH development as a powerful mean to tackle greenhouse gas emissions.
- A DH network which is dimensioned for the present demand may be oversized in the future if the heat demand decreases due to energy efficiency measures. However, this surplus capacity allows to extend the DH network to additional areas without the need to upgrade neither the pipes or the production power. Therefore, in countries where DH has a low heat market share, their densification and development can, despite lower heat demand per building, lead to a need for new plants.
- DH grids could also be used as heat storages, at least on a daily basis.
- To reduce DH additional infrastructure cost, it should be included in the general building cost or, even stricter, include RES DH as an essential building service and therefore have on obligation to build it.

The main barriers which must be highlighted are:

- General competition between DH and low energy houses, also due to high connection costs.
- Lack of specific incentives for developing new DH grids or for renovating existing ones.
- Regulated price for DH in some countries.
- Negative image for DH, sometimes associated with the concept of large industrial polluting infrastructure on the territory.
- Market saturation in some countries.
- “Unfair” competition with electric heat (e.g. by heat pumps) and too low electricity price..
- Specific barriers for SDH:
    - competing technologies are often cheaper (also because more supported) and more well-known and therefore more easily bankable;
    - not many potential installation sites show both high solar radiation and existing DH grids.

COUNTRY-SPECIFIC CONSIDERATIONS		
	Opportunities	**Barriers**
AT	Boundaries between DH systems and local heating systems often overlap; therefore strict distinctions between both systems are not defined. Local district heating refers to a building, supplied by a central heating boiler which can also provide heat for neighbouring buildings. Nearly-Zero	Special challenges occur for a DH system, if buildings with a very low heating demand are interconnected. Building owners do not want to pay high connection fees, especially if the heat demand is very low. The supplier has to pay high connection fees, with risk of no payback. Therefore heating

	energy buildings do not have a heating demand, but they need hot water supply, which can be covered by solar systems in summer and natural gas or heating pumps in winter. Biomass boilers do not fit with this demand, because they need a constant work load.	suppliers do not connect buildings with a hot water demand only. An alternative for low energy houses might be a single house heating system combined with a solar plant.
CZ	The evaluation of DH implementation is mandatory during the building design process since 01/01/2013.	Lower building energy needs imply less business opportunity for DH utilities, since connection costs remain the same, but revenues are lower.
DE	For low-temperature systems consisting of small and well-insulated twin pipes, there is an opportunity of using renewable energy sources directly or in combination with large-scale heat storages.	Technical barriers for SDH: current temperature level in the DH grids. This could be overcome by e.g. building secondary DH grids with temperature level of the heat medium in the range from 70 to 80 °C.
DK	DH is a good solution if pipes are cheap and with low heat losses. The peak consumption is low so solar can cover a large part. If the DH system is already solar assisted, DH can be economically attractive for the customers when calculating social economic costs, because the solar part is already paid.	If some of the nearly zero energy buildings do not connect to DH, it might be too expensive to install new pipes or to maintain existing pipes.
ES	The implementation of DH is very far from reality as it only appears in the Spanish ordinances as comments to meet the European directive. Only a few buildings have DH and SDH is even further from becoming a well-known technology. An upcoming new regulation will probably give new opportunities to DH, because it makes easier to obtain nearly-zero energy building by increasing energy efficiency and reducing the consumption of primary energy.	There are no cities with both high solar radiation and district heating/cooling grids where to integrate a solar thermal plant.
FR	Since 2008, the evaluation beforehand of DH development for a new district or DH connection for a new building is compulsory (but without any official method given to perform the studies). The “positive energy building” planned for 2020 by the French building regulation should have a heat demand of 10÷40 kWh/m^2 and an equivalent RES production which, for cities, can be provided by DH. It is hence a great opportunity to install or extend high RES share DH compared to gas or electrical heating systems. Because they are more efficient, low temperature DH will be more suitable, which provides opportunities for waste water, sewage, geothermal and solar thermal.	Main technical barrier: high operating temperature in most French existing DH. Commercial barrier, not specific to SDH, is the tough competition with electric and gas heating: - gas and electricity prices remain low due to political decision - local authorities influence on electric and gas grid development is too weak. Connection and distribution costs will have to decrease and will have to be included in the ground cost, like water, electricity and gas grids. DH with RES will have to be considered as an essential utility like electricity: its implementation cost will then be

	Because the building heating demand is reduced, the DHW demand will take a larger place in the total heat demand; solar resource is convenient to cover a larger part of it.	naturally shared among the building project owners.
HR	The new Law on Heat market is currently being developed as well as the new Law on RES.	No incentives on DH and on solar thermal. Moreover, DH has a regulated price and its public image needs to be improved, together with a development of innovative RES schemes.
IT	Nearly-zero energy buildings indeed represent a good opportunity for efficient DH networks, since this technology is considered to be crucial for energy saving and may be introduced as mandatory in energy audits.	New laws push for low energy consumption and high share of renewables. This will disadvantage those DH utilities which cannot deliver renewable heat or heat produced with high efficiency systems.
LT	Only few new buildings meet nearly-zero requirements. DH companies are interested in reduction of heat losses in networks only, for instance by lowering supply and return temperatures. This is seen as an opportunity for DH companies.	Development of DH is limited due to market saturation. DH covers between 60% and 90% of the heating market in the largest cities. New wood biomass boilers or CHP units are installed, through EU support, in renovated boiler-houses. New installations, such as solar, will require additional investments. DH companies have no money for additional investment. Majority of not renovated block residential buildings consume a big amount of thermal energy for heating purposes during heating season. Lower heat sales means lower revenues for DH companies.
PL	DH companies are obliged producing heat from renewable resources, however technologies are not specified. The growing cost of DH generation creates economic opportunity for solar thermal, which may reduce bills for customers. Nearly zero-emission building requirements may be supported by solar thermal. More common DH substations may be a technical advantage.	DH companies are more often interesting in biomass, as a cheaper option than solar thermal. The CHP is also more economically interesting solution for them. The RES Act has not been implemented yet and DH companies operating under regulatory risk are suspending investment activities.
SE	It is up to the DH companies to compete with heat prices and claimed environmental advantages. Here the use of bioenergy is a major aspect and the use of a central solar heating plant is one of many other aspects. The building owner can however reduce the specific energy use by installing solar collectors and thereby reduce the amount of purchased district heat. Recently, a number of systems are instead connected in the primary DH system where it enters	Building energy requirements is measured in kWh/m^2 building area, while the economics of DH depends on MWh of sold heat per length of distribution pipes. The DH revenues depend on the difference between income and costs, not on the amount of heat sold, so the development depends on how the DH companies manage to adapt to lower heat demands. Political building energy requirements that encourage electricity (via heat pumps) for heating and low electricity prices are

	the building (sub-station). This approach is then complemented by net-metering of bought district heat and supplied solar heat. An advantage is that the design of the solar system is simpler and the main restriction is the suitable roof area and not the heat demand. A disadvantage is the risk for higher operating temperatures and thereby lower thermal yield and another is the lack of interest and knowledge from DH providers.	probably larger problems than reduced heat demands in new and energy efficiency measures in existing building.
SI	The opportunities can be found especially in new residential areas, where the demand for heating, compared to sanitary hot water, is not too large, and where the temperature levels from solar are sufficient for the supply. New laws give also an opportunity to develop distributed energy systems including solar.	DH systems are becoming over sized, due to the ever decreasing heat demand. One opportunity is that they can be used as heat storage even though, in most cases, this possibility is limited to daily consumption. The largest problem is related to the local policy of municipalities, which may promote gas networks or use of gas. Furthermore, local policies must give priority to DH system over the local production of heat or cold even in the cases of e.g. heat pumps. Because of the low price of electricity versus heat, heat pumps can represent an obstacle in future, except in cases that heat pumps are also used for DHC.

3.2. Relevant regulations and subsidy schemes

Besides the national and regional legislation on energy efficiency in buildings, further regulation could affect the development of DH and SDH.
Moreover, subsidy schemes may foster the development of some technologies.
The table below reports relevant regulations and applicable subsidy mechanisms for all the project countries.

General comments about regulations and subsidies which may influence DH development are:

- Lower VAT for DH:
  - what will happen if it will be removed in the future?
  - should it be, as in France, subject to specific requirements, for instance minimum share of RES in DH?
- Green certificates for CHP can favour RES DH.
- Solar heat is not affected by fees for security of supply, which are applied for instance in Denmark.
- Obligation for connection to a high-efficiency DH system (e.g. with a 50% RES share), if available in an area.
- Subsidies:
  - For RES DH; however solar is sometimes not included in the "green energy sources".
  - For the renovation of old DH grids.
  - Direct contributions for ST plants, but they are usually introduced for small systems.
  - General trend towards the cancelation of subsidies, due to both economic crisis and increasing RES economic competitiveness.

COUNTRY-SPECIFIC CONSIDERATIONS		
	Regulations	**Subsidy schemes**
AT	For construction and connection, subsidies exist based on the environmental subsidy of the federal state (UFI) for local and district heating suppliers. No valid regulations exist for heating supply despite some ÖNorms, which have to be observed.	**National subsidy for large scale solar thermal plants from 100 m² to 2000 m² collector area** In Austria a funding program exists, which is called "Solar Thermal – Large-scale solar plants" of the Austrian climate fund: It promotes the design and construction of innovative solar systems and integration into the system and is divided in four areas: 1) Solar process heat for the industry 2) Solar feed-in grid-connected heat supply systems (micro-networks, local and district heating networks) 3) High solar fraction (over 20% of the total heat demand) in commercial and service enterprises 4) Solar-assisted air-conditioning plants and its combination with solar hot water heating and cooling demand during periods without heating demand The subsidy rate in all four subject areas rang-

		es from 40 % until 50% of the environmentally relevant additional needed invest (compared to conventional energy sources; +5% for SME, +5% for appraised innovative projects). Solar cooling systems are funded on the same terms as the solar thermal part of the plant. Funding is provided through non-repayable investment grants. **Local incentives from the different provinces of Austria; each province has different subsidy schemes; mainly relevant for smaller and standard solar thermal plants for single family houses;** http://www.solarwaerme.at/EFH/Foerderungen/ **Local and district heating networks get subsidies based on their fuel provided or heating and cooling power construction laws.**
CZ	DH has a lower VAT (10 % in 2011, 14 % in 2012, 15 % in 2013).	"Green bonus" for district heat produced in some RES (solar is not included). Subsidy on renovation of some DH systems from The Operational Programme Environment http://en.opzp.cz/ (programme ends in 2013).
DE	Regulations: -grid operators are obliged to connect CHP plants and give priority to buying CHP electricity -grid operators pay a fixed premium for CHP electricity on top of the market price -support for DH grids is based on CHP and costs are shared among all electricity consumers	Subsidies from Federal ministry for Economic Affairs and Energy (Marktanreizprogram): - Large solar plants (>40m²) feeding into a heat net are supported with KfW loan with redemption subsidies up to 40% of investment cost (max. 10 Mio. €). Alternatively, a performance-related subsidy can be chosen: the yearly collector heat gain is multiplied by the number of collectors and 0,45 €. The performance-related subvention is limited to 45 up to 65% of investment cost, depending on the size of the company. - Existing DH nets supplying RE heat and substations are supported via KfW loan with redemption subsidies of 60€/m pipe (up to 1 Mio. €) and 1800 € per substation - For heat storages (>10 m³) the redemption subsidy is 250 €/m³, up to 1 Mio. €. Moreover, for especially innovative plants, incentives can be obtained for investment and related research.
DK	From 2013 a "security of supply fee" is going to be gradually introduced. It will be related to the fuel consumption; hence solar heat will not be affected.	ST counts as fuel saving and the first year production has a value of 35÷45 €/MWh.
ES	The draft of the new technical building code reports that DH can replace par-	No subsidies for DH but regional and state support scheme for ST.

	tially or totally the minimum solar contribution.	National funding: 1000 €/kW with a maximum of 250,000 €/project and a minimum of 20,000 €/project and maximum of 1,000,000 € per ESCO. Moreover, regional support is available in Andalucia.
FR	Since March 2012, local authorities can give a special ranking to DH grids with 50% of RES at least (with other conditions). In these areas, all new buildings and renovated building must connect to the special DH grid. Since the law "Grenelle 2" (July 2010), all new areas have to study the potential for RES utilization, including through DH development.	The main subsidy is the Heat Fund (*Fonds Chaleur*) managed by ADEME (French national agency). This fund finances RES and DH projects and has a 200 million € budget per year. There is a tax credit for ST in households (32% of the investment). Furthermore, there is a reduced VAT (5.5% instead of 19.6%) for heat sold by DH using more than 50% of RES.
HR	None	No incentives are available for district heating or for RES / solar district heating. The new Act on Renewable Energy Sources is at the moment under public consultation but it does include DH. The only support schemes are the occasional tenders from the Fund for Environmental protection and Energy Efficiency. They are addressing solar equipment for preparation of domestic hot water and heating, usually for private households.
IT	Each Italian Region must develop an energy and environmental plan, paving the way towards future energy supply, by defining priorities in energy sources and rules for authorising energy production systems. Some Regions are putting high priority on DH.	A guarantee fund for new DH networks operated with RES has been created (art. 22-4 of the law "dlgs 28/2011") but part of the amount has been redirected for public building energy efficiency measures (art 4ter-2 of the law "dlgs 63/2013"). ST and other RES, as well as energy efficiency measures, have so far been subsidised via tax credit (65% of investment cost up to 60,000€). Another mechanism is available, valid for ST plants up to 1.000 m^2 and giving an incentive per m^2 installed (up to 65% of investment cost). This mechanism is now under revision in order to have incentives per produced kWh (certified by Solar Keymark) for ST plants up to 2.500 m^2.
LT	DH bills have a lower VAT (9%).	No subsidies for heat production.
PL	None	The National Found of Environmental Protection and Water Management supports ST in two programmes. Programme Prosumer (*pl. Prosument*), years 2015-2022 supports ST among other RES heat technologies in hybrid installations (producing heat and electricity is a must) and is addressed for individuals and housing associations. The Stork Programme (*pl. Bocian*), for entrepreneurs, supports large

		ST in larger scale installations (years 2014-2023). European founds are available under Regional Operational Founds (2014-2020) and Rural Development Program. ST is an eligible RES technology supported on a general basis and has to be combined with energy efficiency actions.
SE	Green certificates for electricity produced by biofuel based CHP can have a positive effect also for the development of DH.	From 2000 to 2012 there were grants for supporting ST installations. Investment support is given from 2.50 SEK/kWh annual collector output up to 3 million SEK per project. This support was used in a number of projects based on net-metering model. With the new regulation SFS 2011:1105, the support has been cancelled, due to the opinion on the governmental level that solar heat is profitable anyway.
SI	None	There exist subsidies for solar thermal energy. Maximum co-financing 200-300 k€. - 10% of total costs for public companies - 30% of total costs for large companies - 40 % of total costs for medium size companies - 50% of total costs for small size companies For individual owners the subsidies for solar thermal do not exist anymore. There existed also subsidies for biomass DH systems, which ended in 2011.

3.3. **Competing technologies**

Within the DH sector, the solar energy source faces a continuous and tough competition with several technologies.
The table below reports the detailed situation on this topic in different countries. However, some general considerations can be underlined:

- Main competing technologies, depending on local resource availability, price and subsidies, are:
  - biomass;
  - natural gas;
  - geothermal (trough heat pump technology);
  - coal;
  - waste incineration;
  - industrial excess heat;
  - heat recovery from CHP.
- Solar is often considered one of the less viable solutions due to:
  - high investment cost;
  - zero or low subsidies;
  - not well-known and therefore not bankable;
  - sometimes considered as technologically complicated;
  - cheaper in operation but not that much (it could be competing even with electric boilers in some countries);
  - it cannot cogenerate;
  - low fraction compared to biomass meaning a low influence on CO_2 emission (e.g : 50 g CO_2 emission / kWh ⇔ 79% solar fraction) and more difficult to get benefit.

COUNTRY-SPECIFIC CONSIDERATIONS	
	Technologies competing with solar in district heating
AT	Waste heat from subsidized biomass-CHP, waste incineration, industry excess heat.
CZ	For lower costs: coal Because of subsides: all kinds of CHP, biomass over 200 kW, geothermal over 200 kW.
DE	From the perspective of the whole heat market: natural gas boilers Within the district heating market: waste-to-energy CHP plants
DK	Waste incineration, industry excess heat, large scale CHP plants, biomass (no CO_2 tax but it will pay the above mentioned “security of supply” fee).
ES	Biomass and residual energy for the following reasons: • biomass boilers have an efficiency of up to 95% and work in a wide power range; • biomass is native and has benefits for the environment and society; • it allows access to subsidies and can incorporate cogeneration, thereby improving overall energy efficiency
FR	Other RES have a lower development cost (especially biomass and waste heat). Subsidies from the heat funds finance in priority the cheapest renewable heat (SDH is one of the more expensive technologies). From the technology point of view, SDH competes with waste incineration or industrial process heat which are cheaper and run all the year. SDH also competes with fossil fuels which are less expensive in term of investment. Gas CHP are progressively being removed from existing DH, due to decreasing support on electricity selling price. This short term threat for DH in general could be an opportunity for SDH: questioning the energy mix can lead to studying solar integration and by keeping CHP only for high heat demand periods (which are generally high electricity market price and low insulation periods), solar can offer a complementary production.
HR	Gas fired CHP production (good incentive scheme), biomass (low cost).
IT	Gas fired CHP, biomass (especially in mountain regions).
LT	Biomass boilers, CHP plants because of the lower initial investment. District heating networks operators are obligated to purchase heat from renewable energy sources if price is at least 2 % lower than heat produced in own boiler-house or CHP from renewable energy or natural gas.
PL	Coal as not expensive fuel for DH, CHP installations supported by efficiency bonus and electricity if generated from biomass and biomass itself as a cheap locally available fuel.
SE	Wood chip CHP, waste incineration, industry excess heat.
SI	CHP (coal, gas, biomass, etc.) have surplus heat in summer time. So their interest is to operate as many hours as possible, because of the electricity production. If heat is not used, they reject it through cooling towers or similar applications, or they try to operate in condensation mode. Any additional heat source will therefore only worsen the situation. The tendency is to use heat from cogeneration plant in summer time for absorption cooling. Heat pump (because of subsidies). Electric boilers (because of the low electricity price). Natural gas represents large threat also to all DH systems. Owners of the natural gas networks try to place those everywhere it is possible. There were examples, where the DH system had been switched off because of the gas network. The lobby seem to be so strong, that the municipalities do not have will, nor they make the good regulation. In certain cases, there co-exist natural gas network and DH from cogeneration plant. In certain cases the municipality owns a cogeneration plant with DH network and, at the same time, it allows use of natural gas in the vicinity of the DH network.