Solar Heat Europe
ESTIF

Solar Heat Europe

Policy Analysis

Published in September 2017
Restricted access to Solar Heat Europe's members

Building Solar Heat Europe Policy Position

The Real Costs of Solar Thermal

Support schemes for Solar Thermal
Trends in Europe

Published in September 2017 for Solar Heat Europe's members.

Solar Heat Europe's mission is to achieve high priority and acceptance for solar heat as a key element for sustainable heating and cooling in Europe and, with immediate effect, to work for the implementation of all necessary steps to realise the high potential of solar heat. For more information, visit Solar Heat Europe website: www.solarheateurope.eu

Introduction

This paper puts together a collection of different policy documents elaborated by Solar Heat Europe between the end of 2015 and the beginning of 2017, retracing Solar Heat Europe policy intervention in the whole process of elaboration of the European Commission Strategy for Heating and Cooling first, and the legislative proposals contained in the Clean Energy Package.

In February 2016, the European Commission released its first Strategy on Heating and Cooling. This has been the outcome of several years of activity from Solar Heat Europe and other sectorial stakeholders, to bring on top of the EU agenda the issue of heating and cooling. Plans for this EU strategy were first launched in 2015 as part of the Energy Union strategy. This has been a first step in exploring the issues and challenges in this sector, and solving them with EU energy policies. It has therefore served as the starting point for the following legislation review.

On November 30, 2016, The European Commission released a set of legislative measures related to the energy sector, referred to as the Clean Energy Package. These measures are part of the implementation of the Energy Union strategy, and are aimed at providing the legislative framework for the period 2020 – 2030 for the energy sector in Europe.

Most notably, the package contains the revised Renewable Energy Directive (RED), the Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD). Together, they constitute the legislative pillars underpinning the EU renewable energy sector.

The package contains legislation that will set the framework for the whole energy sector for the next decade. The level, scope, intensity and form of support of Member States to renewable technologies, including solar thermal, will be a result of the final negotiation of the package between the Council and the Parliament. The ambition (or lack of) that will be outlined at EU level will then be translated at national level, as any action undertaken by Members States stems out of commitments taken at EU level.

Solar Heat Europe participated to all different steps of the legislative proposal, participating in stakeholders' meetings, feeding in into public consultations, meeting key policy-makers and pushing forward Solar Heat Europe proposals. The resulting written documents are here presented for Solar Heat Europe/ ESTIF members. This paper thus helps understanding the evolution of the process that led to the Clean Energy Package, and the Solar Heat Europe policy activities in this regard.

It is divided into three sections: the first one provides a non-exhaustive analysis of four issues related to solar thermal policy advocacy: the identification of the technology potential and of the barriers to solar thermal deployment, the solar thermal achievements in light of the EU 2020 targets for renewables, and finally the issue of the electrification of the EU heating sector.

Those four parts are building blocks, used to present the Solar Heat Europe position on the different pieces of legislation currently undergoing the revision process.

The second section discusses the issue of technology costs, presenting a collection of studies and reports on the issue.

Finally, the third section presents the evolution of support schemes for solar thermal in Europe.

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Building Solar Heat Europe
Policy Position

1. Advocating solar heating and cooling

This section provides a non-exhaustive analysis of four issues related to solar thermal policy advocacy: the identification of the technology potential and of the barriers to solar thermal deployment, the solar thermal achievements in light of the EU 2020 targets for renewables, and finally the issue of the electrification of the EU heating sector. Those four parts should be seen as building blocks, which are essential to understand and develop Solar Heat Europe's policy position on the critical issues raised by the EU legislative review process of 2016. This section is therefore crucial in order to present later on, in the second section, the Solar Heat Europe's position on the different pieces of legislation currently undergoing the revision process.

1.1. Potential of Solar Thermal

Defining the potential of solar thermal in Europe is a difficult yet crucial task. Definitions can vary according to methodology, thus affecting the perceived outcome of the analysis. At least five different definitions can be identified[1]:

- **Theoretical potential:** The highest level of potential is the theoretical potential. This potential only takes into account restrictions with respect to natural and climatic parameters.
- **Geographical potential:** Most renewable energy sources have geographical restrictions, e.g. land use, land cover, reducing the theoretical potential. The geographical potential is the theoretical potential limited by the resources at geographical locations that are suitable. For the solar thermal, it is the solar radiation.
- **Technical potential:** The total amount of energy (final or primary) that can be produced taking into account the primary resources, the socio-geographical constraints and the technical losses in the conversion process.
- **Economic potential:** The technical potential at cost levels considered competitive.
- **Market potential:** The volume that solar thermal can reach taking into account the demand for energy, the competing technologies, the costs and subsidies of renewable energy sources, and the barriers.

The limitations to the theoretical and geographical potential caused by solar radiation are not affecting solar thermal as much as it is generally conceived. Most of solar thermal systems are equipped with storage to deliver during the night, and seasonal storage to deliver during winter is being developed more and more. Moreover, solar thermal systems usually run with a backup system as auxiliary heat generator. Even when it cannot satisfy the total heat demand, solar thermal brings several benefits, such as allowing the backup heater to work at higher efficiency thanks to pre heated water. The fact that solar radiation is not such a strong limitation to the potential of the technology is self-evident considering that most well developed solar thermal markets are located in central Europe for space heating and in northern Europe for district heating, where solar thermal systems can be totally competitive and effective.

The technical potential of solar thermal technology is analysed in depth in the ESTTP publication 'Solar Heating and Cooling for a Sustainable Energy Future in Europe'[2], where, based on purely technical perspective, solar thermal is estimated as being able to cover up to 50% of the heating demand in Europe on the long term.

1 The section below is an adaptation from Solar Heat Europe, UNEP publication 'Guidelines for policy and framework conditions', under the Global Solar Water Heating Market Transformation and Strengthening Initiative.
2 Solar Heating and Cooling for a Sustainable Energy Future in Europe - ESTTP

The economic potential takes into consideration the costs of the technology, which are going to be discussed in more depth in the next section. The market potential is resulting from the interaction of the economic potential with the given framework conditions, i.e. the heating and cooling and market development, the public acceptance and awareness of solar thermal, the national and local energy mix, the research and testing capacity, the qualification and training, and the regulatory and policy framework. As opportunities are included as well as barriers, the market potential may in theory be larger than the economic potential, but usually the market potential is lower because of all kind of barriers.

In 2008, Solar Heat Europe commissioned a study on the potential of solar thermal technology in Europe to the Vienna University of Technology and the Institute for Sustainable Technologies- AEE-Intec. Although the European energy landscape has evolved since then -not always positively for the solar thermal sector- and some of the assumptions underpinning the study were made in a slightly different context, most of the results of the study can still be looked as relevant in the identification of the solar thermal medium-to-long term market potential in Europe. The main results are presented below.

The study identified three different scenarios, and compared the results on a 2020, 2030 and 2050 perspective. The scenarios are Business as Usual (BAU), Advanced Market Development (AMD), and Full R&D and Policy (RDP). In 2011, Solar Heat Europe noted that the NREAP's projections for solar thermal deployment in 2020 were closely matching the intermediate AMD scenario of the 2008 study (see table below), thus corroborating the validity of the study projections. The study main findings have also been endorsed by the European Solar Thermal Technology Platform – ESTTP.

			2020			
		2006	BAU	AMD	NREAPs	RDP
Spec. Collector Area	kW_{th}/inhab	0.03	0.14	0.21	0.2	0.56
	m^2/inhab	0.04	0.2	0.3	0.29	0.8
Total Installed Capacity	GW_{th}	14.17	67.9	101.9	102.2	271.6
	Million m^2	20.25	97	145.5	146	388
Solar Yield (ST energy production per year)	TWh/a	0.05	0.9	1.7	-	2.7

BAU: Business as Usual scenario
AMD: Advanced Market Deployment scenario
NREAP: National Renewable Energy Action Plan
RDP: Full R&D and Policy scenario

Figure 1.

Solar Thermal in 2020: Compartive Scenario

Source: Solar Thermal Market in Europe - Trends and Market Statistics 2011 - June 2012

The study particularly looks into the composition of the heat demand in Europe, and highlights the high potential for solar thermal in the low temperature segments of the heat demand. In the baseline year of the study, 2006, the total heat demand in the EU-27 was 6 668 TWh and the low temperature heat accounted for 4 640 TWh, which was 34% of the total final energy consumption. The low temperature heat consumption shows therefore the theoretical potential for solar thermal.

The figure below shows the low temperature heat demand by sector in the EU-27 in 2005. It is to be noted that these figures did not change significantly in the last decade[3], and are therefore still relevant[4].

3 See for instance JRC - Heat and cooling demand and market perspective

4 The incoming study "Mapping and analyses of the current and future (2020 - 2030). heating/

Of this breakdown, 61% of the overall low temperature heat is used in the households sector. The remainder accounts for low temperature process heat (<250° C) industry, 20% and the service sector, 19%. This clearly shows the huge potential for solar thermal applications in the households sector. Another important sector with considerable potential is low temperature process heat for industry. In several specific industry sectors, such as food, wine and beverages, transport equipment, machinery, textiles, pulp and paper, the share of heat demand at low and medium temperatures (below 250°C) is around 60%. Tapping into this potential would provide a significant solar contribution to industrial energy requirements[5].

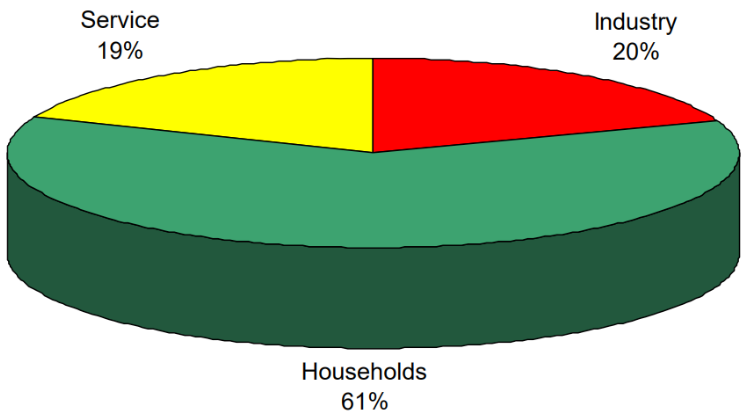


Figure 2.

Low temperature heat demand by sector in EU 27 in 2005 (Total: 4 640 TWh).

Source: Potential of Solar Thermal in Europe

The table below shows data for the baseline year 2006 and the potential solar thermal contribution to the low temperature heat demand of the EU-27 countries under the three scenarios. Depending on the scenario, in 2020 the contribution of solar thermal to the low temperature heat demand of the EU-27 will be between 0.8% (BAU) and 3.6% (RDP). The corresponding annual solar yields would be 38 TWh (BAU) and 155 TWh (RDP). The specific collector area needed to reach these goals would be between 0.2 m^2 (BAU) and 0.8 m^2 (RDP) per inhabitant. The resulting total collector area will be between 97 million m^2 (BAU) and 388 million m^2 (RDP). In comparison, the 2006 baseline data is 0.04 m^2 collector area per inhabitant and a total collector area in operation of 20.3 million m^2, which - corresponds to an installed capacity of 14.2 GWth. According to the scenarios for 2020 a reduction of 0% (BAU) and 9% (RDP) of the low temperature heat demand compared with 2006 is assumed. To reach the goals of the RDP scenario a 26% average annual growth rate of the European solar thermal market is needed until 2020. The goals of the AMD scenario would require a 15% average annual growth rate and the goals of the BAU scenario a 7% growth rate.

The resulting total collector area will be between 97 million m^2 (BAU) and 388 million m^2 (RDP). In comparison, the 2006 baseline data is 0.04 m^2 collector area per inhabitant and a total collector area in operation of 20.3 million m^2, which - corresponds to an installed capacity of 14.2 GWth. According to the scenarios for 2020 a reduction of 0% (BAU) and 9% (RDP) of the low temperature heat demand compared with 2006 is assumed.

cooling fuel deployment (fossil/renewables)" ENER/C2/2014-641, Fraunhofer and alia, 2015, should confirm these data. The lack of articulated sectorial studies between 2008 and 2015 is a symptom of the difficulties in data collection the sector is facing.

5 See the RHC Platform Solar Heating and Cooling Technology Roadmap, 2014.

To reach the goals of the RDP scenario a 26% average annual growth rate of the European solar thermal market is needed until 2020. The goals of the AMD scenario would require a 15% average annual growth rate and the goals of the BAU scenario a 7% growth rate.

		BAU	AMD	RDP
2006 Baseline				
Specific collector area	m²/inhab.	0,04	0,04	0,04
Total collector area	Mill m²	20,25	20,25	20,25
Total installed capacity	GWth	14,17	14,17	14,17
Solar yield	TWh/a	8,5	8,5	8,5
Total low temperature heat demand 2006	TWh	4.715	4715	4715
Solar fraction	[%]	0,2%	0,2%	0,2%
Number of jobs EU 27		31.400	31.400	31.400
2020				
Specific collector area	m²/inhab.	0,2	0,3	0,8
Total collector area	Mill m²	97,0	145,5	388,0
Total installed capacity	GWth	67,9	101,9	271,6
Solar yield	TWh/a	38	59	155
Total low temperature heat demand 2020	TWh	4.715	4.506	4.297
Reduction of low temperature heat demand compared to 2006	[%]	0,0%	4,4%	9%
Solar fraction	[%]	0,8%	1,3%	3,6%
Number of jobs EU 27		46.900	103.200	470.000
2030				
Specific collector area	m²/inhab.	1,0	2,0	3
Total collector area	Mill m²	485	970	1.455
Total installed capacity	GWth	340	679	1.019
Solar yield	TWh/a	198	394	582
Total low temperature heat demand 2030	TWh	4.715	4.251	3.787
Reduction of low temperature heat demand compared to 2006	[%]	0,0%	10%	20%
Solar fraction	[%]	4%	9%	15%
Number of jobs EU 27		306.800	770.400	1.300.000
2050				
Specific collector area	m²/inhab.	2,0	5,3	8
Total collector area	Mill m²	970	2.571	3.880
Total installed capacity	GWth	679	1.799	2.716
Solar yield	TWh/a	391	1.047	1.552
Total low temperature heat demand 2050	TWh	4.715	3.993	3.271
Reduction of low temperature heat demand compared to 2006	[%]	0,0%	15%	31%
Solar fraction	[%]	8%	26%	47%

Figure 3.
Solar Thermal contribution to the low temperature heat demand of EU 27.

Source: Potential of Solar Thermal in Europe

In 2030, the contribution of solar thermal to the low temperature heat demand of the European Union (EU 27) will be between 4% under the BAU scenario and 15% under the RDP scenario. The corresponding annual solar yields are 198 TWh (BAU) and 582 TWh (RDP). The specific collector area needed to reach these goals will be between 1 m^2 (BAU) and 3 m^2 (RDP) per inhabitant. The resulting total collector area will be between 485 million m^2 (BAU) and 1.45 billion m^2 (RDP). According to the scenarios for 2030 a reduction of 0% (BAU) and 20% (RDP) of the low temperature heat demand compared to 2006 is assumed.

In 2050, the contribution of solar thermal to the low temperature heat demand of the European Union (EU-27) will be between 8% under the BAU scenario and 47% under the RDP scenario. The corresponding annual solar yields are 391 TWh (BAU) and 1552 TWh (RDP). The specific collector area needed to reach these goals will be between 2 m^2 (BAU) and 8 m^2 (RDP) per inhabitant. The resulting total collector area will be between 970 million m^2 (BAU) and 3.88 billion square metres (RDP). According to the scenarios for 2050 a reduction of 0% (BAU) and 31% (RDP) of the low temperature heat demand compared to 2006 is assumed.

The figure below illustrates the solar thermal potential in the EU-27 based on three scenarios. As can be seen in this figure even the BAU scenario shows moderate growth rates of the annually installed capacity until 2035. Around 2035 a saturation of the installed capacity can be observed. This is mainly due to the fact that under this scenario the main application of the solar thermal systems is hot water preparation and solar combi-systems with low solar fractions. By 2030 nearly the full potential for these applications will be exploited and the annually installed capacity will be reduced mainly to the replacement of old systems.

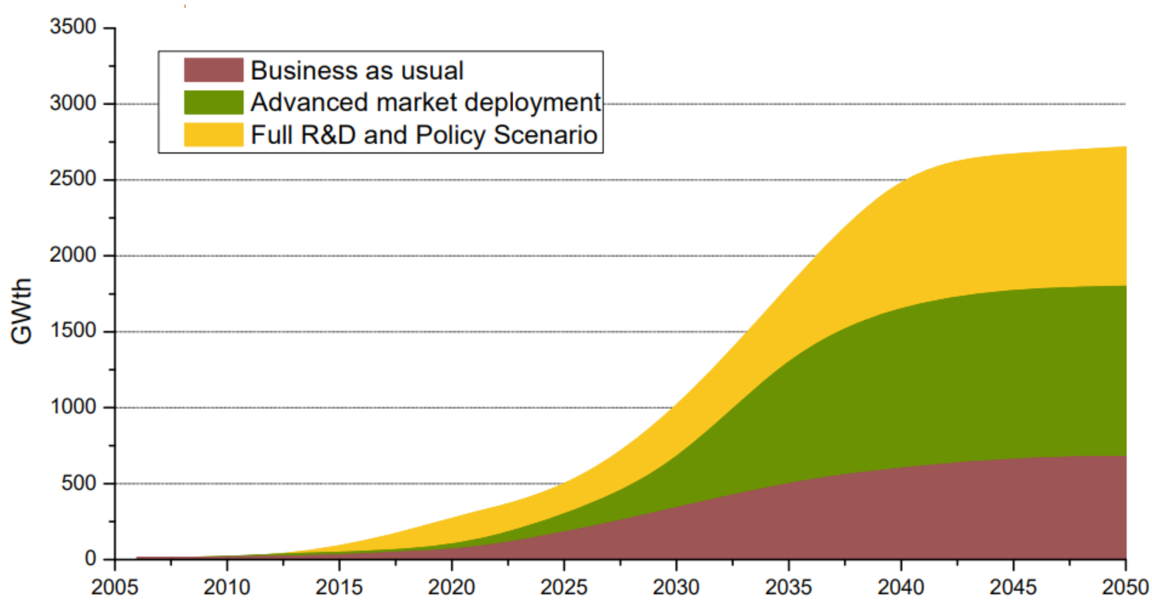


Figure 4.

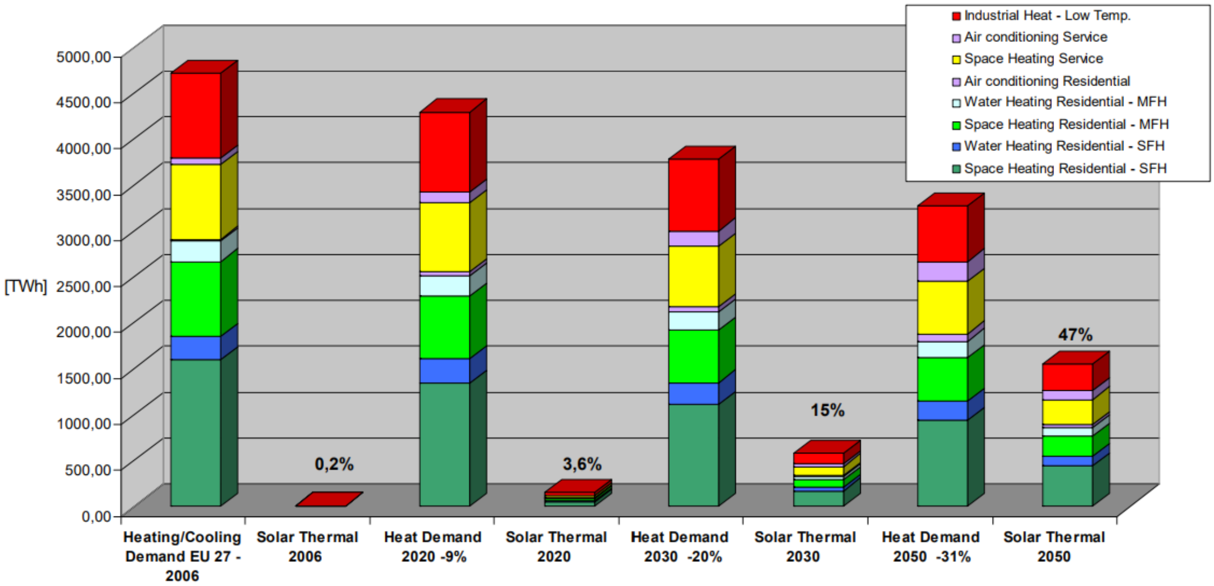
Solar Thermal Potential in the European Union (EU27) based on three Scenarios.

Source: Potential of Solar Thermal in Europe

Both the RDP scenario and the AMD scenario are based on the assumption that the main focus is on the space heating (solar combi-systems) systems in the residential and service sectors in central and northern European countries and on combined systems providing space heating, hot water and air conditioning in the Mediterranean countries.

In addition, a moderate to substantial market diffusion in the other sectors is assumed. Solar combi-systems will provide heat for hot water and space heating (also cooling where needed) and will have the ability to switch to high density energy storages when available without changes to the collector area. Using high density energy storages would increase the solar fraction significantly.

The figure below shows the contribution of solar thermal to the European Union heating and cooling demand by sector in comparison with the development of the overall heating and cooling demand from 2006 to 2050. The figure is based on the assumptions of the RDP scenario. The 2006 baseline shows the total heating and cooling demand of 4715 TWh in the EU 27 countries. In 2006, 0.2% of this demand was provided by solar thermal systems.



Taking energy efficiency measures of 9% into account until 2020 would result in a reduced heating and cooling demand of 4297 TWh. Based on this reduced demand and the additional collector area the solar fraction would be 3.6% by 2020. In the medium-term (2030) the solar fraction will be 15%, based on a 20% reduction of the demand compared with the 2006 level. And, in the long-term (2050) the solar fraction will be 47%, based on a 31% reduction of the demand compared with the 2006 level.

Figure 5.

Total heating and cooling demand of EU-27 and contribution of solar thermal by sector according to the Full R&D and Policy Scenario (RDP).

Source: Potential of Solar Thermal in Europe

1.2. Identifying Barriers

Barriers to the deployment of solar thermal to its full potential can be classified in economic and non-economic barriers. Non-economic barriers can vary significantly according to the specific market. Their impact is not to be underestimated, and often economic incentives are not sufficient to overcome them properly. Specific actions are needed to tackle them, once they have been identified. Non-economic barriers can be social and cultural, when they refer to the understanding or use of the technology; geographical, when they are related to supply or servicing bottlenecks; technical, when related to functionality or performance of the technology; political, when related to incentives or market access distortions; environmental, when related to resource supply and waste production. A number of actions are needed to tackle those barriers, ranging from education/information campaigns, to standard and certification measures, to resource and waste management policies, and so on.

Economic barriers relate to prices, costs and competitiveness of solar thermal in the market. This includes the price of the system installation, the price of the heat produced over the life cycle of the system and the comparison with the alternative solutions on the market, in particular with traditional heating devices based on fossil fuels. Economic barriers are thus related to the real and to the perceived price of the solar thermal system, therefore the concepts of pay-back time and initial upfront investment costs are crucial, as their variation directly impacts consumers' choices and preferences. Economic barriers are also related to market distortions such as import tariffs and other taxes on equipment.

The table below provides an overview of the major barriers affecting the solar thermal market, and ways to tackle them.

	What are the main barriers?		How do we solve them?
NON ECONOMIC	Lack of knowledge of solar thermal technology, of its real costs and benefits among European citizens		Promote information through Europe-wide campaigns, involving the EU institutions, the Member States, the industry, the consumers…
	The solar thermal technology and, more in general, the renewable heating and cooling sector is not well understood even by policy-makers.		Produce a comprehensive evaluation of the H&C sector, describing MS markets and different national regulations. Build up a data collection system mapping heat demands in EU!
	The energy security challenge is being met with large scale solutions, which do not always guarantee effective decarbonisation of the H&C sector, and discourages investments in a mostly decentralised technology such as solar thermal.		The decarbonisation of the H&C sector must be comprehensive and involve the decentralised local level!
	Lack of skilled installers, informed urban planners.		Promote training in the sectorial workforce, identify bottlenecks and improve competition in the installation market!
	Legislation that would solve several problems is already in place, but implementation is not always in place.		EU Institutions should push Member States to proper implement existing legislation in the sector, with a particular focus on the art. 13 and 14 of the RES-Directive!
ECONOMIC	Investments in solar thermal from end-users at local, domestic level are held back by upfront investment costs.		Design and spread specific financing tools that would help citizens overcome the upfront investment!
	Even when the upfront costs are tackled, access to financing is difficult for most consumers in times of economic crisis.		Increase awareness of existing financing opportunities!
	Solar thermal must compete with over-subsidised fossil fuels in an uneven playing field.		Design a roadmap to phase out fossil fuels subsidies, put a price to CO2 emissions in the H&C sector to take into account the fossil fuels negative externalities and bring a real level-playing field!
	Some EU markets are closed to new entrants or are affected by overregulated prices for dominant conventional fuels.		Promote a competitive market where consumers have choice.
	Lock-in effects can be produced by investments decisions from end-users at local, domestic level in energy efficiency alone.		Promote the smart combination of energy efficiency and solar thermal in the building sector. Share best practices and roll out existing integrated solutions!
	Solar thermal technology potential is not fully explored.		Promote R&D&I, starting from the implementation of the RHC Technology Roadmap!

1.3. Solar Thermal and the EU 2020 Targets

In the Renewable Energy Progress Report launched in June 2015, the European Commission mentions that the EU Member States are on track to reach the 2020 targets. However, projections for 2020 show a different scenario with targets not being reached. At first, following the adoption of the Renewables Directive in 2009, the development of renewables was impressive. Afterwards, as support dwindled, there was a dramatic slowdown in renewable energy investments with a lower uptake of renewable technologies.

And, even if the EU Member States combined have exceeded the indicative target for 2014, the results are quite different per country and per technology, highlighting the diversity that characterizes Europe and the different levels of commitment.

Figure 6.

Projected deployment and deviation from planned EU technology deployment 2014 and 2020, Renewable energy progress report, European Commission, June 2015. Values on Mtoe.

Source: Solar Thermal Markets In Europe - Trends and Market Statistics 2014 - Published in June 2015

Technology Category	Projected deployment 2014	NREAP target 2014	Projected 2020 deployment (max)	2020 target	Deviation 2014	Deviation 2020 deployment (max)
RES total	176.7	172.3	221.5	221.5	3%	-9%
RES heating & cooling	**87.6**	**80.5**	**107.5**	**107.5**	**9%**	**-1%**
RES electricity	72.5	73.3	94.9	94.9	-1%	-9%
RES transport	16.6	18.4	19.1	19.1	-10%	-35%
Solar Thermal	**2.2**	**2.6**	**3.7**	**3.7**	**-15%**	**-42%**

The projection in terms of development per technology shows that, for several technologies, the indicative targets were not met in 2014 and risk not being met by 2020. Solar thermal is one of the most obvious cases where, if intentions are not met with concrete actions, the indicative 2020 targets for this technology will unfortunately be missed. While in 2012, the sector was 1.7% below the indicative target, in 2014 it is already -15.3% and the projections indicate that by 2020, the deviation from the target will be between -41.8% and -45.6%.

The indicative targets for solar thermal proposed by the Member States in the NREAPs were already modest in terms of ambition. A study on the Potential of Solar Thermal in Europe, published in 2009, projected different scenarios (see chapter 4.1): Business As Usual (BAU), Advanced Market Deployment (AMD) and a more ambitious one, Full R&D and Policy Scenario (RDP). Interestingly, the combination of national indicative targets for solar thermal in the NREAPS, published slightly later, were extremely close to the AMD scenario[1].

1 The scenarios on the study on the Potential of Solar Thermal in Europe were developed for EU27

		2020				
		EU Path	**BAU**	**AMD**	**NREAPs**	**RDP**
Total Installed capacity	GWth	60	68	102	104	272
	Million m²	86	97	146	148	388
Target 2020	Mtoe	3.7	4.2	6.3	6.4	16.7

Figure 7.

Source: Solar Thermal Markets In Europe - Trends and Market Statistics 2014 - Published in June 2015

The current projection presented by the European Commission indicates that Members States are on a 'path' that is below the business as usual scenario presented in the referred study. Clearly, measures being taken by the Member States are not supporting the development of the technology as expected.

The main causes behind the difficulties in the solar thermal market have been broadly discussed. It is, in general, agreed that these include consumer preference for lower investment costs needed for conventional heating solutions, being rather more sensitive to this factor than to the actual energy cost. This effect is enhanced by the current market approach, where the replacement of existing equipment is mostly with an equivalent equipment rather than with a new solution. Other factors are the low fossil fuel prices (subsidized in several cases) and additional competition in the market provided by alternative renewable energy solutions.

Removal of several of the existing barriers depends on the eventual intervention of public authorities, such as the limited awareness of the technologies, instability in support measures, and lack of regulations promoting the switch from fossil fuels to clean options or scarcity of qualified installers. It is obvious that, in general, Member States are falling short on the implementation of the renewables directive, in particular with regard to 'Administrative procedures, regulations and codes'[2] or 'Information and training'[3], on issues such as building regulations[4], adequate information and awareness raising initiatives at local and regional level[5] or on the certification and qualification of installers[6].

and the current total for the NREAPS is for EU28.
2 Art. 13 of the RES-Directive (Directive 2009/28/EC).
3 Art. 14 of the RES-Directive (Directive 2009/28/EC).
4 Art 13.6 - By 31 December 2014, Member States shall, in their building regulations and codes or by other means with equivalent effect, where appropriate, require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation. […]
5 Points 1, 2, 5 and in particular point 6 of Art. 14 of the RES-Directive (Directive 2009/28/EC): Member States, with the participation of local and regional authorities, shall develop suitable information, awareness-raising, guidance or training programmes in order to inform citizens of the benefits and practicalities of developing and using energy from renewable sources.
6 Art. 14.3 - Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. […]

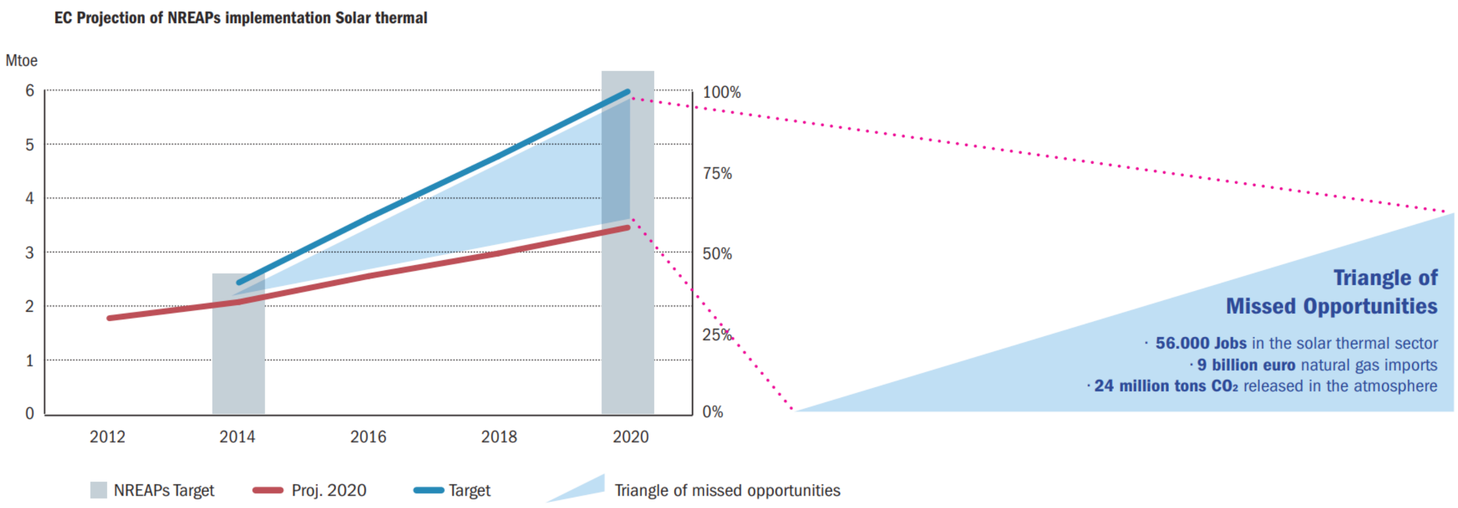


Figure 8.
The triangle of misses opportunities.

Source: Solar Thermal Markets In Europe - Trends and Market Statistics 2014 - Published in June 2015

Not meeting the indicative targets for solar thermal also implies a lost opportunity in terms of job creation. Since solar thermal is mostly a decentralized energy source, nearly half the investments in the sector are allocated to the lower end of the value chain. This means that, even when collectors are not produced locally, the installation is done by local companies. This has an important impact on the local economy and thus contributes to local job creation. The local dimension of the solar thermal sector is a major positive externality and a key success factor for the industry. Nonetheless, this potential for job creation is being squandered.

According to the estimation in the study on the Potential of Solar Thermal in Europe, in a Business as Usual scenario (above current EC projections for ST in 2020), the number of jobs in the sector by 2020 would be 46 900. If the indicative targets for solar thermal were achieved, this would represent an additional 56 000 jobs in the solar thermal sector in Europe by 2020, totalling 103 200. Furthermore, it would represent a saving of 9 billion euros in natural gas imports and avoid the release of 24 million tons CO2 into the atmosphere.

In terms of energy production, it would represent the equivalent to 78 TWhth, while in 2014 the estimated energy generation amounted to 21.9 TWhth, only 28% of the target, with Italy, France and Spain being the countries that are the furthest away from their indicative national targets in absolute terms.

1.4. Solar Thermal and the Electrification of Heating and Cooling

A. The electrification of the heating sector: introduction

The European Commission has published its major legislative reviews on the energy sector -EED, EPBD, RED, Market Design- at the end of November 2016. These changes to the current energy policies could affect the future energy mix. The electrification of the energy system (both for the heating and for the transports sectors) is on top of this agenda.

In the wake of the debates on the EU Strategy on Heating and Cooling, a large coalition of actors, ranging from utilities and RES-electricity trade associations, to research centers and NGOs, has successfully managed to bring to the forefront of the discussions the issue of the electrification of the heating sector. Although different views, goals and interests are behind this initiative, the issue is unanimously brought forward in the light of the decarburization advantages that electrification would bring to the whole EU energy sector. These views have been received positively and took roots in different sections of the European Commission, and are echoed in the European Parliament as well, as recently seen in the ITRE Report on the Heat Strategy.

Sensible (or efficient) electrification vs wild electrification

In its position, Solar Heat Europe acknowledges that in the long run, a certain amount of electrification of the H&C sector will inevitably happen, but warns against an indiscriminate use of the electrification. Electrification should be done on the basis of efficient technologies, such as efficient heat pumps – sensible electrification - avoiding the use of direct heating solutions – "wild electrification". The direct heating solutions have been induced into the discussion by different stakeholders from the power sector.

The main concern is that strong pressure groups push for an easy and fast solution that can bring to the market a fast increase in electricity consumption. This fast increase in consumption is essential for some important players that are facing difficulties due to excess power generation capacity installed. This excess brings down process and leads even to stranded assets (gas-fired power plants and co-generation plants are most obvious examples). Besides, increasing demand will also allow for additional investment opportunities, for both conventional technologies and for renewable electricity.

Heating sector contributing to balance power sector

This is a good example of the strength of simple and strong messages, even if misleading. The question of electrification of the heating sector has been wrongly presented as a solution for coping with the overcapacities in the power sector. Such over capacities generated strong imbalances in specific areas or periods. The best example is related to wind power generation in the north of Europe.

Though it is unclear, though poorly debated, how can the electrification of heating, using thermal storage and demand-response mechanisms, solve the problems in the variability of the variable centralised RES power generation.

Electrification of heating providing decarbonisation

One of the arguments used for electrification is that it will promote the decarbonisation of buildings. This is again a massive simplification.

Solar Heat Europe has expressed its concern about the CO2 consequences of a massive electrification, and warns against the different results that such outcome might have in different EU Member States: electrifying H&C in Poland, for instance, a country with high carbon content in its power generation, will inevitably have a different impact in terms of CO2 emissions that is different from France or Denmark, with lower carbon content, due to either nuclear or RES. Electrification is therefore not to be seen as an automatic synonym of decarbonisation.

One of the Commission arguments is that by 2030, 50% of the power generation will come from renewables. This assumption brings another serious concern – that the focus in terms of RES will be almost solely in RES power generation and very little on thermal renewable sources (RHC).

Impact on the grid overlooked

The electrification of the heating sector also brings severe disadvantages in terms of grid management and grid development costs. Considering the fact that H&C represents 50% of the EU final energy demand, while the power sector is not even 25%, the idea of covering such a large amount of energy with electricity would imply such a massive expansion of grid infrastructure and power production (which necessarily could not be covered only by RES-E), that the costs of such scenarios are hardly predictable.

Legislative review as opportunity for combined measures

The current legislative review brings forward several opportunities to implement measures that shall facilitate or promote the electrification of the heating sector. The review of the EED allows for a review of the Primary Energy Factor, the Energy Market Design will allow to promote business models for storage, both power thermal (power to heat) storage. The review of the EPBD can promote solutions for prosumers that include RES power to heat options.

Cover low temperature needs with low temperature resources

One of the factors that must be taken into account is the energy content. Electricity has higher exergy than RHC. Such "valuable" source of energy should not be "wasted" in low grade heat. Hence it should be used to supply more complex and intense demand, such as high temperature level industrial process heat, or transports.

Electrify only using efficient and clean options

Electrification of heating and cooling is already happening today, namely in an effective way using heat pumps. Electrification should be done using efficient solutions, such as heat pumps or solar thermal thermosiphons using an electric resistance as backup, and assuring that it is done using renewable electricity.

Combine solutions for a more balanced system

Centralised and decentralised energy supply, power and heat generation can be combined in order to have a more balanced system, shaving power consumption peaks. This means that the concepts of smart cities shall include both power and heat grids, that concepts such as smart meters are applied both for power meters and for heat meters.

Empowering consumers

The empowerment of consumers has been a strong message from EC, with claims such as "putting the consumer" in the center of the energy system. Empowering consumers means also that they need to have choices. Basing all energy demand on power supply will give a edge to utilities, that will be, even more than today, too big to fail.

Centralised and decentralised energy supply needs to be promoted, as well as self-generation. For the supply of heat, consumers already have solutions for self-generation. This should be potentiated, not reversed, as long as if it is done by promoting more RES.

B. Primary Energy Factors role in the electrification process

The European Commission launched a consultation on the definition of the Primary Energy Factor (PEF). This factor indicates a reference value for the primary energy required per unit of final energy demand. This calculation is relevant for different legislative pieces:

Energy Efficiency Directive (EED)
The European Commission has set the target in the EED to reduce EU primary energy consumption in 2020. Due to the fact that the target is defined on primary energy level the primary energy factor that is applied for electricity is a crucial aspect in the overall assessment of energy saving measures that affect electricity demand.

Energy using products – Eco-design and Energy Labelling Directives (ED / EL)
The PEF is also used to define efficiency criteria for energy using products (eco-design and energy labelling) and has hence an impact on the choice of electricity versus fossil fuel based technologies, e. g. for space and water heating purposes.

Energy performance of buildings Directive (EPBD)
The PEF is also used in the EPBD in the framework of the cost optimal calculations. These are directly related to the performance level required for different types of buildings in different countries. The current discussion was brought up by several Nordic countries, in particular Norway[1]. As such, the Commission

General Comments

The main discussion regards the energy labelling and eco-design, more concretely Lot1 and Lot2. In the context of the EED and EPBD, the PEF might be calculated at national level[2]. The discussions at European level are relevant in terms of setting the framework for the such calculation. But both the values and the calculation might be specific for each Member State. With regard to energy labelling, the PEF is relevant when comparing products using different energy carriers/sources, as it is the case of the water and space heaters (Lot1 and Lot2).

The current discussion of the PEF, clearly meaning to bring the value down will have two main implications:

- EL/ED: products using electricity will have a better result in terms of efficiency and might go up in the energy label classes. This effect will be mostly felt on the lower classes (with smaller intervals). In the case of heat pumps the PEF of electricity and the efficiency are the two central factors to assess the potential primary energy savings of the technology.
- EED: in the case of EED, the calculation of the PEF will affect the statistical data regarding the energy efficiency targets. In case of electricity saving measures a lower PEF leads to a lower theoretical contribution to the stated target on reduction of primary energy demand.

Expected impacts

The only solar thermal products that might be subject to the energy labelling for products are the thermosiphon systems with an electric back-up element. In this case, a lower PEF would benefit these systems. The impact would not be as strong as for electricity-only powered products, but would a slight increase in efficiency and in some cases, for those on the top of one energy class, could represent jumping one class.

The main impact is for heat pumps and mostly for direct heating. For these, they might in most cases benefit with one (some cases two) jumps in class. Therefore, on one side, the packages with solar thermal are likely to have to face heat pumps with “improved” classes.

But the main impact is related to the electrification of the heating sector. The current changes will benefit mostly low performance products, with

1 Norway is member of the European Economic Area, and as such some EU regulations apply to them.

2 Annex IV of the Directive 2012/27/EU states that: “For savings in kWh electricity Member States may apply a default coefficient of 2.5. Member States may apply a different coefficient provided they can justify it.”

low classes and in some cases not surpassing the thresholds defined in the Eco-design regulations (for Lot1 and Lot2). Some products might go above the threshold (and continue in the market) and most are likely to jump at least one class.
This is the most serious issue and justifies also the urgency of revising the PEF in the framework of the ongoing legislative review, where the Commission is also bringing other instruments that can support the electrification of the heating sector.

Relevance for solar thermal

The PEF is the main tool to calculate the primary energy consumption in EU. As such, it impacts most energy related EU legislations, and influences both the balance between energy efficiency measures and decarbonisation of the supply, and the relative competitiveness of electricity in the decarbonisation of the energy system. The lower the PEF, the better electricity would be performing in the future EU energy mix, compared to alternative fuels.

The main impact is related to the electrification of the heating sector, as electricity will be advantaged as a source of energy for the production of heat. The decrease of the PEF value will benefit mostly low performance electric heaters, with low classes and in some cases allowing them not to surpass the thresholds defined in the Eco-design regulations (for Lot1 and Lot2). Some products might go above the threshold (and continue in the market) and most are likely to jump at least one class.

Open issues

The European Commission has set the boundaries for the current discussion. The following topics are considered closed and not for discussion anymore:

- There should be a value for the PEF;
- This value should be only one (i.e., not a set of values, so no seasonal PEF);
- The calculation process should last, meaning that should be replicable in the coming years

Other topics, related to the scope where addressed, but rather for clarification, as the Commission considered them as non-controversial:

- The data used will be for EU 28 plus Norway
- The method will work on average PEF rather than marginal PEF
- It will use an annual PEF rather than seasonal ones
- Data on physical energy content being used.

There is in fact some dispute on the use of Norway, a country with very low PEF and that can bring down average. The Commission explained that this discussion applies to EU and EEA, hence only Norway should be considered.

Other questions brought for discussion included:

- Should the PEF take an average of 2015 to 2020, intermediate year (middle of the 5year period) or statistical data
- Proposal to use PRIMES data for the estimate 2015 to 2020
- Use a PEF rounded to the nearest decimal

Finally, a set of more complex discussions on methodology and very much related to nuances on the CHP processes and the way RES-E is considered:

- Should there be a different calculation for thermoelectric than power or heat
- Should non-biomass RES be counted or not
- What should be the system boundaries.

The positions differed clearly between those supporting electric power use and those support thermal energy use. The Member States were not active in this discussion, so it was mostly done between Commission and different trade associations.

Solar Heat Europe's position

Solar Heat Europe's position regarding the PEF are focused on the fact that this discussion is mostly related to the heating sector and electrification of heating, and as such, the impacts will be felt mostly on EL/ED Lot1 and Lot2.

As such, Solar Heat Europe defended:

- Seasonal PEF

A seasonal PEF would reflect better the higher PEF during winter, when most of the demand for heating occurs. Therefore, electric –powered products would consume more primary energy than an average annual PEF would indicate.

This proposal was dismissed by the Commission due to the complexity of adopting different values for the PEF.

- Base PEF calculation on historical data

The use of projections would reduce the value of the PEF further, as it is expected that there will be a higher level of RES in the power mix. These projections would be based on the PRIMES model which has been criticized by RHC association (Renewable heating and cooling) due to its limitations (and errors) in estimation heating demand.

This points is one of the main points currently discussed. EC wants to use an average of the projections up to 2020. Their argument is that statistical data is available too late and will be always outdated, not reflecting the current/future mix. They have the support of the "electricity lobby" and the opposition of the thermal one.

- Methodology should be comparable between countries

Each country will be able to calculate their own PEF, which will be relevant mostly for EED and EPBD. Taking into account the differences in the transposition at national level of the requirements stemming from EED and EPBD, Solar Heat Europe advised that the methodology should be consistent across borders, even if applied to local conditions and hence providing different values.

As such, following the work CEN is doing on PEF would also be relevant.

The Commission said that being able to compare methodologies would be desirable but that is solely up to the Members States. As for CEN, the Commission is focusing on their own approach and not interested on CEN method, also because that work will still take quite some time.

- Impact on Lot1 and Lot2 to be considered

The main impact of the PEF will be on Lot1 and Lot2. In spite of this, the Commission is not presenting or even preparing (at least officially) any analysis of the potential impact of the PEF in the current regulations for space and water heaters.

Ongoing process

After the Commission consultation on the review of the PEF, the DG Energy Unit on Energy Efficiency, in charge of the dossier, has been elaborating the inputs of this consultation, and started working on its results. The PEF affects several EU legislations, from the EPBD to the Ecodesign and Energy Labelling, however, it is on the EED that a clear mention has appeared first.

In mid-September, after entering into the Inter-Service Consultation process, a first draft of the new EED and EPBD has been leaked. Among some other points of concern, an article has been inserted, changing a footnote of the original EED, which would bring down the PEF value from 2.5 to 2.0. The tiny article change has been overshadowed by more general debates on the leaked version, and did not receive much attention, apart from electrification vested interests.

The value of 2.0 is surprisingly even below the 2.2 value being discussed among stakeholders during the consultation process. The Commission justifies it in the introduction of the revised EED, as follows:

'*Calculations of the PEF for electricity are based on annual average values. The Physical energy content accounting method is used for nuclear electricity (and heat) generation and the Technical conversion efficiency method is used for electricity (and heat) generation from fossil fuels and biomass. For non-combustible renewable energy, the method is the direct equivalent based on the Total primary energy approach. To calculate the primary energy share for electricity in CHP, the method in Annex II of the Directive is applied ('Finish method' or 'Alternative production method'). An average market position is used rather than a marginal one. Conversion efficiencies are assumed to be 100% for non-combustible renewables, 10% for geothermal power stations and 33% for nuclear power stations. Total efficiency for CHP is calculated based on the most recent data from Eurostat. As for system boundaries the PEF is 1 for all energy sources. Calculations are based on the most recent version of the*

PRIMES Reference Scenario. The PEF value is based on the projection to 2020. The analysis covers the 28 EU Member States and Norway'.

There is still debate in the interpretation of this new value of 2.0, as to whether it comes from the projections being moved form an average date between now and 2020, to 2020, or if it stems from the PEF electricity being now calculated with the value of 1 being attributed to all fuel sources (including fossil fuels). w opens what it is right now the main weakness of the whole Commission reasoning, hence a strong argument for the anti-electrification camp. Considering a PEF=1 for all fuels in the calculation of the electricity PEF, would lead to an unfair treatment and market distortion, as there would be no consideration of upstream energy losses for the electricity sector, leading to a situation where fuels applied to direct heating (such as gas) are considered differently from the same fuels, when applied to power production (gas turbines).

2. Solar Heat Europe Contribution to EU Legislative Consultations

This section presents Solar Heat Europe contributions to the different European Commission consultations, stemming from the 2016 EU legislative revision process. It builds on the considerations illustrated on the previous section, and tackles with specific topics, following the consultation documents issued by the Commission. In order, the contributions to the Strategy on Heating and Cooling, to the review of the Energy Performance of Buildings Directive, of the Energy Efficiency Directive and of the Renewable Energy Directive are presented.

2.1. Tapping the potentials of the Building and the Heating & Cooling sectors - The Solar Thermal Contribution

As part of the consultation regarding the review of the Energy Performance of Buildings Directive and an EU Strategy on Heating and Cooling, Solar Heat Europe addressed the following topics under consultation during a stakeholders' consultation workshop, in June 2015:

- What are the 'no regret' options to reduce and decarbonise buildings' heating and cooling needs by 2050?
- How can synergies be ensured between building level efficiency measures and supply side measures exploiting renewable energies and waste heat?
- What policy mechanisms would allow energy savings and decarbonisation of energy supply at district level?
- How can we harness synergies between buildings and smart electricity networks?

- **What are the 'no regret' options to reduce and decarbonise buildings' heating and cooling needs by 2050?**

The combination of energy efficiency and renewables is the real no regret option, as stressed by many speakers during the EUSEW. The only regrets will be when we realise that we were preventing market innovation and that the decisions we made, either for large investments or infrastructure, tipped the energy supply balance in favour of some conventional sources. Thus slowing down the pace of change or coming to the conclusion that those investments were not worth it. We should learn also from experiences in the power sector: who would have thought that nuclear would be considered as non-competitive as it is today? Things are moving very fast. Looking towards 2050, the regret might come from having locked-in options and not letting the various technologies and the market work it out for themselves.

The other issue is to understand the diversity of the market and that the market can develop further if there is competitiveness, as the result of having available in the market various solutions for heating and cooling and several options for energy efficiency. The consumers will then drive the market change and push for innovation and competitiveness. Trying to choose which way they should go is not the right way, we should instead help them to operate these changes.

The other no regret option is therefore to combine forces with the consumers and give them the tools to really make the change in their own houses, or in their neighbourhoods or cities. Here we are not talking about whole countries because this is also what we need to grasp: the big difference with the heating sector is that here we are talking about a decentralised reality, we are talking about the local level. Sometimes this is difficult to understand from Brussels where we always try to bring big solutions and try to fit everything in big packages. We also need to understand that one of the key issues here is that there is not one-size-fits-all solution, no silver bullet. The best thing we can do is try to facilitate the change, be it by reducing energy consumption with energy efficiency, or with fuel switch from fossil fuels to renewables.

- **How can synergies be ensured between building level efficiency measures and supply side measures exploiting renewable energies and waste heat?**

There are different benefits for both sectors. In our sector, solar thermal systems are performing better in well insulated buildings, because there is a reduction of the heat demand variation between winter and summer. On the other hand, in what regards domestic hot water, where solar thermal is more competitive, the demand will continue, whether a building is well insulated or not.

Again in this case, the main point is that the energy efficiency and the renewable heating and cooling sectors face very similar barriers in the market, these barriers are the upfront investment and the technical side. The question of installers has already been raised - they require special expertise both for renovations or retrofitting, so we believe that working together is the way forward to arrive at the solution best suited to each situation, location, type of building, type of consumer demands and so on.

- **What policy mechanisms would allow energy savings and decarbonisation of energy supply at district level?**

When people think about district level they think about district heating, while we should also think about decentralised level and demand aggregation. One of the challenges for making a change is that here we are talking about very small investments, and at EU level we like to talk about investments in billions, with EFSI and so on. What we need here is not a few investments of billions of euros, we need millions of investments in thousands of euros, and that is the big difference. This demand aggregation can be done with local authorities. Of course district heating solutions are there and they should be exploited, and we should work as soon as possible on the district heating supply fuel switching into renewables.

There are also very good solutions for small networks, we believe that for a group of buildings they will continue to be extremely good solutions. But when we think about district level we should think about working with local authorities in creating demand aggregation, in creating programmes that empower neighbourhoods to make the change we are talking about with energy efficiency measures and the inclusion of renewable heating and cooling solutions.

- **How can we harness synergies between buildings and smart electricity networks?**

We hear a lot about this idea of using wind and other renewable power sources for heating. What you might not know is that the solution of using wind for heating is only possible because there is solar district heating systems requiring huge heat storage, and this is where the excess wind energy is stored in the form of heat (transformed using heat pumps).

Therefore, for solar thermal, this is also a very interesting combination, we are not talking about replacing one with the other, but making them work together, balancing the grid. In this case, when the storage becomes part of the systems and is not only linked to the investment in solar thermal, our business model improves drastically because all the costs of investment in the district heating network storage are not all solely allocated to solar thermal and serve different technologies. But it is also important to understand that this happens at a decentralised level, at the building and residential level.

We need to do it in a balanced way: it should be there that the combination should help manage peak loads and not the opposite, that we do not create too much pressure on the electricity grid, because we just are using too much heating generated by electricity as we already have very clear examples today, as highlighted by the problems already faced by France with such solutions. So it should be achieved in a combined way, finding synergies, instead of one technology overwhelming another in what is the supposed best solution.

2.2. Addressing Commission Issue Papers Informing the EU Strategy On Heating And Cooling

As part of the drafting process in view of the elaboration of the Heating and Cooling Strategy, the European Commission launched five issue papers[1] dedicated to the following topics:

- Decarbonisation of heating and cooling use in buildings;
- Heating and cooling use in industry and the tertiary sector
- Technologies for heating and cooling
- Linking heating and cooling with electricity
- Integrated planning and mapping and scenarios for heating & cooling

The five issue papers were an interesting starting point in the description of the heating and cooling in Europe. In particular, the recognition of the key role decarbonisation and renewables must play in the future of the European heating and cooling sector is encouraging. Moreover, the quest for combined synergies between energy efficiency and renewable energy supply is to be welcomed.

Each of these documents described different factors and findings regarding the Heating and Cooling sector, raising questions to be addressed and clarified.

We present below Solar Heat Europe contribution's to those questions.

1. **What are the trade-offs between and how can we assess the cost-optimal balance of:**

- Measures to reduce energy consumption in buildings;
- On-building renewable energy;
- Remote low-carbon electricity; and
- Waste heat and renewable energy based district heating and cooling in decarbonising building heating and cooling?

- One of the main questions is to ensure a pre-existing level playing field in the H&C sector, giving the possibility to renewable heating and cooling, and energy efficiency to compete on an equal basis against fossil fuels, for instance by internalizing the cost of CO2 emissions.

- Once this is completed, the market should be let free to decide the cost-optimal balance between renewable heating and cooling solutions and energy efficiency measures and other options (be it other energy sources, such as centrally generated electricity, waste heat or other energy efficiency enablers, such as district heating).

- The cost-optimal balance between the necessary components of the European heating sector cannot be established and determined on a top-down approach and applied everywhere equally across Europe because climate,

1 The full documents can be found in the Members-only section of Solar Heat Europe website.

economic and sourcing preconditions vary strongly.

- What can be done from a top-down perspective is to encourage a holistic approach to the heating and cooling sector, promoting solutions that integrate both renewable heating and cooling, and energy efficiency at the same time.

- The data modelling of the European Commission could be improved better reflecting the reality of the heating and cooling sector, in particular when it comes to the very high discount rates still applied for the energy efficiency and renewable heating and cooling.

2. What would help to improve our understanding of heating and cooling use in industry and in the service sector to better assess the technical potential for energy efficiency and renewable deployment?

- Need to determine a stable scenario describing the desirable future energy mix in order to decarbonise the heating and cooling sector and avoid stranded investments into carbon intensive infrastructure. Those scenarios should be European and differentiated on national level.

- Need to establish a data collection system in partnership with relevant sectorial stakeholders, capable of providing reliable information on the heating and cooling sector on an EU level. In the particular case of industry, there is the need for matchmaking between industrial processes using heat and renewable solutions. This includes understanding different uses of heat, different thermal system configurations and industrial process design and identifying the potential and requirements of suitable renewable energy options.

- The Commission could set up an expert group on heating & cooling to provide expertise and advice on the development of political strategies and specific actions in the H&C sector, aiming towards the improvement of EU energy security and energy efficiency, the development of an EU internal energy market and greater innovation, while decarbonizing the sector. The experts group should include suppliers of energy for heating, equipment suppliers, energy efficiency industry, representatives of local and regional authorities, energy agencies, academic experts, environmental NGOs and industrial and commercial heat consumers' representatives.

3. What are the most important barriers for companies to deploy existing energy efficiency and renewable energy solutions and how can these barriers be overcome?

- Policy discontinuity is among the most important barriers, as it undermines a stable framework for investments and projects development. Reliable, steady and attractive support instruments, as long as no level playing field with fossil sources has been established, are needed.

- Financing is a crucial barrier, as both energy efficiency and renewable heating & cooling have high up-front investment cost which deter consumers from opting to more sustainable options.

- Another important barrier is the lack of consumers' and investors' (such as DH companies) knowledge of the actual technology's costs and benefits. Consumer awareness campaigns targeting the EU wide public, promoted in collaboration with all the sectorial stakeholders, could help overcoming this barrier. Better information would also tackle trust issues towards such technologies. These can also be tackled efficiently promoting standards and certifications, as well as training of installers.

4. **Are there technical limitations to substitute fossil fuels with biomass in heating and cooling supply in industry? Are there environmental and economic limitations? Ditto for other alternative energy sources.**

- The most important technical limitation to substitute fossil fuels with solar thermal in heating and cooling supply in industry is related to the technological potential of solar thermal. In fact, solar thermal can provide heat only into a limited temperature range (up to approx. 250 degrees centigrade) and performs best on low level temperatures. However, medium and low temperatures cover a large part of the industrial heat demand, thus leaving room for a considerable solar thermal deployment potential.

- There are no foreseeable environmental limitations to the use of solar thermal in the industry sector. Solar thermal has a very low negative externality (concentrated in the minerals extraction phase)[2], and does not involve the use of toxic chemicals or materials, neither it produces combustion gases. There are also no reports of solar thermal heat impacting on the local biosphere.

- Economic limitations to the deployment of solar thermal in the industry sector stem from the competitiveness of the technology, which is hampered by the inexistence of a level-playing field with traditional fossil fuel alternatives.

- Restrictive investment viability considerations (on payback period, e.g.) by industrial end-users impairing viable investments on a Net Present Value based analysis, as is often the case with solar thermal.

5. **What are the areas where industrial and tertiary sectors would need support from national and local authorities and what are the mechanisms to establish better cooperation and coordination between companies and national and local authorities?**

- National and local authorities can contribute actively to the deployment of renewable heating and cooling, by creating positive and stable frameworks in which those technologies can flourish. Several actions can be taken at the local level, from the simplification of the authorisation procedures, to the mandatory integration of renewable heating and cooling solutions in buildings, starting from the public sector. National and local authorities should adopt a comprehensive approach to urban planning including decarbonisation of the heating and cooling supply measures, in order to maximise active and passive solar gains, and allow the deployment of solar thermal solutions that require appropriate areas for collectors and storage. Promoting the development of ESCO's, that can specialise on

2 See Ecofys study 'Energy subsidies and costs in Europe', 2014

energy contracts combining energy efficiency measures and renewable energy options.

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6. **What is needed to accelerate the deployment of energy efficient and renewable heating and cooling technologies in buildings?**

- Reliable, steady and attractive support measures to promote renewable solutions.

- Improve access to financing for consumers. Promote new financial tools and improve knowledge of existing opportunities.

- Promotion of integrated solutions combining renewables with energy efficiency measures (see Annex I).

- Awareness raising among consumers on available technologies, their real cost and benefits.

- Disseminate information and personnel training in local planning and permitting authorities.

- Installers training (rooftop installations) and incentivation to promote RES-HC technology.

- Renewable and efficiency obligations for existing buildings.

7. **What is needed to secure the buy-in of installers, builders and architects of the most efficient and renewables technologies?**

- Installers, builders and architects should be informed about the advantages of the renewable technologies, for consumers and for their activity. Simplified training mechanisms should be in place to facilitate the adoption of these technologies, in particular for those professionals used to deal mostly with conventional solutions, using fossil fuels. Specific support mechanisms, making it more attractive for these professionals (installers, builders and architects) to opt for solutions promoting a fuel switch should also be considered.

8. **How can the deployment of energy efficient and renewables heating and cooling technologies in industry be facilitated?**

- Reduce cost privileges for industrial heat supplied by fossil sources.

- Promote awareness and information on existing renewable solutions, real costs over the lifespan of the technology, and its benefits. Promote the sharing of best practices.

- Foster R&D targeting in particular system integration and mid-to-high level temperatures.

- Implement the RHC European Technology Platform Solar Heating and cooling Technology Roadmap, in particular the pathway on solar heat for industrial processes. The main targets here should be the achievement of cost optimal solar heat for industrial process systems, their integration into relevant industrial applications, the development of next generation systems with increased solar fraction, and the adaptation of solar heat for industrial process systems to industry machinery standards and development of new ways to feed in solar heat into the industrial processes.

- Promote energy intensity/renewable energy labelling schemes for industrial production in different industrial branches (e.g. food & beverages, textile, etc).

9. How can the conditions for financing for the transition to a renewable dominated and more energy efficient heating and cooling systems be made more attractive?

- As a transition towards bankability of RES-H&C projects, governments should support the sector by providing guarantees mechanisms lowering the interest rates for private and commercial investments into renewable heat and energy efficiency.

- Knowledge of the benefits, long term gains and reliability of the technology must be promoted among the financing community.

- Consumers' aggregation tools should be explored and promoted.

- ESCOs should be incentivised to switch to renewable heating and cooling.

- Tools promoting long term period financing (over 10 years or more) must be promoted.

- Integrated solutions, including energy efficiency measures and renewable heating and cooling at the same time, should be promoted, and deployed as off-the-shelf packages, which should be easier to get financed (see Annex I). Best practices and data from such solutions should be disclosed, in order to promote knowledge of their bankability in the financial community.

- Facilitate access to third-party financing mechanisms supported on a clear and stable securitization framework (Guarantee of Results, heat Purchase Agreements, Insurance, Definition of liabilities, etc).

10. What steps to take to link heating and cooling and electricity systems?

- Caution must be the underlining principle when tackling the electrification of the heating sector. A certain amount of efficient electrification is necessary, in particular in the high range temperature needs, in the path towards the decarbonisation of the European heating sector. However, the idea of using the heating sector to absorb excess electricity from inflexible or intermittent sources is the result of a wrong market design and lack of flexibility, which lead to overcapacity and inefficiencies. A wild electrification of the heating sector is not desirable, as it is an inefficient energy form, in terms of exergy, to cover the mostly low temperature demands of the heating sector – in brief, it is a waste to use electricity for low temperature heat. Moreover, massive electrification of the heating sector might be non-affordable, as the electricity prices are set to raise in the future[3], while alternatives such as renewable heating and cooling are costing less and less. The electrification of the heating sector puts under stress the power grids, while also putting the decarbonisation of the sector at risk, as in many EU countries, the bulk of the power production is still concentrated into heavily pollutant fossil fuels such as coal.

- The European Commission should therefore examine cautiously the heating and cooling sector to find areas where an electrification through highly efficient systems can be applied, and reject a massive, wild electrification in sectors where more sustainable solutions are already existing, and are becoming more and more competitive.

11. How cost-effective is thermal storage?

- Thermal storage is probably the cheapest form of energy storage available today[4]. In combination with solar thermal systems, thermal storage can be a very efficient way to improve the performance of the system, both at a small scale, residential level, and at a large scale level. There storage can increase its competitiveness, as it can provide seasonal storage, and it can integrate different sources such as excess variable power supply via efficient heat pumps, making it even more cost effective.

12. How dependant is an integration of heating and cooling and electricity on collective solutions (CHP, district heating)?

- One of the potential solutions for the use of excess renewable power generation is to store it in the form of heat in seasonal heat stores. Several solar thermal plants providing heat to district heating networks use very large heat stores, making it easier to integrate power to heat solutions, making use of RES variability and excess power in the grid. On the other hand, new large heat stores can be added to existing district heating networks, to use both solar thermal energy or take advantage of excess power from RES. In such case, the additional investment in a solar thermal solution would be even lower, making this option even more economically attractive.

- Another interesting solution, already considered in several district heating systems, is to use solar thermal during spring and summer, when the solar resource is abundant but the heat demand is drastically reduced. In such cases, it is possible to shut-down heating plants or CHP plants that are not efficient at a low level of heat generation.

13. What should the key features of the heating and cooling system in 2050 be?

- The EU heating and cooling system in 2050 should be on track towards a full decarbonisation.

- Renewable heating and cooling technologies are the most competitive

3 Commission Staff Working Document (SWD(2014)15) - Impact Assessment Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A policy framework for climate and energy in the period from 2020 up to 2030, pp.28-29.
4 IEA-ETSAP and IRENA - Thermal Energy Storage - Technology Brief E17 - January 20013.

solutions and are the majority of the market, replacing old equipment using fossil fuels, since the right framework to ensure a level playing field has already been set.

- Renewables for heating and cooling and renewables for power generation are main elements of smart cities, where power grids, heat networks and decentralised generation of renewable heating and of renewable electricity are integrated in an efficient way, providing cost-optimal solutions.

- Carbon emissions from traditional fossil fuels heating appliances are subject to carbon tax, and thus heavily discouraged.

- District heating systems should be expanded wherever feasible, efficient and competitive, and all existing ones should be turned to renewable energy sources and upgraded to the highest efficiency standards. Solar thermal could be used, in combination with other renewable sources, to cover large part of the demand of the European district heating networks.

14. What can be the benefits of an integrated approach to set pathways for the transformation of heating and cooling?

- An integrated approach to the decarbonisation of the heating and cooling, combining its two most important elements, energy efficiency and renewables for heating and cooling, is crucial as it allows for a maximisation of synergies and benefits resulting from each element. An integrated approach allows:
    - Better policy interventions, as those elements face similar barriers and constraints;
    - Better urban planning, as combined interventions reduce inconveniences
    - Better access to financing
    - It would prevent the creation of lock-in effects, i.e. when the consumer decides to invest either in energy efficiency or in renewable heating and cooling to the detriment of the other one. At domestic level, usually once end-users have carried out major works in their homes, they are loath to start other works for many years afterwards.

15. What elements does such an integrated approach need to consider in terms of the options of demand reduction and the deployment of renewable energies, e.g. the share of electricity in heating, the balance between reducing demand in buildings and industry and the deployment of renewable supply sources, the role of district heating and cooling, technologies deployment, and the roll-out of smart energy networks, the empowerment of consumers?

- The balance between reducing heat demand in buildings and industry and the deployment of renewables cannot be struck once and for all from a top-down perspective. This balance is subject to different variables in different geographic, social and economic locations across Europe. What can be done from a top-down level is to ensure a level-playing field with traditional fossil fuels, and ensure a proper legislative framework is in place and implemented to promote both energy efficiency and renewable heating and cooling. There are also certain heat demand segments where energy efficiency can hardly replace clean production of heat, as it is the case of domestic hot water, which demand is not greatly reduced by energy efficiency measures.

- The share of electricity in heating must be cautiously analysed, in order to avoid scenarios where massive, wild electrification of the heating sector is carried on, forging ahead to solve imbalances in the power market (see question 14).

- District heating can have an important role to play in the decarbonisation of the heating sector, insofar as they are based on renewable energy, and are planned in a participated way, involving consumers, instead of being imposed on a top-down approach. District heating networks are a smart delivery solution, but cannot cover the full heat demand in Europe, not even in urban landscapes. They should be promoted whenever feasible, competitive and sustainable, but should not be considered as the silver bullet for European cities, as in many cases they simply cannot replace decentralised installations.

- The change in the energy system and in particular in heating and cooling needs to be done at decentralised level, mostly in private homes, companies and institutions. The change can only be done if consumers are engaged and empowered. The empowerment of consumers must be a transversal basis for an integrated approach to the heating sector. There is no policy, no regulating framework, no financing measure that can properly work without citizens' involvement and consumers' empowerment.

16. At what level should such integrated approach be applied, i.e. EU, national or local levels?

- Since the European heating and cooling sector is mostly a decentralised sector, solutions must also be applied at a decentralised, local level.

17. What are the best practices of integrated mapping for heating and cooling at local and national level?

- Solar roof cadastre of City of Graz[5]: The "Graz solar roof cadastre", created in collaboration with the municipal statistical office and the environmental office and the industry, aims at helping individual citizens, property developers, real estate developers, construction companies or the building authorities to assess whether solar installations are competitive and effective in specific locations in Graz.

5 Graz Geoportal - NEU: Solardachkataster der Landeshauptstadt Graz

2.3. Solar Thermal and the Heat Strategy An Action Plan

This section contains Solar Heat Europe position regarding the EU Strategy on Heating and Cooling. It outlines how ideally the Strategy should act to promote the decarbonisation of the heating and cooling sector, envisaging general objectives and specific actions. It was produced and presented to the Commission between August and September 2015, in the process leading to the publication of the Strategy.

Introduction

The solar thermal sector, despite covering still a minor fraction of EU heating production, has the potential and the ambition to have a central stage in the Heat Strategy, and more generally in the EU policy for the heating and cooling, insofar as it is a crucial part of the answer the EU must give to the challenges faced by the heating and cooling sector in Europe. Being a flexible, versatile technology, easily deployable at different scales, solar thermal can cover different needs in different contexts, from urban to rural scenarios, from domestic to industrial usages. Having low planning and installation requirements, solar thermal deployment on a larger scale would be extremely rapid, and, with the right incentives and policy framework, it could be ramped up to meet a larger share of the European heating and cooling demand in just a few years.

The Heat Strategy was a very welcomed first step in setting a right framework for such a technology deployment. However, it is just a starting point. Crucial next steps are going to be the review of specific legislation affecting the heating & cooling sector and the setting up of a 2030 governance framework, alongside with the full implementation of the 2020 framework.

General objectives

The main objective of the Heat Strategy should be to define a pathway for the heating and cooling sector to contribute to the overarching goal of reaching a sustainable, competitive and secure energy sector for Europe.

This goal is to be met in two complementary ways: through the decarbonisation of the heat production (by reducing GHG emissions of heat production) and through the reduction of the heat consumption. If energy efficiency measures are clearly the most direct way to reduce heat consumption, renewable technologies for heating and cooling - such as solar thermal - must be the key element for the decarbonisation of the H&C sector! These technologies are fundamental for an efficient and affordable switch from fossil fuels to sustainable alternatives, be it at the residential and tertiary level, or for industrial processes.

The Strategy should therefore focus on how to promote fuel switch from fossil fuels to renewables in the heating sector, focusing on two key areas:

the building and the industry sector. The fuel switch is to be pursued both at a central level, switching large scale installations such as district heating networks, and –most importantly- at a decentralised, local level, switching individual domestic installations from inefficient old heating equipment to small scale renewables.

The Strategy should concretely foster the roll-out of renewable technologies for heating and cooling for a truly efficient decarbonisation of the heat consumption, identifying challenges and barriers to the decarbonisation of the heating & cooling sector via the deployment of renewable technologies for heating and cooling, and finding ways to overcome those barriers.

In brief, for the solar thermal sector, the Heat Strategy should:

- identify barriers to the renewable heating and cooling deployment and ways to overcome them, avoiding medium-to-long term solutions in the heating sector that would lock-in inefficient fossil fuels infrastructure;
- look at energy efficiency always in combination with renewables for heating and cooling;
- provide a sound basis for all future legislative interventions in the heating sector;
- include a roadmap of how to gradually phase-out fossil fuel subsidies and reach a truly decarbonised heating sector by 2050;
- recognize the importance of meeting heat demand with renewable heat production, limiting the role of electrification of the heating sector to segments where it is truly efficient.

Actions

After identifying the main barriers to an effective decarbonisation of the heating & cooling sector, the Heat Strategy should focus its attention on four main actions, or pillars, which together are capable of tackling most of the existing barriers. For each pillar, several sub-actions can be identified.

Those pillars are:

➢ Tackling the issue of access to financing for renewable heating and cooling and energy efficiency measures, in order to promote investments in the decarbonisation of the H&C sector.

- The Heat Strategy should direct financing in the H&C sector towards the promotion of fuel switch from fossil fuels to renewables, both in centralized installations (district heating and CHP) and in decentralised, small scale installations. The Strategy should particularly focus on the fuel switch in the building sector and in the industrial sector, as well as recommending strategic switch in targeted countries highly dependent on external gas supplies.

- The Commission should address as an outmost priority the issue of the upfront investment cost for renewable heating and cooling technologies installed by citizens at local, small scale level. Innovative financing tools must be explored, focusing on decentralised and small scale investments.

- When considering the financing of projects, renewables for heating and cooling and energy efficiency should be addressed at the same time, notably in the building sector, as they face similar barriers and can generate synergies.

- The Commission should increase awareness and transparency on already available financing opportunities to finance the investment cost for renewable heating and cooling technologies in decentralised, small scale installations.

- The forthcoming Smart Financing for Smart Buildings Initiative should explore the synergies between energy efficiency and renewable heating and cooling in the building sector, focusing in particular on integrated solutions combining the two elements.

➢ Ensuring the proper implementation of the existing legislation.

- The Heat Strategy should aim at providing a sound basis for all future legislative interventions in the H&C sector, and ensure a correct implementation of the existing legislation. It should foster a new regulatory framework to ensure the integration of RES-H&C in buildings, industry and smart thermal grid.

- Special attention should be paid to the correct implementation of articles 13 and 14 of the Renewable Energy Directive dedicated to renewables in buildings, to the reduction of administrative barriers, to improved information for consumers, and training of installers. Beyond 2020, these measures should be strengthened, boosting the renovation of the existing building stock. The Commission should better monitor Member States actions to implement those key articles, and should be firm in considering eventual infringement procedures.

- The Heat Strategy should ensure consistency for the incoming revision of the EPBD, EED and RES Directives, and make sure the main pillars outlined here are adequately represented in the revision.

➢ Fostering research, development and innovation.

- The Heat Strategy should build on the work already accomplished by the RHC Technology Platform, and aim at implementing the Technology Roadmaps[1].

- R&D&I in RES-H&C technologies should target costs reduction, improvements in the temperature level, the enhancing of system performance and the integration of RES-H&C into existing infrastructure. It

1 RHC-Plateform - Technology Roadmaps

should also target the commercialisation phase and should aim at covering additional industrial sectors.

- The R&D&I should also be targeted towards the development of integrated solutions, combining RES-H&C technologies with energy efficiency interventions.
- The Heat Strategy should explore ways to foster and mobilize private investment, in combination with EU financing.

Two additional transversal issues on which the Heat Strategy should be based are:

➢ Gathering information and promoting knowledge on the heating & cooling sector.

- The Heat Strategy should include a comprehensive evaluation of the heating and cooling sector. This should include:
    - A description of the H&C sector in Europe, carefully distinguishing between energy sources (gas, heating oil, coal, biomass, geothermal, solar thermal, aerothermal), enablers (heat pumps, boilers, stoves, district heating, cogeneration), end-users (households, industry, commercial).
    - A description of heating and cooling market in the different MS, including an evaluation of the potential for RES-H&C technologies;
    - An analysis of existing EU-level policies and regulations, which have direct or indirect influence on heating and cooling.
    - A description of different regulations in the heating and cooling sector currently in place in the different MS.
- The Strategy should propose a permanent data collection system aiming at mapping heat demand and production across Europe, in cooperation with MS, industry, consumers.

➢ Involving the citizens as active and informed prosumers.

- Citizens' involvement is a transversal issue of the outmost importance, as any other action is likely to fail if it is not sustained by wide public support. The Strategy should therefore strive to involve citizens at all levels, including as small scale investors, consumers, and heat producers.
- The most direct way to involve citizens is providing them with information and knowledge. Citizens must be involved in their energy choices, and informed about available options. The Strategy should therefore promote campaigns at national and local level both to increase awareness of economic and environmental benefits of switching fuels to RES-H&C in centralized installations, and to inform citizens on available options and relative advantages of RES-H&C in decentralised, small scale installations.

- In order to give real choices to the consumers, the Strategy should aim at removing relevant bottlenecks in the market, such as lack of skilled installers for RES-H&C technologies. It should therefore promote and increase information and trainings of relevant actors (installers, architects, builders, suppliers of equipment, etc.), fully implementing art. 14 of the RES Directive.

- Another bottleneck to be removed is the burdensome or problematic authorisation procedure for RES-H&C technologies by local public authorities. This should be done in close cooperation with local authorities and civil society at local level, and according to the measures foreseen in art. 13 of the RES Directive.

Altogether, the structure of the Heat Strategy should look like the image below.

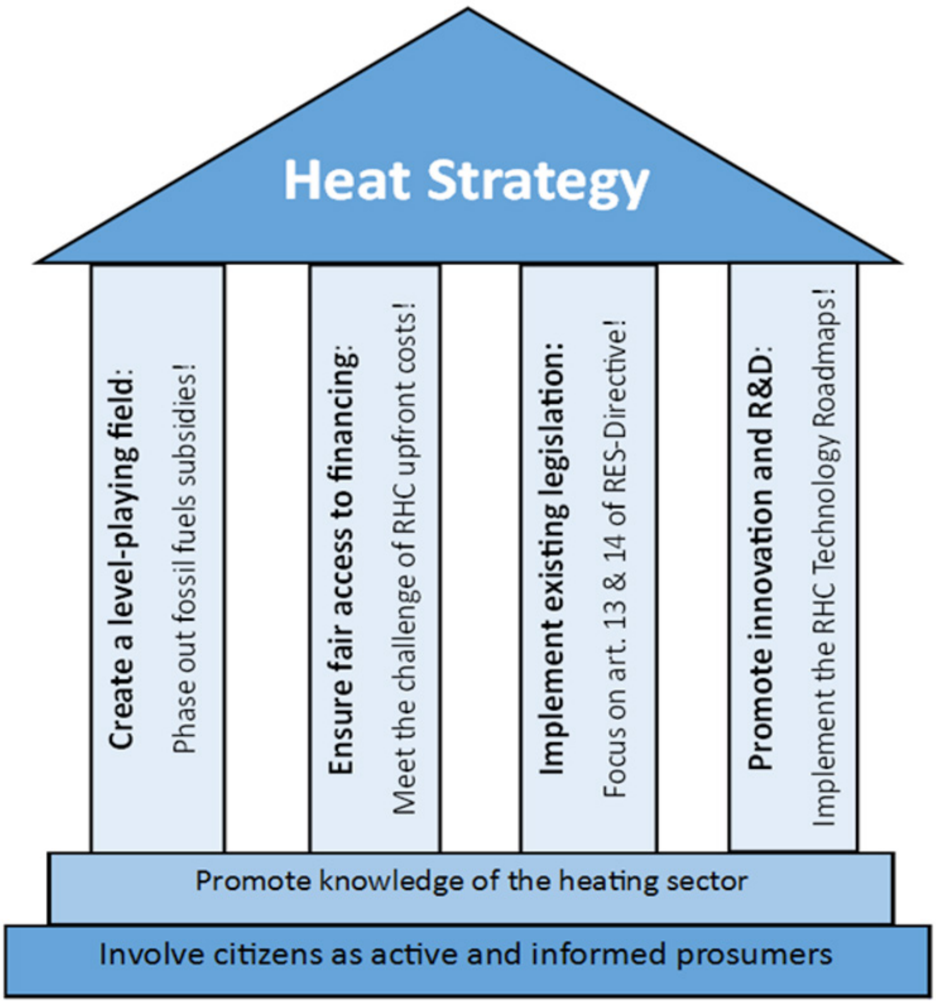


Figure 9.

The four pillars of the Heat Strategy

Source: Solar Heat Europe

In brief, the Heat Strategy should:

- Aim at decarbonising the EU H&C sector, giving a central role to the RES-H&C technologies;

- Promote as a goal the fuel switch in the residential, commercial and industrial sectors, particularly focusing on the decentralised, small scale and local level.

- Explore synergies between RES-H&C technologies and energy efficiency measures, promoting integrated solutions that combine both aspects.

- Be sustained by four pillars…
  - ∆ creating a level playing field;
  - ∆ ensuring fair access to financing;
  - ∆ implementing existing legislation;
  - ∆ promoting innovation and R&D;
- ...and be based on two transversal issues:
  - ∆ Promoting knowledge of the heating sector;
  - ∆ Involving citizens as active and informed prosumers.

2.4. Solar Thermal and the Energy Performance of Buildings Directive

This section illustrates Solar Heat Europe contribution submitted to the Commission public consultation on the review of the Energy Performance of Buildings Directive. It is structured around a selection of the most relevant questions asked by the Commission in its consultation document.

1. How successful has the EPBD been in achieving on its goals?

The EPBD is a key legislation for the achievement of the long term EU climate and energy goals. It has set a positive framework for the improvement of the energy performance of the building sector. However, its success has been hampered by a number of factors. First of all, its slow implementation rate. Secondly, the delays in the creation of EPBD standards, which did show slow results in the market. Thirdly, the failure to properly address the bulk of the building sector, i.e. the existing buildings. Fourthly, the Directive has failed to properly address the existing synergies between efficient technologies for the production of renewable heating and cooling energy and energy efficiency measures. All those factors combined have diminished the achievements of the EPBD. However, they constitute now an incredible source of opportunities to improve the energy performance within the building sector. Much of the efforts at EU and national level should be targeted towards the implementation of the existing measures: the EPBD sets a positive EU legislative framework for the building sector. What is urgent is a proper implementation of the measures already in place.

2. Overall, do you think that the EPBD is contributing to cost-effective improvements of energy performance? Why/Why not?

Overall, EPBD is contributing to improvements of energy performance, but more could be done by promoting energy efficiency in combination with renewables, in particular in the heating and cooling sector. Indeed, deploying energy efficiency measures in combination with efficient renewable heating and cooling technologies for the production of energy, in combination, while implementing building renovation projects, drastically improves the cost efficiency of the project. On the one hand, renewable heating and cooling technologies work better in a better insulated environment, since their performance is less constrained by drastic seasonal temperatures changes. On the other hand, energy efficiency measures cannot erase the heating demand completely. And when higher levels of energy efficiency are attained, cost-effectiveness can be affected. This means that it should be taken into account that there will always be a residual space heating demand to be covered, and hot water demand is left unaltered by any major building renovation. Avoiding lock-in effects, i.e. when the consumer decides to invest either in energy efficiency or in renewable heating and cooling to the detriment of the other one[1], is essential to ensure cost-effective projects when addressing the energy per-

1 At domestic level, usually once end-users have carried out major works in their homes, they are loath to start other works for many years, even decades, afterwards.

formance of buildings.

3. **Has the EPBD effectively addressed the challenges of existing buildings' energy performance?**

The EPBD effects on the existing buildings stock have been marginal and represent the main weakness of the Directive, as well as the main opportunity to be seized in the review process of this legislation. The renovation rate is at an alarmingly low level, considering the potential in terms of energy efficiency gains and decarbonisation of the sector. Buildings, and in particular the demand and supply of heating and cooling for buildings, are indeed the low hanging fruit of the EU energy sector: the technology is there, the business case too. A political signal is needed in order to foster the renovation market, and to better connect available and existing financing with projects on a local level. There is a need to better connect the different legal provisions shaping the sector: art. 7 EPBD and art. 4 EED should be better connected, as to ensure that deep renovation strategies from Member States do include evaluations on high-efficiency alternatives systems referred to in art. 6.1(a) EPBD. Renovation strategies should also be better connected to the national assessments of the heating and cooling needs (art. 14 EED), which should however not be limited to the centralised solutions such as cogeneration and district heating, but also include the decentralised level, which is by far the most important segment of the H&C sector in Europe. The European Commission and Member States should focus their efforts towards the correct implementation of the measures in place to promote the increase of the renovation rate and of the energy performance of the existing building stock.

4. **How successful has the inclusion of Energy Performance Certificates in the EPBD been? Have the certificates contributed to improvements in energy performance of buildings?**

The Energy Performance Certificates are an important tool with great potential to be developed further. EPC dissemination should be stepped up, in particular for existing buildings and rental situations. EPC constitute also a relevant tool to inform consumers on how to improve the energy efficiency of a building and should therefore take further into account renewables, in particular for heating and cooling, in the recommendations section (art. 11.2 EPBD). Mandatory measures to that end could be envisaged. The combination of mandatory recommendations for technical building systems and the spread of the EPC in the rental market could help, for instance, to gap the split-incentive dilemma. It is important to consider in this respect that EPC recommendation for technical building systems improvements should consider the advantages of decentralised efficient technologies for the production of renewable heating and cooling energy, alongside centralised decarbonisation solutions such as district heating.

5. **Is the EPBD helping to contribute to the goals of EU climate and energy policy (Reduce greenhouse gas emissions by at least 40%; increasing the share of renewable energy to at least 27%; increasing energy efficiency by at least 27%; reform of the EU emission trading system)?**

The EPBD is a key contribution to the EU climate and energy goals. However, more could be done, by promoting energy efficiency in combination with renewables, in particular in the heating and cooling sector, and by better tackling the existing building stock.

6. **Is it in line with subsidiarity? What should continue to be tackled at EU level and what could be achieved better at national level?**

The EPBD is in line with subsidiarity. Although the general framework must be set at EU level, the implementing measures must be tackled at local level. It is then in turn the Commission task to better monitor on implementation.

7. **What are the main reasons for the insufficient take-up of the financing available for energy efficiency in buildings?**

The first barrier in the energy efficiency financing for buildings is merely the general lack of knowledge of existing funds and available financing opportunities. Information from the European and national level is often incomplete, patchy or simply divulgated in a way which fails to reach the local level, where it is actually needed. Then, the existing financing tools do not always cover the up-front costs of investment, which represent the most common barrier for projects development. Design and planning of financing tools must better take into consideration what are the real needs of project developers on the ground. Also, the financing community must be made more aware of the energy efficiency and renewables sectors characteristics, potentialities and constraints, as well as the available options already existing and working in the market. There is also the need to bridge the lack of trust in energy efficiency measures and renewable technologies. This should be tackled with collection and intensive dissemination of best practices, including financial data of successful projects combining energy efficiency and renewables in the building sector, in order to provide a basis for the financing community to gather information on the reliability, real costs and long term benefits of such projects.

Overall, there is a need for new ways to bring together project developers and providers of capital potentially interested in projects focused in implementing energy efficiency and renewables. This should be the aim of the Smart Financing for Smart Building Initiative. For it to succeed, it is important to combine interventions in the energy efficiency of buildings, with improvements on the efficiency of the heating systems, through efficient technologies for the production of renewable heating and cooling, such as solar thermal. A critical part of building renovation must be the upgrade of the heating system – as any renovation is likely to leave some room for space heating supply needs, and hot water needs are not altered by building renovations – and this is the right moment to deploy renewable technologies such as solar thermal. Energy efficiency measures and efficient technologies for the production of renewable heating and cooling face similar barriers and are complementary in terms of benefits, they must therefore go hand in hand.

8. **What non-financing barriers are there that hinder investments, and how can they be overcome?**

- Instability in the market signals provided by policy changes and by the lack of long term, structured and accountable commitments. A strong legal framework for the governance of the Energy Union would give certainty to investors, and thus tackle this barrier.
- Lack of expertise in the sectorial working force, in particular in the installation phase. There is a need to promote training and formation in the sectorial workforce, identify bottlenecks and improve competition in the installation market.

- Non-existence of level playing field in the sector, particularly in relation to fossil fuels, which prices are artificially altered by direct and indirect subsidies and by not incorporating negative externalities on its price. Moreover, below-cost regulated prices for traditional sources of energy contribute to the distortion of the market, drawing investments away from the energy efficiency sector. Member States should phase out below-cost regulated prices and fossil fuel subsidies.

- Lack of knowledge of benefits and real costs of energy efficiency measures and renewables in the heating and cooling sector. EU, national and local information campaigns, in cooperation with relevant stakeholders, are needed to tackle this barrier.

9. **What are the best financing tools the EU could offer to help citizens and Member States facilitate deep renovations?**

The best financing tools should first of all target the issue of the up-front investment costs. This is for instance the case with the German market incentive programme, which has been improved in March 2015. Since then, upfront investment grants for the solar thermal technology have been increased to up to 25% of total investment costs. Secondly, financing tools should also improve the legal framework for contracting, bringing stability and trust between the financing community and the project developers. Finally, financial tools should lower risks for investments, decreasing cost of money for project developers. Financing tools should not be focusing only on the quantity of money made available to the energy efficiency market, but also on the quality of the financial instruments. It is not enough to provide access to a significant level of financing, this financing should be easy to access and with a low capital cost.

10. **What role do current national subsidies for fossil fuels have in supporting energy efficient buildings?**

Fossil fuels subsidies are hindering investments in energy efficient buildings, artificially altering the perception of costs and benefits of alternative solutions. Those subsidies also alter the public perception of what should be good and suitable solutions for society as a whole: as governments appear to sustain fossil fuels, their exemplary role in leading to a low carbon economy is weakened by giving the wrong signal to citizens and consumers. Finally, fossil fuel subsidies are also locking-in inefficient solutions for decades. Subsidies for fossil fuels induce larger consumption than in a level-playing field situation, thus altering decisions on infrastructure planning and spending. Big fossil fuels infrastructure is therefore being built according to altered perceptions. This infrastructure will however condition EU consumption patterns for decades to come, thus deterring more socially and environmentally beneficial investments in energy efficiency and renewables.

11. Have energy efficiency and renewable energy projects been combined to maximise their financing? How can the EU help?

Energy efficiency and renewables –in particular for the efficient production of heating and cooling- have not been combined in a systematic and constant way. In order to fully grasp the benefits of the synergies between these two, he EU could provide assistance:

- Promoting and disseminating best practices on integrated solutions combining energy efficiency and renewable energy in new or renovated buildings
- Promoting projects developing integrated solutions
- Enabling funds covering energy efficiency measures to also include on-site renewable energy solutions.

In more general terms, the EU should avoid in its policies and programmes any situation leading to the creation of lock-in effects, whereby investments in energy efficiency or renewables alone in the building sector hamper the deployment of the other. Any funding directed towards energy efficiency projects in the buildings or in the industrial sector should also take into account the supply side, considering, whenever feasible, the fuel switch to efficient technologies for the production of renewable heating and cooling.

12. How is investment in high-performing buildings stimulated and what is being undertaken to gradually phase out the worst performing buildings? Is it sufficient?

The renovation rate of poorly performing buildings is not sufficient to reach the EPBD targets. The European Commission and Member States should focus their efforts towards the correct implementation of the measures in place to promote the increase of the renovation rate and of the energy performance of the existing building stock. A stable policy framework, underpinned by political commitment and legal accountability, is needed in order to attract and promote investments in the renovation of the European building stock. Moreover, financing must be made more accessible, and should be targeted at energy efficiency measures in combination with efficient technologies for the production of renewable heating and cooling. Member States renovation strategies under art. 4 EED should be better promoted and coordinated with national and local stakeholders, and synchronised with national comprehensive heating and cooling potential assessments, targeting both centralised and decentralised solutions.

13. **What is being undertaken to solve the problem of 'split incentives' (between the owner and the tenant) that hampers deep renovations? Is it sufficient?**

The split incentives dilemma is a key problem, which hampers the possibility to truly reach the goals of the EPBD in a cost-optimal way. More must be done to meet this challenge. From a regulatory point of view, the EU could help by promoting the use of EPC on a compulsory basis in rental situations, including an estimation of the technical building systems. This would provide tenants with the correct information on the building energy performance, hence encouraging worst energy efficiency performers to promote renovation measures, including of their heating equipment, in order to better perform in the rental market. Moreover, the Commission should explore ways to share the benefits of building renovations and heating equipment improvements between tenants and landlords.

14. **Should have further measures tackling energy poverty been included in the EPBD?**

Energy poverty should not only be approached as a short term relief based on existing solutions, but also on a structural, long term basis. The best answer to energy poverty is an energy efficient house, well insulated, with thermal energy sources independent from fluctuations of energy prices in the global markets. Financing measures tackling the issue of energy poverty should not only be directed towards fuel consumption support, but also include renovation, energy savings and fuel switch to efficient technologies for the production of renewable heating and cooling energy. A lower bill does not come only from subsidies to fossil fuel consumption, but can also come from more strategic investments in energy efficiency and renewables. This would also help to grasp the collateral benefits of energy efficiency and renewables – as opposed to subsidies to fossil fuels consumption – such as environmental friendliness, local jobs creation and energy independence. Those collateral benefits would in turn help solve or alleviate energy poverty, as those incurring into energy poverty are also those most likely to suffer from environmental hazards, unemployment, and vulnerability from international energy markets fluctuations.

15. **Are energy costs for heating and air conditioning being made available to interested buyers/tenants?**

Information on energy costs for heating and cooling are not always made available to buyers/tenants, when they are, it is not always done in a transparent and understandable way. Energy costs are seldom expressed over the lifetime of the appliances, and are usually limited to the initial investment, thus misleading consumers on key issues such as real costs and benefits. Users should be encouraged to save energy by making a considerable share of the costs to be billed dependent on the user's level of consumption. Moreover, energy check-ups for low income households should be introduced. Energy Check programs allowing tenants and house owners to bring in experts to examine their homes for energy conservation opportunities (such as the German programme "BAFA Vor Ort Beratung") could improve energy poverty situations, by making information more accessible and widespread.

16. What are the best policies at district and city level to increase energy efficiency in buildings? Have specific targets on renewable energies in buildings been included?

- In Germany the Renewable Energy Heat Act ("Bundeswärmegesetz") already stipulates the use of a certain share of renewable in newly erected buildings. Under this law, builders of new buildings are required to generate a percentage of their heating requirements from renewable sources of energy, to undertake certain compensatory measures such as installing additional insulation, or to use combined heat and power systems or long-distance heating.

- Municipal heat plans: Oblige municipalities to provide heat and cold supply concepts on a regular basis. They allow for a systematic planning of heating networks/ grid.

- Databases which provide tailor made information about incentive programmes for municipalities. The German DENA has just started such a database: http://www.energieeffiziente-kommune.de/service/foerdersuche/

- Drafting special maps that pinpoint roofs which are especially convenient for solar thermal installations (solar register – "Solarkataster").

- Deployment of energy consulting for municipalities.

17. On the basis of existing experience, are provisions on targets or specific requirements for new buildings, beyond the current NZEB targets, missing in the EPBD which could help achieve the energy efficiency 2030 target? If so, in what types of targets or requirements?

Specific requirements for new buildings targeting a minimum share of efficient technologies for the production of renewable heating and cooling energy, such as solar thermal, should be considered in order to promote the energy efficiency 2030 target. Indeed, technologies such as solar thermal improve the overall energy efficiency of the heating system of a building, reducing the normal consumption of traditional fuels for heating.

18. Has the EPBD framework improved the self-consumption of electricity in buildings?

Self-consumption of energy in the building sector should not only look at electricity generation. Heat production should be considered as a key part of the self-consumption debate, as heat is by far the most used form of energy in the building sector. And most of the existing systems are generating heat locally, either for water or space heating. Hence, self-consumption of heat is not only existing today, it is the most relevant form of heat supply to buildings in Europe.

Moreover, it is important to consider that the advantages of self-consumption, in particular when considering self-consumption of electricity in buildings, should be measured over a monthly/seasonal basis, reflecting the energy supply and demand, as well as the energy conversion efficiency, for that month/season. Using a yearly average is misleading and may generate imbalances in the power system.

19. Is demand response being stimulated at the individual building level and if so, how?

Demand response is an important tool, but must be set in the appropriate framework. Most of the consumption in the building sector is heating, and most of that is decentralised consumption. Demand response in the power sector, as a way to expand electricity consumption in the heating sector, is just adding complexity to the energy system and to the grids. Changing consumers' behaviour to fit their consumption patterns to the grid needs is difficult and unnecessary. Simpler and more effective ways do exist, starting with renewable in the heating and cooling sector, such as solar thermal, which allow consumers to switch part of their consumption to off-grids alternatives, thus avoiding both putting national grids under stress and implementing complicated behavioural patterns shifts.

20. What obligations are missing at EU level and national level, and at regional and local level to meet the goals of the EPBD?

- Measures promoting the increase of the buildings renovation rate

- Measures promoting the combination of energy efficiency and renewables, in particular for heating and cooling, in integrated solutions.

- Measures promoting integrated approaches in urban planning, including both passive solar and active solar considerations in buildings design.

- Comprehensive quality, advice and awareness campaigns: broad-based regional measures to inform and educate people about energy efficiency. Combined advisory service from financial institutions and energy consultants so that home-owners can be given a comprehensive service covering improvement and financing aspects.

21. What are the best policies at district and city level for increasing energy efficiency and use of renewable energy in buildings?

An energy efficiency strategy for buildings is needed, thereby developing an overall strategy for this sector that will integrate electricity, heat and efficiency aspects, and will draw together all the measures required in these fields.

22. Are there any separate (new) obligations set at city and district level missing from the EPBD which would help increase energy efficiency and use of renewable energy in buildings?

Stronger obligations to decarbonise the district heating networks across Europe, including minimum requirements for the use of renewables in district heating, would not only help increase energy efficiency and use of renewable energy in the buildings sector, but also help in meeting the long term climate and energy EU goals.

23. What incentives are missing, that would help promote efficient district heating and cooling or meeting the goals of the EPBD?

In order to meet the goals of the EPBD, incentives promoting energy efficiency & renewable integrated solutions are missing and should be deployed. Efficient district heating and cooling could be improved by promoting fuel switch to efficient technologies for the production of renewable heating and cooling.

24. Have cost-optimal policies been devised that improve the performance of buildings so that they use less heating and cooling, while ensuring a decarbonised energy supply?

A compulsory label for boilers to provide consumers with initial information, as well as thorough studies of a building's entire heating system which deliver information about the optimal settings should be introduced.

25. Based on existing experience, do you think the setting of minimum requirements in the EPBD for technical building systems is missing? Would have technical building systems minimum requirements contributed to the improvement of buildings' energy performances?

The setting of mandatory minimum requirements for technical building systems is indeed missing in the EPBD. In particular, a minimum share of efficient technologies for the production of renewable space and water heating, such as solar thermal, should be considered in order to promote the EPBD goals.

2.5. Solar Thermal and the Energy Efficiency Directive

This section illustrates Solar Heat Europe contribution submitted to the Commission public consultation on the review of the Energy Efficiency Directive. It is structured around a selection of the most relevant questions asked by the Commission in its consultation document.

1. **What is the key contribution of the EED to the achievement of the 2020 energy efficiency target?**

- The key contribution of the EED has been the creation of a positive framework for energy efficiency investments and policies to flourish. It has also increased the attention on the importance of achieving separate targets alongside the CO2 objective, and on the relevance of tackling sectors outside ETS.

- However, the EED needs better implementation in order to fully achieve its goals. Although the overall structure and main measures should not be dramatically altered, better synergies are to be created with complementary legislation, such as the EPBD and RED. A stronger focus is also to be put into the decentralised, local level, particularly for the heating and cooling sector. Better synergies could also be created by having a combined approach towards energy efficiency and renewable heating and cooling. They must be addressed at the same time as they face similar barriers and have complementary benefits.

2. **How has the EED worked together with the Effort Sharing Decision, other energy efficiency legislation (on buildings, products and transport) and ETS? Could you describe positive synergies or overlaps?**

The EED has worked in synergy with the EPBD in tackling the building sector, thus being mostly complementary to the ETS action. More synergies between the EED, EPBD and RED are to be promoted.

Specific links are to be built for instance between art. 6 EED and art. 6.1(a) and art. 8 EPBD: high efficiency alternative technical building systems such as decentralised energy supply systems based on energy from renewable sources are to be better recognised for their role in reducing final energy consumption in the EED. The potential synergies deriving from a joint approach towards energy efficiency measures and renewable sources in the heating and cooling sector could also be recognised in art. 20 EED. Synergies between the different goals of the sectorial legislation could also be fostered by widening the scope of art.14 EED, and better linking it to art. 13.3 RED, in order to include the decentralised level when mapping the territory for the identification of the potential of different sources and options for heating and cooling.

3. **What are the main lessons learned from the implementation of the EED?**

Since the implementation of the EED is still at an early stage, it is difficult to draw lessons. The delays in transposition and in implementation show that lack of binding national targets on one hand, and little political commitment to promote energy efficiency at national level have been major barriers so far. Since the entering into force of the EED, the policy landscape has however improved, and now the 'energy efficiency first' principle is widely accepted. The review of the EED should build on this momentum, by pushing forward innovative approaches that would generate synergies between the different goals of the EU energy policy. Most notably, energy efficiency should be seen as complementary to renewable sources of energy, in particular when it comes to heating equipment upgrading. Renewable heating and cooling and energy efficiency go hand in hand. They must be addressed at the same time as they face similar barriers and can generate synergies.

4. **What are the main lessons learned from the implementation of the EED?**

- Growing expectations both from civil society, industry and international partners, building on the momentum generated by COP21

- The need to better link energy efficiency target with the decarbonisation of the overall EU energy system, starting with its larger part: heating and cooling.

- The need to have a clear target, backed up by a solid costs and benefits analysis and a fair modelling including a wider range of options, and more realistic discount rates for EE and RES investments.

- The lessons learned from the REFIT exercise mid-term evaluation of the RED, namely the benefits of national binding targets.

- The growing trends of integrated solutions combining EE measures with renewable heating and cooling, such as pre-fabricated facades modules integrating solar thermal collectors to wall insulation.

- The increasing concerns related to energy security for the EU, and the great potential of EE, in combination with renewable heating and cooling, to cost-effectively displace significant amounts of imported fuels.

5. **What should the role of the EU be in view of achieving the new EU energy efficiency target for 2030?**

The EU should accompany MS in deciding for the best possible framework for EE and RES in Europe after 2020, by pushing for ambitious targets and effective ways of delivery if national binding targets should not be put in place. The Commission should provide appropriate guidance and carefully monitor implementation, working in partnership with MS and regional/local authorities, and it should take decisive actions to correct eventual shortcomings.

The Commission should also tackle general barriers affecting the EE and renewable heating and cooling sectors altogether, such as lack of information or capacity, administrative burdens, up-front investment costs, or uneven-playing field in the energy sector.

The Commission should review the State Aid and Eurostat rules on public finance (for special status to energy and climate-related investments) and EU taxation law in order to promote green VAT. It should promote green public procurement rules, and stricter conditionality on the use of EU funds.

6. **In your view, are the existing EU energy efficiency requirements for public procurement sufficient to achieve the needed impact of energy savings?**

The existing energy efficiency requirements for public procurements are insufficient to achieve the needed impact, as the scope and width of art. 6 EED are too narrow. Firstly, its provisions apply only to central governments, leaving behind a large share of public procurement uncovered. Secondly, there is not enough clarity on the definition of 'products, services and buildings with high energy-efficiency performance'.

7. **How could public procurement procedures be improved in the future with regard to high energy efficiency performance?**

- Public procurement procedures could be improved by: (1) extending them to all levels of public administration, including the regional and local level; (2) providing better guidance and assistance, in particular to local authorities; (3) fostering group purchasing, also promoting best practices sharing; (4) develop common Green Public Procurement criteria; (5) aligning public procurement requirements with energy labelling and eco-design policies, taking into account a system approach (package label both for water and space heating); (6) promoting a gradual approach in introducing NZEBs in the requirements; (7) better identifying high energy-efficiency performance products by linking art.6 EED with art. 6.1(a) EPBD.

8. **In your view, is Article 7 (energy efficiency obligation scheme or alternative measures) an effective instrument to achieve final energy savings?**

Art 7 has been an effective instrument wherever EEO schemes have been put in place. It is therefore crucial to keep existing EEOs running, extending the provisions of art. 7 for the post-2020 period, while also strengthening the synergies with other existing measures stemming from the EPBD and the RED.

The revised article 7 of the EED should:

- Be more ambitious and clearly include renewable heating and cooling (both on-site and nearby); It is already eligible according to EU law, but not always at national level.

- Aim to develop a true white certificate market with developed energy services in the residential sector;

- Counterbalance the absence of carbon pricing in the building sector (being mostly outside ETS).

- Avoid undesirable effects, hampering RES deployment by locking-in non-renewable options for decades to come.

9. Do you believe that the current 1.5% level of energy savings per year from final energy sales is adequate?

The level is adequate for the current level of ambition of the EED. A future framework should however be adapted to an increased ambition in EED targets. Exemptions to the baseline calculation should be further limited, as all sectors, including transports, should contribute to EE objectives.

The current article 7 allows taking into account the energy savings from the replacement of conventional heating systems to RES heating systems. It is an excellent way to give more options to energy suppliers and guarantee cost-optimality, while ensuring EU long-term energy objectives are met, but this is rarely recognised, promoted and applied at national level. It should be therefore made clearer to make sure Member States and energy suppliers are aware of this possibility, and take advantage of it. Promoting renewable heating and cooling as part of EEOs would also ensure that achieved energy savings match with effective CO_2 reduction, thus promoting a real decarbonisation of the energy sector.

10. Should energy efficiency obligation schemes have specific rules about energy savings amongst vulnerable consumers?

Vulnerable consumers are to be protected. However, protecting them does not mean exempting them from costly energy efficiency improvements, but rather helping them in achieving the best results on a long term approach. The best answer to energy poverty is an energy efficient house, well insulated, with thermal energy sources independent from fluctuations of energy prices in the global markets. Financing measures tackling the issue of energy poverty should be diverted from fuel consumption support, to renovation, energy savings and fuel switch to efficient technologies for the production of renewable heating and cooling energy.

This would also help to grasp the collateral benefits of energy efficiency and renewable heating and cooling – as opposed to subsidies to fossil fuels consumption – such as environmental friendliness, local jobs creation and energy independence.

11. **Overall adequacy: Do you think the EED provisions on metering and billing (Articles 9-11) are sufficient to guarantee all consumers easily accessible, sufficiently frequent, detailed and understandable information on their own consumption of energy (electricity, gas, heating, cooling, hot water)?**

- Information on energy consumption for heating and cooling is not always made available to citizens, particularly in the rental market. When information is available, it is not always in a transparent and understandable way. The Commission should better promote smart heat metering in a harmonised way across EED, EPBD and RED.

- In general terms, the provisions of art.9 EED are reasonably adequate for the intended purposes, the great challenge lies in implementation at national and local level. A better connection to the provisions of art. 8.2 EPBD should be established, in order to ensure a consistent approach across different but complementary legislations promoting synergies between energy efficiency and renewable heating and cooling, and between smart power metering and smart heat metering.

12. **Do you think it appropriate that the requirement to provide individual metering and frequent billing (Articles 9(1), 9(3) and 10(1)) is subject to it being technically feasible and/or cost effective?**

A stricter interpretation of this article should be given. Technical feasibility is less and less a realistic reason not to implement art.9. Regarding smart heat metering, developments in sensors and controls and even on the 'Internet of Things' are already providing more options. Moreover, a more competitive and mass market for smart heat metering would gradually drive prices down.

13. **Should such conditions of being technically feasible and/or cost effective be harmonised across the EU?**

An increased harmonisation of those conditions could improve the implementation of art. 9, increasing consumers' understanding of the costs of their energy, and allow for greater comparison across countries.

14. **How would these conditions of being technically feasible and/or cost effective affect the potential for energy savings and consumer empowerment?**

Being properly informed is the first step for consumers to be empowered. An incorrect implementation of art. 9 leads to un-informed consumers, who would be then less inclined to take decisions to improve their condition by, for instance, better insulating their homes and switching their heating system to renewable heating solutions. Users should be encouraged to save energy by making a considerable share of the costs to be billed dependent on the user's level of consumption.

15. **What should be the most appropriate financing mechanisms to significantly increase energy efficiency investments in view of the 2030 target?**

Financing mechanisms could perform better by targeting the up-front investment costs. EE investments, as well as renewable heating and cooling technology such as solar thermal, have high initial capital costs, and then little or no running costs, but in turn they have longer return of investments. Financing tools should also improve the legal framework for contracting, bringing stability and trust between the financing community and the project developers. Thirdly, financial tools should lower risks for investments, decreasing cost of money for project developers, and facilitate bankability of projects.

- The EE and renewable heating and cooling sector could also greatly benefit from a well-functioning white certificate market stemming from a solid obligations schemes framework, bringing much needed liquidity in the non ETS sector. It is critical however, to compare the estimated energy savings of the reported measures with the actual CO_2 reductions and to adjust the obligation schemes accordingly.

16. **Do you believe that measures on public procurement of energy efficient products, services and buildings should become mandatory also for public bodies at regional and local levels?**

Yes. This measure should also be harmonised with art. 13.5 RED, 11.5 EPBD. Whenever the exemplary role of public authorities is to be put forward, it should also be referred to local and regional levels, as those are the main contact points of the public authority for citizens. It is at local level that a true exemplary role can be displayed. Group purchasing practices among different local authorities should be accepted and promoted.

17. **In your view, should all EU public procurement rules relating to sustainability (including in particular energy efficiency in buildings, the use of renewable energy sources, etc.) be gathered into a single EU guidance framework?**

Yes, the Commission should develop one single EU guidance framework addressing all the procurement aspects, criteria and rules related to sustainability, developing common Green Public Procurement criteria.

18. **Do you think that there is sufficient guidance/framework to know what is meant by "energy efficient products, services and buildings"?**

Stronger links must be built between the EED and the EPBD and the EU energy labelling policy. Public procurement requirements should be aligned with energy labelling and eco-design policies, taking into account a system approach (package label both for water and space heating). A gradual approach in introducing NZEBs in the requirements should be promoted. Requirements on high energy-efficiency performance products should be better clarified, by linking art.6 EED with art. 6.1(a) EPBD.

19. While energy efficient products will be cheaper to operate, their initial cost might be higher and a longer period of time will be needed to "pay back" this higher cost. Is this a problem and if so, how can public authorities overcome it?

The Commission should review EU public accounting and finance rules, in order to promote energy efficiency and renewable heating and cooling investments. Those investments should be to a certain extent exempted from public expenditure thresholds, moreover it should be allowed to spread them on several budgetary years and not be compulsory to concentrate the total expenditure on one budgetary year.

20. What role should the EU play in assisting the Member States in the implementation of Article 7?

The Commission should provide guidance, improve synergies between different measures undertaken according to EPBD, EED and RES, and should strengthen its European monitoring role and verify if claimed savings match actual energy statistics. It should take actions in case there is a mismatch and claims of efficiency measures are inflated. To do so, the Commission should also improve EU statistics, by better including renewable heating and cooling.

21. Would it be appropriate and useful to design a system where energy efficiency obligations would also include elements aiming at gradually increasing the minimum share of renewable energy applicable to energy suppliers and distributors?

It would be important to allow and promote renewable energy measures that replace final end use of fossil energy to be counted as energy efficiency measures. Measures to switch fossil fuel heating and cooling fully or partially to renewable energy are particularly important in order to avoid a lock-in effect in fossil fuels use. In fact, in some Member States, the obligation scheme lead to the replacement of old oil and gas boilers by new oil and gas boilers without the integration of RES elements, such as solar thermal, thus effectively locking-in those options for decades to come. This would not in line with long-term EU decarbonisation goals up to 2050.

22. Could the option of establishing an EU wide 'white certificate' trading scheme be considered for post 2020?

A strong European market for white certificates issued in accordance to energy efficiency obligation schemes might trigger much-needed investments and promote innovative business and financial models. However, caution is needed so that it would not be possible to fulfil obligations only with foreign certificates, as it would create imbalances among Member States markets. Moreover, white certificates markets should be linked to accountable CO_2 reduction, so that measures certified are really translated in increased decarbonisation of the energy system.

2.6. Solar Thermal and the Renewable Energy Directive

This section illustrates Solar Heat Europe contribution submitted to the Commission public consultation on the review of the Renewable Energy Directive. It is structured around a selection of the most relevant questions asked by the Commission in its consultation document.

1. **To what extent has the RED been successful in helping to achieve the EU energy and climate change objectives?**

The RED had an overall positive effect on the development of RES in Europe, and has therefore been successful in helping to achieve the EU energy and climate change objectives. This is mostly due to the national binding targets, which ensured medium term stability for investors and fostered the right legislative framework in which a number of support schemes in all Member States could come into place. However, the effects of the RED have not been consistent across time and across different sectors. At first, following the adoption of the RED in 2009, the development of renewables was impressive. Afterwards, as support dwindled, there was a dramatic slowdown in renewable energy investments with a lower uptake of renewable technologies. In the last couple of years, a positive trend for RES has been detected once again in many Member States, however this time it appears to be mostly related to RES-electricity. Renewable heating and cooling appear to have been left behind in this development, despite its tremendous potential to decarbonize what represents almost half of Europe's energy consumption.

In the 2015RES Progress Report, the Commission mentions that the EU Member States are on track to reach the 2020 targets. However, projections for 2020 show a different scenario with targets not being reached. The results are quite different per country, sector and per technology.

The projections per technology show that, for several technologies, the indicative targets were not met in 2014 and risk not being met by 2020. Solar thermal is one of the most obvious cases where, if intentions are not met with concrete actions, the indicative 2020 targets for this technology will unfortunately be missed. While in 2012, the sector was 1.7% below the indicative target, in 2014 it is already -15.3% and the projections indicate that by 2020, the deviation from the target will be between -41.8% and -45.6%.

The indicative targets for solar thermal proposed by the Member States in the NREAPs were already modest in terms of ambition. A study on the Potential of Solar Thermal in Europe projected different scenarios: Business As Usual (BAU), Advanced Market Deployment (AMD) and a more ambitious one, Full R&D and Policy Scenario (RDP). Interestingly, the combination of national indicative targets for solar thermal in the NREAPS, published slightly later, were extremely close to the AMD scenario (see http://goo.gl/roqHPz). The current projection presented by the Commission indicates that Members States are on a 'path' that is below the BAU scenario.

Clearly, measures being taken by the Member States are not supporting the development of solar thermal as expected. It is obvious that, in general, MS are falling short on the implementation of the RED, in particular with regard to 'Administrative procedures, regulations and codes' or 'Information and training', on issues such as building regulations, adequate information and awareness raising initiatives at local and regional level or on the certification and qualification of installers.

Not meeting the indicative targets for solar thermal also implies a lost opportunity in terms of job creation. According to Solar Heat Europe calculations based on the above-mentioned study, if the indicative targets for solar thermal were achieved, this would represent an additional 56 000 jobs in the solar thermal sector in Europe by 2020, totaling 103 200. Furthermore, it would represent a saving of 9 billion euros in natural gas imports and avoid the release of 24 million tons CO2 into the atmosphere.

2. **What are the lessons from the RED (mandatory national targets, national plans, progress reports etc.)?**

The most important lesson from the Directive 2009/28/EC is clearly stated and acknowledged by the European Commission in its 2015 REFIT exercise. The mid-term evaluation of RED clearly concluded that binding provisions (e.g. national targets, NREAPs) have proven more effective than non-binding measures (e.g. administrative procedures, spatial planning).

In absence of binding national targets, the European Commission needs to define 2030 indicative renewable energy benchmarks per Member State which, aggregated, amount to at least 27%. This will provide an early indication of the required contribution per country. Member States should set their post-2020 renewable energy pledges and trajectories in their national energy and climate plans considering the indicative benchmarks and the need to collectively deliver at least 27%, and develop the enabling policy frameworks in line with the revised RED. If Member States deviate from their trajectories and a gap between the aggregated national commitments and the overall 27% target is identified, the European Commission must be able to propose corrective measures which, unheeded, would trigger infringement procedures, before resorting to EU level measures.

In view of the Paris agreement, the 2030 EU-wide renewable energy target should be seen as a bare minimum. The 2030 renewable target should factor in an increase in the energy efficiency ambition to ensure coherence between the EU climate and energy goals and international commitments. The European Commission should fully capitalise on its right of initiative and propose ambitious mechanisms that incentivise Member States to pledge higher than 27%.

The revised RED should build upon the current acquis to capitalise on success achieved and ensure a seamless transition to the 2030 regime. There is no need to radically alter the RED structure: continuity, with some specifically targeted improvements, should be privileged over abrupt changes. For instance, well-established articles (Article 2 'Definitions', Article 5 'Methodology to calculate the share of renewables') should remain unchanged, with the exception of including renewable cooling in Article 5. Moreover, the new RED should be transposed in national legislation by end 2020 to avoid a legal vacuum in the post-2020 period and provide investor certainty.

The revised RED should furthermore focus on improving the implementation of existing legislation and bridging regulatory gaps. Existing provisions should be reinforced through binding measures (e.g. building codes) to ensure predictability for investors. The European Commission should ensure that the post-2020 sectorial legislation for renewable energy, energy efficiency, energy performance of buildings and state aid are coherent.

3. **What are the lessons from the RED (mandatory national targets, national plans, progress reports etc.)?**

In absence of a real level-playing field in the energy sector, support schemes are still needed to compensate RES from the market imbalances created by fossil fuels subsidies. This is particularly true for renewable heating and cooling, which faces competition in a mostly ETS-free sector such as small scale heating and cooling installations, which are mostly based on subsidy-intensive, carbon-based fuels.

In consideration of the large share of European energy consumption represented by heating and cooling, strong support schemes should be created or maintained by Member States, in order to promote deployment of renewable heating and cooling technologies such as solar thermal.

Being heating and cooling a mostly decentralized sector, such support schemes should act as close as possible to the local level in order to fully succeed. The appropriate geographical scope of support schemes is therefore the closest possible to final consumers. The Commission should explore the possibility to promote regional (NUTS-2) level support schemes, rather than macro-regional or EU-wide schemes, which would be farthest away from final consumers at local level, and their real needs.

4. **What kind of complementary EU measures would be most important to ensure that the EU and its Member States collectively achieve the binding at least 27% EU renewable energy target by 2030:**

Measures to prevent gaps between the collective obligation of the EU and Member States' plans (gap-avoiders) and instruments to fill such gaps (gap-filling instruments) should be agreed in advance and enshrined in the revised RED.

Gap-avoiders, the impact of which should be modelled in the revised RED Impact Assessment, should focus on removing existing barriers to the deployment of RES, be it market, technological or societal barriers. The first step of a gap-avoiding mechanism is ensuring a proper implementation of the already existing measures in the current RED (ex. Art. 13, 14), and making sure the 2020 targets are delivered on time. A gap-avoiding tool should therefore be a combination of different elements, promoting better implementation, reinforcing existing measures and adding new ones in order to remove existing barriers. These measures could include:

- Reinforced measures on information and training, awareness raising, urban planning, simplification of authorization procedures at local level.

- Target EU financing tools to lower capital costs and investment risks, to better connect existing and available finance with local, decentralised RES projects. Synergies must be explored with other sectors, such as energy efficiency, together with RES, particularly in heating and cooling in the building sector. The incoming Smart Financing for Smart Building Initiative should develop such synergies, promoting RES and energy efficiency in combination.

- Improved role of renewables in energy efficiency obligation schemes under the revised EED, including solar ordinances.

- Mandatory minimum shares of renewables in new buildings, and other measures to increase renewable heating and cooling consumption in existing buildings and industry;

- Conditionality in the allocation of existing EU funds and adapting public deficit accounting rules (exemptions for investments in RES).

The above mentioned measures should ensure that MS are collectively delivering the 27% EU binding target, in addition to the volumes which have to be deployed under the 2020 legally binding national targets. The identification of a potential gap in the post-2020 period could therefore only relate to these additional volumes.

The gap-filling instrument should be triggered as a measure of last resort but its design should be clear as of 2020. The post-2020 RED should outline the concrete circumstances under which a gap-filling instrument will be activated.

It should be composed of different mechanisms, covering both large scale RES installations and decentralised, small-scale systems. Therefore, 'EU-level incentives such as EU-level or regional auctioning of RES capacities' is important, but must be completed with other mechanisms promoting the same results also for small scale, local RES technologies. Such mechanisms should promote the aggregation of small, similar projects, facilitate access to existing financing at a lower cost for small players in the market, and disseminate 'off-the-shelf' turnkey products, improving their bankability.

If gap-filling measures would be needed to achieve 2030, then there will be a clear case for trying to attract private capital, as public money and EU funds alone won't probably be enough to meet this challenge. Such a large amount of resources can only be raised by activating the local, decentralised level. Rather than focusing on a few number of large RES projects worth millions each, the Commission should aim at promoting smaller investments by millions of consumers, all switching to RES solutions at local level.

5. **The Energy Union Framework Strategy sets the ambition of making the European Union the global "number one in renewables". What legislative and non-legislative measures could be introduced to**

make/strengthen the EU as the number one in renewables? Has the RED been effective and efficient in improving renewable energy industrial development and EU competitiveness in this sector?

Since solar thermal is mostly a decentralized energy source, nearly half the investments in the sector are allocated to the lower end of the value chain. This means that, even when collectors are not produced locally, the installation is done by local companies. This has an important impact on the local economy and thus contributes to local job creation. Local added value is self-evident when analysing the breakdown of the purchase price of a solar thermal system: on average, installation covers from 40 to 60% of the final costs. The local dimension of the solar thermal sector is a major positive externality and a key success factor for the industry. It gives the opportunity to adapt to different demands in a flexible and timely way, while providing benefits to local economies. Nonetheless, this potential for job creation is being squandered. While globally the number of jobs in the renewable sector is growing 10 to 20% a year, in Europe the scenario is very different, with a lower growth or even a decrease observed in 2014.

For a European renewable energy industrial development, there is the need to put more focus on the RES sectors where the value chain is mostly located in the EU, and where benefits are mostly kept at local level. The European renewable heating and cooling sector is such an example. Better promoting it would not only increase decarbonisation and energy security for Europe, it would also reinforce its industrial basis.

6. **How would you rate the importance of the barriers for consumers to produce and self-consume their own renewable energy?**

Today, the vast majority of energy self-consumption in Europe is for heat. However, this is generally achieved through intensively carbon-based heating technologies, such as individual gas boilers. Therefore, self-consumption should not only look at electricity generation. Heat production should be considered as a key part of the self-consumption debate, as heat is by far the most used form of energy in European households. Most of the existing heating systems are generating heat locally, either for water or space heating. Hence, self-consumption of heat is not only existing today, it is the most relevant form of heat supply to energy consumers in EU. Empowering consumers by promoting self-consumption should be done by looking at what is most relevant for ordinary citizens: in the vast majority of EU countries, heating and cooling costs exceed by far power bills.

Moreover, it is important to consider that the advantages of self-consumption of electricity in buildings, should be measured over a monthly/seasonal basis, reflecting the energy supply and demand, as well as the energy conversion efficiency, for that month/season. Using a yearly average is misleading and may generate imbalances in the power system.

Therefore, the listed barriers related to RES electricity are not the most important ones for consumers to produce and self-consume their own renewable energy, as the energy that should be addressed is mostly heat instead.

The complexity and length of administrative procedures is indeed a very relevant barrier for renewable energy self-consumption. The situation varies greatly across different countries and regions. The Commission should therefore circulate and promote administrative best practices, foster exchanges and capacity building at local level, encourage Member States to adopt one-stop-shop solutions and fixed and transparent timeframes for procedures approval.

Similarly, lack of smart metering systems deployment among consumers, in particular for heat, is a crucial barrier. The absence of precise information on heat consumption leads to un-informed consumers, who would be then less inclined to take decisions to switch their heating system to renewable heating solutions such as solar thermal. Users should be encouraged to use smart heat metering and save energy by making a considerable share of the costs to be billed dependent on the user's level of consumption. The Commission should better promote smart heat metering in a harmonised way across EED, EPBD and RED. Developments in smart heat metering technology such as better sensors and controls and even on the 'Internet of Things' are already providing more options. Moreover, promoting a more competitive and mass market for smart heat metering would gradually drive prices down.

Storage is a crucial issue for RES. Thermal storage is already competitive and effective today. Solar thermal systems have a consolidated and established practice of working in integration with storage tanks and their system competitiveness is reinforced by adding adequate thermal storage. Moreover, thermal storage is usually included in solar thermal systems prices, which is not the case in most other RES technologies. The average thermal storage for solar thermal (200-300 liters) is not cumbersome and is easy to integrate in architectural elements. It is however between our reach to have even better thermal storage systems in a relatively short time, further reducing the size and shifting to more compact storage at even lower prices, provided that sufficient R&D investment is put into it.

7. **Has the RED been effective and efficient in helping exploiting the renewable energy potential at local level?**

The RED has set a positive general framework for the development of RES, including at local level, mostly thanks to national binding targets. However, most of the potential of renewable energy at local level remains still untapped. This is particularly true for the heating and cooling sector where, since the entering into force of the RED, renewables penetration has been slower than in the power sector. This is even more alarming, since the heating and cooling sector is mostly consisting of decentralised, local level or even individual systems. In Europe there are approximately 120 million heating boilers, at least 80% of which are estimated to be too old and inefficient. There is a huge potential in Europe to gain from converting our boiler fleet to more efficient and renewable technologies such as solar thermal systems in combination with modern condensing boilers, or in combination with other renewable heating and cooling technologies. This represents an effective solution that could reduce our gas consumption in a relatively short amount of time.

The change in the energy system and in particular in heating and cooling needs to be done at decentralised level, mostly in private homes, companies and institutions. The change can only be done if consumers are engaged and empowered. The empowerment of consumers must be a transversal basis for an integrated approach to the heating sector. There is no policy, no regulating framework, no financing measure that can properly work without citizens' involvement and consumers' empowerment.

The new RED should include measures to engage with local authorities in order to promote the deployment of renewables at the decentralized level. Local authorities can contribute actively to the deployment of renewable heating and cooling, by creating positive and stable frameworks in which those technologies can flourish. Several actions can be taken at the local level, from the simplification of the authorisation procedures, to the promotion of ESCOs specialized on energy contracts combining energy efficiency measures and renewable energy options, to the mandatory integration of renewable heating and cooling solutions in public buildings.

Solar ordinances are a very effective way to promote renewable technologies, while also contributing to job creation, urban health improvements, energy security, and SMEs growth. See more at http://www.Solar Heat Europe.org/policies/solar_ordinances/

The new RED, in combination with other relevant legislation (EED, EPBD) should help local authorities in adopting a comprehensive approach to urban planning including decarbonisation of the heating and cooling supply measures, in order to maximise active and passive solar gains, and allow the deployment of solar thermal solutions that require appropriate areas for collectors and storage.

8. **How would you rate the importance of the barriers that may be specifically hampering the further deployment of renewable energy projects at the local level (municipalities and energy cooperatives):**

An important barrier for the development of RES projects at local level is represented by accounting rules for local authorities. The Commission should review Eurostat and EU public accounting and finance rules, in order to promote energy efficiency and renewable heating and cooling investments, granting special status to energy and climate-related investments. Those investments should be to a certain extent exempted from public expenditure thresholds, moreover it should be allowed to spread them on several budgetary years and not be compulsory to concentrate the total expenditure on one budgetary year. Local authorities should therefore be allowed to undergo ESCOs contracts for energy efficiency and renewable energy that would effectively bring them a positive return (not only economic) on the medium-long term, without having the budget and debt procedures constrains that are preventing them to do so in many cases around Europe.

A second barrier consists in the lack of knowledge in the financial community of the benefits, long term gains and reliability of RES technologies. The Commission should promote training and information in this sector, together with best practices sharing and collecting data on projects in order to familiarize financial institutions with renewable projects at local level.

An additional barrier is represented by the lock-in effect of one-sided projects only covering energy efficiency measures at local level. Such an approach might indeed lock-in a specific technology, hampering the development of renewable energy for decades. A combined approach is important particularly for heating and cooling in the building sector, as renewable heating and cooling and energy efficiency measures face similar barriers, and are complementary in terms of benefits, thus must be implemented at the same time.

Integrated solutions, combining energy efficiency measures and renewable heating and cooling, should be promoted and deployed as off-the-shelf packages, which should be easier to get financed. Best practices and data from such solutions should be disclosed, in order to promote knowledge of their bankability in the financial community. The new RED should, in this regard, build a bridge with the EED revision proposal to create a Smart Financing for Smart Buildings Instrument, in order to make sure that it takes into account both energy efficiency and renewable projects in the building sector. They should be addressed both at the same time in the planning and financing of projects at local level.

On public perception, the whole RES sector has been suffering from negative perceptions, most of which derived from past mistakes in design and management of FiT schemes for RES-electricity. For renewable heating and cooling, there is yet not enough information and knowledge among consumers (see relevant deliverables of EU funded FROnT project: http://www.front-rhc.eu/), who often tend to confuse RES in different sectors. A proper information campaign, based on debunking myths and false perceptions, for renewable heating and cooling would definitely promote public perception of such technologies.

9. Please rate the importance of the barriers in hampering the deployment of renewable heating and cooling in the EU:

- Barriers for solar thermal can be economic and non-economic. Non-economic barriers vary significantly, and often economic incentives alone are not sufficient to tackle them. Non-economic barriers can be social and cultural, when they refer to the understanding or use of the technology; geographical, when they are related to supply or servicing bottlenecks; technical, when related to functionality or performance of the technology; political, when related to incentives or market access distortions; environmental, when related to resource supply and waste production.

- Economic barriers relate to costs and competitiveness of solar thermal, including installation costs, the costs of heat produced over the life-cycle of the system and the comparison with alternative fossil-based solutions. They are related to real and perceived costs of solar thermal, thus the pay-back time and upfront investment costs are crucial, as they impact consumers' choices and preferences. Economic barriers also include market distortions such as import tariffs and other taxes on equipment, regulated prices of gas and electricity, no carbon pricing in the heat sector (mostly outside ETS), lack of transparency and availability of prices and costs of heat technologies.

- The main causes behind the current difficulties for solar thermal include consumer preference for lower investment costs, rather than the actual energy cost. This is enhanced by the fact that existing equipment are mostly replaced with equivalent systems. Other factors are the low fossil fuel prices (subsidized in several cases) and competition from alternative RES solutions. Removal of several of the existing barriers depends on the intervention of public authorities, such as the limited awareness of the technologies, instability in support measures, and lack of regulations promoting the switch from fossil fuels to RES, or scarcity of qualified installers.

- Lack of information, awareness and knowledge in installers, consumers and local authorities is probably the most important barrier that can be met by policy measures. A mix of soft measures (information campaigns, training, capacity building, consumer-oriented tools, etc.) and regulatory measures (EPC, mandatory requirements for local authorities) must be put in place.

- Incoherence between different EU policies and legislation must be tackled. A harmonized approach towards supporting RES must exist across RED, EPBD and EED. A more general coherence is to be kept in all EU policies: for instance, the EU cannot promote the decarbonisation of heating and cooling, while at the same time promote large infrastructural investments for gas security of supply.

- Lack of physical space for solar thermal is not a major barrier today, but as soon as the technology will become mainstream, this barrier will significantly grow in importance.

- Lack of requirements in building codes is a barrier, although in many MS those are already in place and are producing positive effects. It is crucial that future legislation, in particular the implementation of NZEBs requirements, safeguards the RES building obligations already in place.

- Lack of tools to compare the lifecycle costs of the various alternative is an important barrier, however the ongoing EU funded FROnT project (http://www.front-rhc.eu/) is developing such tool.

- Underestimation of the RES potential in the H&C sector in EU modelling exercise for mid/long term projections. Assumptions of such exercise need to be revised (in particular, discount rates) and data collection need to be improved.

10. **Please rate the most effective means of addressing these barriers and advancing the decarbonisation of EU heating and cooling supply:**

The EU must adopt a comprehensive approach, building on the incoming EU Strategy on Heating and Cooling, to achieve a complete decarbonisation of H&C by 2050, taking into account the following principles:

- Renewable heating and cooling (RHC) must be promoted in all sectors: in new and in existing buildings, in large industries and SMEs, in the tertiary and the public sector. Wherever a H&C need arises, a RHC solution must be explored.

- The Commission must promote RHC in a coordinated manner across different legislation (EED, EPBD, RED) and avoid contradiction among different EU policies.

- The EU must determine the desirable future energy mix for H&C in order to decarbonise it and avoid stranded investments into carbon intensive infrastructure. This stable vision must be translated into policy measures continuity and predictability, in order to attract investors in the sector.

- The post-2020 RED must focus on tackling RHC market barriers. Implementation of measures must be decentralised, involving local actors and stakeholders.

- H&C is a decentralized sector. Solutions for its decarbonisation must come from a decentralized level too.

- Synergies must be explored between RHC and energy efficiency. They face similar barriers and have complementary benefits, thus must always be treated in combination.

- Start from the low-hanging fruits: the building sector and low temperature industrial segments can be rapidly converted to RHC supply.

And the following actions:

- The revised RED should maintain and reinforce flanking measures on installers, consumers and local authorities in art. 13 and 14 beyond 2020. MS must better implement certification schemes for RHC installers, and apply mutual recognition of qualifications.

- For new buildings or ones undergoing major renovations, minimum requirements in terms of primary energy in line with EPBD cost optimal methodology should be complemented with reinforced, binding minimum share of RHC. Such measures are already in place in several MS. Hence, the future RED should maintain and reinforce article 13.4 after 2020, ensuring consistency between RED and EPBD, and complementing NZEB concept.

- For existing buildings, a renovation strategy (in the EED) tackling the existing buildings stock, starting with the worst efficient ones, should be coupled with minimum requirements in terms of primary energy (following a cost-optimal approach established by the EPBD but taking into account age, climate, end-use etc), rather than setting a RHC obligation for existing buildings, which might not be understood by citizens. Such a provision would require building owners to plan renovation in advance as it happens for other types of works (e.g. elevators, etc.).

- Specific measures must be tailored for the industry, promoting demonstration projects, developing synergies between RHC and energy efficiency, enhancing RHC integration in industrial processes, fostering standardized solutions, and tackling the industry's needs for short payback periods and for accessible, low cost financing.

- Local authorities should include H&C decarbonisation in urban planning, maximizing active and passive solar gains, and making room for collectors and storage. Solar ordinances should be promoted among local authorities, and best practices disseminated.

- The Commission should improve its data collection system and its modelling, in order to better take into consideration RHC. An expert group on H&C could be set up, to provide expertise and advice to increase H&C competitiveness and energy security, while decarbonizing it.

The Real Costs of Solar Thermal

1. The real costs of solar thermal: A policy approach

Solar thermal technologies are usually referred to as sleeping giant, since their market potential is not yet unlocked, and their costs are often perceived as uncompetitive. Yet, solar thermal is already competitive today in many market segments, and can be cheaper than fossil fuel alternatives for some applications in some European regions.

There are two reasons, why people usually do not have a clear picture of the competitiveness of solar thermal energy[1]. Firstly, there is not 'one price' for solar thermal heat, since solar thermal systems vary greatly, reflecting different system types, qualities, and standards by the integration into the building[2]. Additionally, the yield of a solar thermal system depends on the insolation (solar radiation) intensity at the installation site, a solar thermal system in Southern Europe has the same energy yield than a system with a 50% larger collector area in Northern Europe. The prices for heat from fossil fuels and electricity vary a lot across Europe. Therefore, competitiveness must be calculated for each system type, for each installation, and in comparison with the specific heat costs of the alternative heat source.

Secondly, costs for solar thermal heat are usually incorrectly compared with today's prices for fossil fuels or electricity, as the two types of costs differ considerably. The investment costs plus the operating and maintenance costs during the lifetime of a system, e.g. 20 years, are taken into account to calculate solar heat costs, these are then divided by the solar heat generated during that period. These costs represent the average costs for solar heat per kWh over the entire lifetime. To achieve a fair comparison with costs for heat from fossil fuels or electricity, their average costs should be calculated over the next 20 years as well. Since oil and gas prices vary a lot, the costs comparison depends greatly on the assumption made for the energy price growth rate over the next 20 years, which is highly unpredictable. However, generally consumers do not calculate average fossil heat prices over 20 years, but are only aware of today's fossil heat prices. Therefore, they systematically underestimate the competitiveness of solar thermal energy, since there is a high probability that fossil and electricity energy prices will rise significantly.

The figure below shows typical ranges of solar heat costs for different solar thermal systems in different European regions, representing average heat costs over the lifetime of the systems of typically 20 years, compared with the costs for useful heat produced by natural gas and electricity in the year 2011[3]. Even though this is an unfavourable comparison for solar thermal,

1 The section below is an adaptation from Solar Heat Europe, RHC Technology Platform Strategic Research Priorities for Solar Thermal Technology.
2 E.g. it is much easier to install a compact thermosyphon system on a flat roof in Southern Europe than to install a collector on a pitched roof with the solar storage in the basement which is usually the case in Central and Northern Europe.
3 Range of solar thermal heat costs for various types of solar thermal systems in different European regions (average costs over lifetime), compared with the range of costs for useful heat. Useful

as average solar thermal energy costs over lifetime are compared with today's gas and electricity prices, solar thermal energy is already in some cases cheaper than heat from natural gas and is in most cases cheaper than heat from electricity. However, for combi-systems in central Europe, where the large solar thermal markets are located, solar thermal heat costs aresignificantly higher than the price for heat from natural gas, which is mainly used as an alternative. Since industry is usually expecting a short payback time for investments, competitiveness of solar thermal process heat is only given, if it is significantly cheaper than heat from fossil fuels which is usually not yet the case.

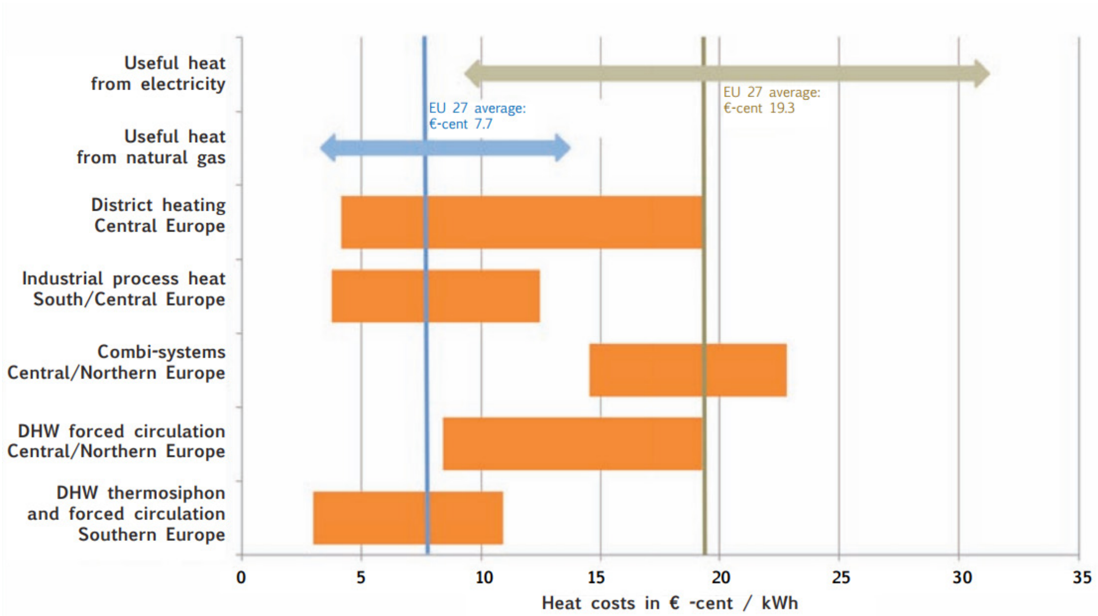


Figure 10.

Range of solar thermal heat costs for various types of solar thermal systems in different European regions (average costs over lifetime), compared with the range of costs for useful heat.

Source: ESTTP, Eurostat (for natural gas and electricity).

Solar thermal heat costs are mainly determined by the upfront investment consisting of: the solar collector, storage, plumbing, pumps, controller as well as other components, and the installation costs. The investment depends on the type and size of system used, varying from below 300 EUR per kWth for large-scale district heating systems up to 1700 EUR per kWth for a combi-system.

In addition, financing investment costs, operation and maintenance (O&M) costs over the lifetime of 20 years (15 years for low price thermosyphon systems) are taken into account by calculating the average solar thermal heat costs over the lifetime of the system. Based on these assumptions, the ranges of costs for solar thermal systems are as follows: between 3 and 11 Eurocents per kWh for small solar domestic hot water (DHW) thermosyphon systems in Southern Europe; between 5 and 10 Eurocents per kWh for larger solar forced circulation DHW systems in Southern Europe; between 8 and 19 Eurocents per kWh for small and collective solar DHW in Central and Northern Europe; between 14 and 13 Eurocents per kWh for solar combi systems for DHW and space heating in Central and Northern Europe; between 4 and 12 Eurocents per kWh for solar industrial process heat systems in Southern and central Europe; and between 4 and 19 Euro-

heat takes into account losses by converting natural gas and electricity into heat. The conversion efficiency of 85% for gas and 95% for electricity is assumed. Heat costs from natural gas and electricity are taken from 2011 and include VAT. Solar cooling systems are not included since cooling and heating prices are not comparable and a matured solar cooling market does not yet exist. However, cooling costs of about 45 Eurocent per kWh were achieved in solar cooling pilot plants and average costs for heating and cooling of about 20 Eurocent in combined heating and cooling pilot plants. *Source: ESTTP, Eurostat (for natural gas and electricity).*

cents per kWh for solar district heating systems both without storage and with very large seasonal storage[4].

The table below shows a range of prices for heat generated by a solar thermal system and the price projected for 2030[5].

Cost in €-cent per kwh				
	Today		2030	
	Central Europe	Southern Europe	Central Europe	Southern Europe
Solar thermal	7 - 16	5 - 12	3 – 6	2 - 4

Figure 11.

Solar Thermal Cost in €-cent per kwh

Source: Solar Heating and Cooling for a Sustainable Energy Future in Europe - Revised version ESTTP

The spread is wide, because the total costs vary strongly, depending on factors such as quality of products and installation, ease of installation, available solar radiation (latitude, number of sunny hours, orientation and tilting of the collectors), ambient temperature, and patterns of use determining the heat load.

An Ecofys study for the European Commission on Energy Subsidies and Costs in Europe[6] shows that the Levelised Cost of Heating and Cooling for solar thermal varies between €60 and €80/MWh (depending on climatic conditions). Therefore, solar thermal is competitive with similar heating technologies. External costs are estimated at 9€ per MWhth in the same study, among the lowest of the technologies analysed.

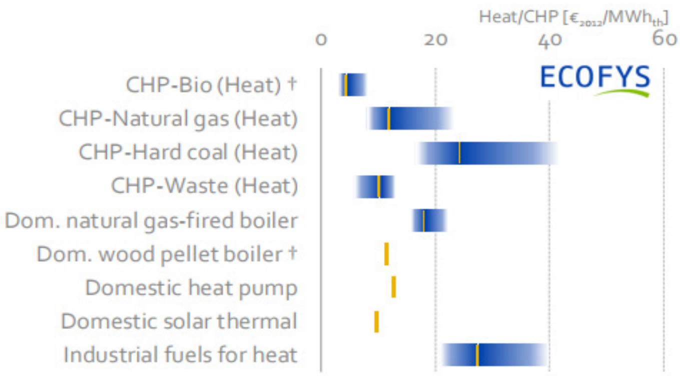


Figure 12

Range of external costs across different Member States per technology (in €2012/MWh).

The blue bars represent the range of values, the yellow line represents the weighted average.

Source: Subsidies and costs of EU energy by Ecofys - 2014

There are three main issues that combine to determine the competitiveness of a solar thermal collector system for domestic hot water in single family houses: the initial cost of the system, the maintenance cost, and the compared cost of alternative systems[7]. The initial cost of the system varies depends on the quality of the system and on the specific market, including labour costs, and geographic location. It can vary significantly from country to country (see Annex II). The cost of solar thermal systems is cheaper than natural gas and electricity heating and cooling in several European countries, namely in Southern Europe. While the costs of the energy pro-

4 The figures given are representing the costs for solar heat produced by the collector (at the collector outlet) including VAT.
5 The cost of heating equipment is not taken into account, as this is deemed to be a necessary back-up for a solar thermal system. To reduce the effect of outliers, the cheapest and the most expensive countries have not been taken into consideration. It should also be stated that larger customers, such as big business, are able to obtain lower prices and do not pay VAT. The costs of solar heat include all taxes, installation and maintenance.
6 Ecofys - Subsidies and costs of EU energy - Final report - 11 November 2014
7 See IRENA, Solar Heating and Cooling for Residential Applications, 2015.

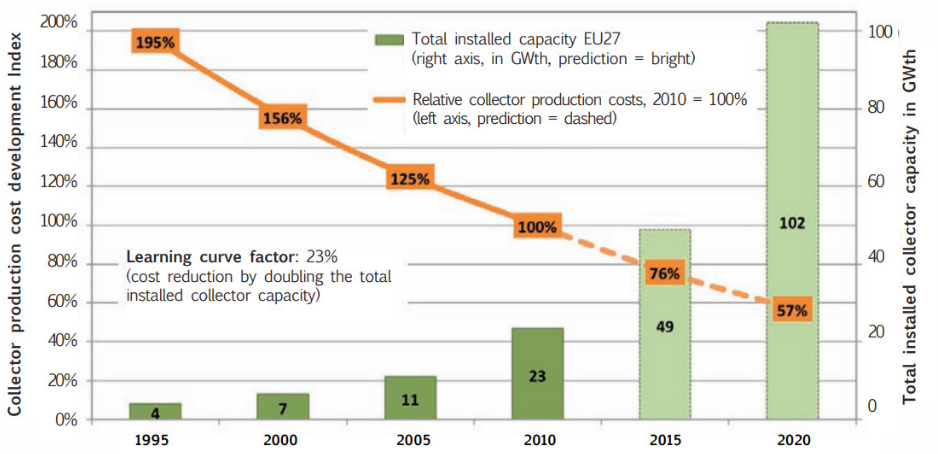
duced with solar thermal energy are competitive, these take mostly the form of upfront investment (as operation and maintenance costs are low and there aren't fuel costs). The learning curve for the solar thermal sector is estimated at 23% (see graph below[8]), meaning that per every doubling of the solar thermal market, prices go down 23%.

Figure 13.

Collector production costs development for high-efficient flat plate collector panel of about 2.2 to 2.5 m² gross collector area manufactured in Europe (Source: solrico & trenkner consulting).

Based on a learning factor of 23%, derived from these historical data, cost reduction projections are calculated up to 2020 based on market expectations of the National Renewable Energy Action Plans (NREAPs).

Source: Strategic Research Priorities for Solar Thermal Technology - European Technology Platform on Renewable Heating and Cooling



However, improved competitiveness is necessary for moving from early markets to mass markets[9]. Under positive boundary conditions, solar domestic hot water is often already cost-competitive with fossil-fuel based technologies, if considered over the lifetime of the solar system. Applications for space heating in multi-family houses are also close to competitiveness. These applications have the potential for short payback times. They are reliable, but their higher initial investment costs means they appear more expensive to potential purchasers when compared with conventional heating systems. However, this is not the case if costs are compared over a full life cycle.

Overall, cost competitiveness does not automatically lead to a mass market. In economic terms, this may be due to incorrect information about the perceived transaction costs. In practical terms, it may be due to inertia, lack of information, lack of financial resources and other priorities, or the effects of publicity. This means that cost competitiveness does not necessarily create a mass market for a product. However, it can be assumed that moving towards a mass market will be easier, as return on investment times become shorter.

By 2030, it is assumed that technological progress and economies of scale will lead to around a 60% reduction in costs. While important cost reductions in solar thermal can be achieved through R&D and economies of scale, the priority is to enable the large-scale use of solar thermal energy through the development to mass market of new applications, such as Active Solar Buildings, solar cooling, and Solar Heat for Industrial Processes.

8 Collector production costs development for high-efficient flat plate collector panel of about 2.2 to 2.5 m² gross collector area manufactured in Europe (Source: solrico & trenkner consulting). Cost reduction projections are calculated up to 2020 based on market expectations of the NREAPs.
9 This section is an adaptation of the ESTTP, Solar Heat Europe study on Solar Heating and Cooling for a Sustainable Energy Future in Europe.

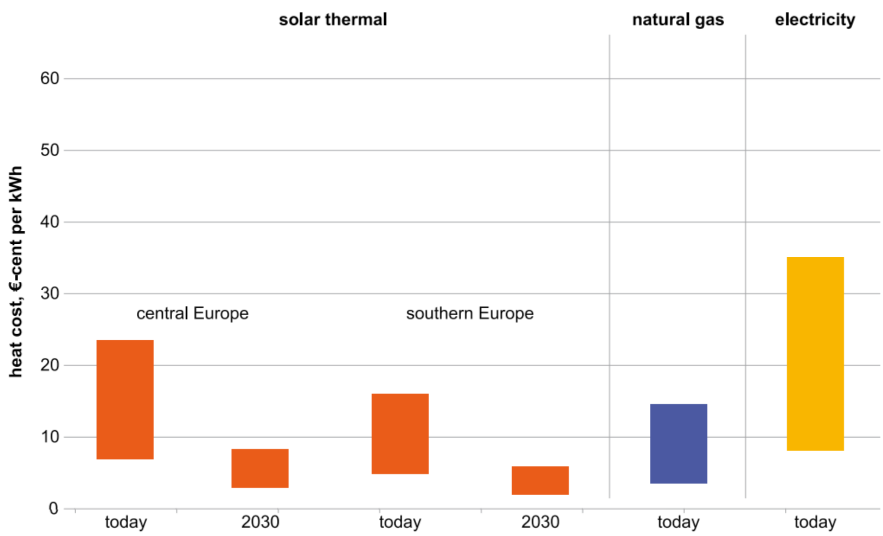


Figure 14.

Typical cost ranges of domestic water/space heating with solar thermal, gas and electricity (Source: ESTIF, 2008)

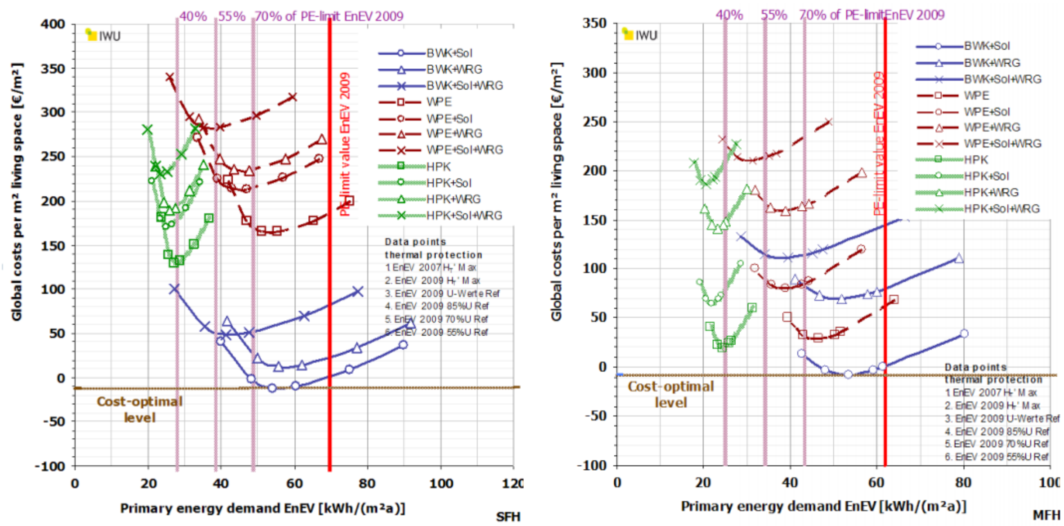
Combi-systems in particular have benefited from these cost reductions, and have increased their market share. Further RD&D investment can help to drive these costs down further. Cost reductions are expected to stem from direct building integration (façade and roof) of collectors, improved manufacturing processes, and new advanced materials, such as polymers for collectors. Furthermore, cost reduction potential can be seen in increasing productivity by the mass production of standardised (kit) systems, which reduce the need for on-site installation and maintenance works.
Advanced applications, such as solar cooling and air conditioning, industrial applications and desalination/water treatment, are in the early stages of development, with only a few hundred of first generation systems in operation. Considerable cost reductions can be achieved if R&D efforts are increased over the next few years.

The competitiveness of solar thermal systems is more obvious when the analysis is based on life cycle costs. In this respect the concept of cost optimality introduced by the EPBD is essential to identify the best solutions for reducing CO2 emissions in a cost effective way. Taking into account the requirements set in the EPBD, we can observe that solar thermal is part of cost-optimal solutions already today. Furthermore, with reduced loads in nZEB (nearly zero-energy buildings), the solar thermal yield can easily increase, improving its competitiveness.

Figure 15.

Global costs for SFH and MFH for all heat supply systems (baseline scenario, medium energy price development).

Source: BPIE, 2013



The figure above shows the global costs per living space square meter versus the primary energy demand for the single-family houses (SFH) and multi-family houses (MFH) for all heat supply systems, considering a medium energy price development scenario, in Germany, resulting from an independent study from the Building performance institute (BPIE), as an attempt to benchmark different energy efficiency measures using the EPBD Cost-optimality criteria[10].

In this study it is shown that solar heating systems are part of the cost-optimal solutions, both for SFH and MFH, combined with a condensing boiler within a package including also standard thermal insulation, attaining with a primary energy demand of approx. 53-54 kWh/m²a. Furthermore, we can also find other interesting options using solar thermal, in combination with pellets or heat pumps, with lower primary energy consumption.

It is important that Member States when performing the pre-assessment and cost optimality studies do include renewable heating solutions, and solar thermal, in particular in countries where such solutions might not be very present on the market today.

Relevant Sources on Solar Thermal Costs

Figure 16.

Source: IEA, Solar Heating and Cooling Technology Roadmap, 2012.

	Thermosiphon Southern EU	Forced circulation central EU	Forced circulation northern EU	Solar cooling	Large scale EU
Investment costs (USD/kW)	630	850-1 900	1 600-2 400	1 600-3 200	350-1 040
Collector yield (kWh/m²a)	685	395	360	395-685	685
Discount rate	3%-6%	3%-6%	3%-6%	3%-6%	3%-6%
Lifetime (yrs)	15	20	20	20	20
Operation and maintenance	0.5-1.5%	0.5-1.5%	0.5-1.5%	0.5-1.5%	0.5-1.5%

Note: Actual observed system prices can go beyond these ranges.

Table 2: Solar thermal system characteristics and costs for single-family dwellings, 2007

Figure 17.

Source: IEA, Energy-efficient Buildings: Heating and Cooling Equipment – Technology Roadmap, 2011.

	Single-family dwelling		
	OECD Europe	OECD North America	OECD Pacific
Typical size: water heating (kW_{th})	2.8-4.2	2.6-4.2	2.1-4.2
Typical size: combi systems (kW_{th})	8.4-10.5	8.4-10.5	7-10
Useful energy: water heating (GJ/system/year)	4.8-8	9.7-12.4	6.5-10.3
Useful energy: space and water heating (GJ/system/year)	16.1-18.5	19.8-29.2	17.2-24.5
Installed cost: new build (USD/kW_{th})	1 140-1 340	1 200-2 100	1 100-2 140
Installed cost: retrofit (USD/kW_{th})	1 530-1 730	1 530-2 100	1 300-2 200

Source: IEA Solar Heating and Cooling Implementing Agreement; ESTTP, 2007; Navigant Consulting, Ecodesign Hot Water Task 4; and NEDO, 2009.

10 Implementing the cost-optimal methodology in EU countries, BPIE 2013

Table 3: Solar thermal system characteristics and costs for multi-family dwellings, 2007

	Multi-family dwelling		
	OECD Europe	**OECD North America**	**OECD Pacific**
Typical size: water heating (kW_{th})	35	35	35
Typical size: combi systems (kW_{th})	70-130	70-105	70
Useful energy: water heating (GJ/system/year)	60-77	82-122	86
Useful energy: space and water heating (GJ/system/year)	134-230	165-365	172
Installed cost: new build (USD/kW_{th})	950-1 050	950-1 050	1 100-1 850
Installed cost: retrofit (USD/kW_{th})	1 140-1 340	1 140-1 340	1 850-2 050

Figure 18.

Source: IEA, Energy-efficient Buildings: Heating and Cooling Equipment – Technology Roadmap, 2011.

Costs	**Typical current international values and ranges**						
Typical Breakdown Heating (US)	Collector: 51% Storage: 11% BoS Costs: 38%						
Typical Breakdown Cooling (Greece)	Solar loop: 37%; Storage: 8%; Thermal chiller (100 kW): 29%; Heat rejection loop: 7%; Services: 18%						
System	**Thermo-syphon direct**					**Thermo-syphon indirect**	
Country/Region	**Australia**	**China**	**India[b]**	**South Africa**	**Turkey**	**Southern Europe**	**US[c]**
Investment costs[a], USD/kW	1100	100-250	130-180	630-650	130	630	2 300
Collector yield, kWh/m^2a	850	770-860	850	900-1000	770-900	685	550-700
Collector size, m^2	3.5	4	2-4	2.5-4	4	2.5-4	6

Costs	**Typical current international values and ranges**				
System	**Pumped Indirect**			**Pumped Direct**	
Country/Region	**US[c]**	**Central Europe**	**North Europe**	**US[c]**	**South Africa[d]**
Investment costs[a], USD/kW	2 300	850-1900	1600-2 400	1700	760-820
Collector yield, kWh/m^2a	550-700	395	360	550-700	900-1 000
Collector size, m^2	6	4-6	4-6	6	2.5-4

Figure 17.

Source: IRENA, Solar Heating and Cooling for Residential Applications - Technology Brief, 2015.

Figure 18.

Source: IRENA, Solar Heating and Cooling for Residential Applications - Technology Brief, 2015.

Table 1: Investment costs of STS in different regions.

	Country/ Region	Investment costs[a] (USD/kW)	Collector yield (kWh/m^2a)	Collector size (m^2)
Thermo-syphon direct	Australia	1100	850	3.5
	China	100-250	770-860	4
	India[b]	130-180	850	2-4
	South Africa	630-650	900-1000	2.5-4
	Turkey	130	770-900	4
Thermo-syphon indirect	US[c]	2 300	550-700	
Pumped direct	US[c]	1700	550-700	
	South Africa[d]	760-820	900-1000	2.5-4
Pumped indirect	US[c]	2 300	550-700	6
	Central Europe	850-1900	395	
	North Europe	1600-2 400	360	4-6
ICS collector	USA[e]	450-800	700	3-4.5
Solar CS[f]	China	980-1400	580	12
	Germany	1800-	530-622	12
STS district heat	Denmark[g]	350-400	450-480	10 000

a without subsidies
b ETC are supposed to be 1/3 cheaper than FPC (Epp, 2013c), exchange rate 1 INR = 0.01661 USD, June '11.
c NREL, 2012
d Exchange rate 1 ZAR = 0.1 USD, June '14
e DoE, 2012
f Personal communication with manufacturers
g IEA, 2012

Support schemes for Solar Thermal Trends in Europe

1. Section's introduction

This section aims at analysing the recent trends and evolution of support schemes covering solar thermal heating and cooling technology in Europe. It shows that after several years of incentives downsizing following the economic crisis (broadly, from 2011 to 2014), the tide is now slowly turning and many European countries are now rethinking their strategies when it comes to supporting solar thermal. The potential of this technology to meet countries' energy and climate 2020 targets is being more and more recognised, and actions are being taken to help the recovery of a still too stagnating market.

The European solar heating and cooling market has been suffering from the contraction of sales in most part of the European markets in recent years. There are several factors behind this under-performance, such as the low gas prices, difficult access to finance for consumers, slow-moving construction sector, less public support schemes for solar thermal and competition from other energy sources, namely those with more attractive market incentives.

While worldwide IRENA stated that "In 2014, solar thermal had the largest total installed capacity of all non-hydro renewable technologies, slightly more than wind and more than two times greater than PV"[1], in Europe solar thermal is far from delivering its real potential in terms of growth, jobs and decarbonisation. Despite this growth below potential, solar heating and cooling still plays an important role in the European energy strategy, allowing for decentralised solutions to meet the heating and cooling demand in Europe, replacing the dependency on imported fossil fuels and creating local jobs. The 31.8 GWth in operation generate an estimated 24 TWhth of solar thermal energy while contributing to a saving of 2.75 Mt CO_2. In terms of economic significance, the solar thermal sector reached a combined turnover of 2 billion euros in 2014, directly employing 25 000 people.

2016 has been a key year for the renewable energy and solar thermal sector. After the COP21 in Paris in December, 2016 has been repeatedly called by EU officials the 'year of delivery', as major legislation underpinning the sector will be reviewed and enhanced. Renewable heating and cooling has benefited from a particular focus, as a result of increased attention from policy-makers on the share of heating and cooling in Europe's final energy consumption. The publication of the European Commission's Heat Strategy in February has been a key policy momentum for the renewable heat-

1 IRENA - Quality Infrastructure for Renewable Energy Technologies Solar Water Heaters - 2015

ing and the solar thermal sector, giving a clear signal to European governments, the markets, and industry.

Many Member States are reacting to this new trend, and are recognising the need to better support renewables in the heating and cooling sector, in order to achieve their 2020 energy and climate targets. Some countries have enlarged the scope of pre-existing support schemes, or increased the available funding, others have created new ones where none were existing.

Solar thermal has an important potential in all EU Member States, and across different sectors, from the building to the industrial process heat[2]. This technology is already available, established and competitive in many segments across Europe, and it would be even more competitive if a level-playing field in the European heating and cooling sector were to exist. Solar thermal must compete with heavily subsidised traditional sources of energy[3], which negative externalities are not captured in their prices. Until a level-playing field is not in place, support schemes will be needed in order to compensate solar thermal for the imbalances in the market, and to allow the technology to reach a maturity level sufficient to trigger further cost-reductions and deployment on a large scale.

This section summarises the main recent evolutions and changes in support schemes in selected Member States across Europe, using established sources such as the IEA-SHC country reports, the RES-Legal portal of the EU[4], the SolarThermalWorld database of incentives[5], Eur'Observer Policy and Statistics Reports[6], national energy agencies' web-portals, and Solar Heat Europe's own data and reports. The countries analysed are those in which a change in the policy regime and support schemes for solar thermal took place in the period 2014-2016.

2 Solar Heat Europe - Potential of Solar Thermal in Europe
3 European Commission - Energy prices and costs in Europe - 2014
4 RES-legal website
5 SolarThermalWorld database of incentives
6 Eur'Observer Policy and Statistics Reports website page

2. European Union Framework

2015-2016 have been key years for the recognition of the importance of decarbonising the heating & cooling sector at EU level. In February 2015, EU Energy Commissioner Cañete announced, during the conference 'Heating and cooling in the European energy transition'[1], the intention to publish a Strategy on the heating and cooling sector. The European Commission officially planned the publication of the Strategy in its Roadmap for the Energy Union[2], as part of its Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy.

Later on, the Commission engaged in a series of stakeholders consultation events, in order to gather feedbacks and inputs from the industry, consumers and environmental associations across Europe. Solar Heat Europe participated actively to this consultation process, and elaborated a position paper on the Strategy (see dedicated section in this publication).

The EU Strategy on Heating and Cooling is the result of an increasing positive attention the EU institutions have been giving to the Heating and Cooling (H&C) sector, and is a fundamental step in the recognition of its key role in the overall EU climate and energy objectives. The Strategy has therefore the potential to lay solid and long-lasting foundations for the European H&C sector, and must be considered a milestone for future policy interventions in the sector.

The Strategy, delivered in February 2016, aims at the decarbonisation of the heating and cooling sector, focusing on the buildings and industry sectors. Energy efficiency and renewables are recognised as major players in this decarbonisation path. Moreover, Member States are recommended to focus their incentives on non-fossil fuel based heating and cooling technologies.

In June 2015, the Commission released its Renewable Energy Progress Report[3], assessing Member States progress in achieving the 2020 RES targets. It shows mixed results for the heating and cooling sector, and in particular, it showed that Member States are severely lagging behind in achieving their targets for solar thermal.

During the course of 2016, all major EU legislation underpinning the renewable energy sector (RES-Directive, Energy Efficiency Directive, and Energy Performance of Buildings Directive) is being reviewed. After the Commission proposals, in late 2016, debates in the EU Parliament and Council are underway for 2017.

1 Heating and cooling in the European energy transition: conference
2 European Commission - Energy Union package - Roadmap for the Energy Union - A framework Strateg for a Resilient Energy Union with a Forward-Looking Climate Change Policy
3 European Commission - Renewable energy progress report

The European Commission is consulting the sectorial stakeholders in this legislation review process. The accompanying document of the RES-Directive consultation shows in particular that the Commission is willing to increase support measures for the renewable heating and cooling sector:

'more targeted measures could be considered to further increase renewables deployment in the heating and cooling sector, building on and interacting with energy efficiency and security of energy supply legislation. A comprehensive approach could be developed targeting buildings, individual energy use for heating and cooling, and the share of renewable energy in district heating and CHP units. Efficient ways need to be found to stimulate switching from fossil fuels to renewable heating and cooling and hot water generation in the large number of EU homes with individual heating equipment [..]Measures will also need to encourage a shift in consumer behaviour, perhaps through better information about renewable energy alternatives from heating equipment suppliers and installers'

The Commission also wants to identify barriers hampering the deployment of renewable heating and cooling in the EU, and will propose measures to tackle them.

This legislation review process is giving a clear indication to Member States on the direction the EU as a whole, and each country accordingly, should embrace when it comes to the decarbonisation of the heating and cooling sector. It is therefore expected that the new legislative proposals issued during 2016 will reinforce EU support for renewables in the heating and cooling sector.

3. Analysis of selected European countries

Germany

Key elements

- Market stagnating up to 2015. Some improvements since.
- Main support scheme (MAP) increased in scope and budget in April 2015.
- Incentive based on performance introduced

Solar Heat Europe's Market Statistics

The support for solar combi-systems for hot water and space heating, which remained unchanged until March 2015, proved not to be sufficient to stimulate the market. The new support scheme of up to 50 % of the investment costs for solar process heat applications, introduced in August 2012, has so far only resulted in around 200 new installations for systems with an average size of 44 m^2. [..]

The focus on electricity by the "Energiewende" is gradually diminishing since the energy transition and climate protection goals cannot be reached with the electricity sector on its own, although this is only dawning on decision makers. The support scheme (market incentive programme MAP) as well as the building obligation have provided insufficient incentives for new investments. Marketing of the MAP support scheme has been poor and consumers might not be aware of its existence. In addition, consumers tend to install only the minimum required number of m^2 of collectors to receive the subsidy.

In the first months of 2015 the market has deteriorated, although since 1 April a drastically improved MAP offers some hope for improvements in the market. Higher support per m2 and inclusion of solar water heaters make investments far more attractive than before. Moreover, policy makers seem to realize that Germany may not reach its 2020 EU goals for renewable energy consumption (18 %).

From IEA-SHC

Besides the environmental awareness of the population the main market drivers in Germany are the European and national building regulations for nearly zero emission buildings in 2020. In Germany this is being achieved through regulation with the Energy Savings Regulation (EnEV) to reduce energy consumption and the Renewable Energies Heat Act (EEWärmeG) to use renewable energy.

The most important support for solar thermal systems is the German Market Incentive Programme (MAP) for renewable heat. The funding depends on solar yield and quality assurance (Solar keymark). Since the middle of August 2012, the funding rates increased for solar thermal systems, especially for solar process heat and solar district heating.

From SolarThermalWorld.org

On 1 April 2015, the German Federal Ministry for Economic Affairs and Energy, BMWi, increased the subsidies for renewable heating systems – solar thermal, biomass boilers and heat pumps – within the German Market Rebate Programme for Renewable Energies, MAP. The main reason for taking this step was that political targets have not been achieved [..]. The MAP amendment is needed to achieve the ambitious 2020 target of 14 % set forth in the Renewable Energy Heat Act[..].

The following list shows the adjustments which were made to the basic subsidy scheme and are relevant to existing buildings. All subsidies will be paid based on gross collector area.

Domestic hot water systems will again be subsidised with 50 EUR/m^2, capped at 500 EUR per system (at least 3 m^2 and 200 litres).

The subsidy level for combi systems of hot water and space heating of up to 14 m^2 will increase from EUR 1,500 to 2,000.

All other applications, such as combi systems above 14 m^2, process heat and solar cooling, will receive higher specific subsidies of 140 EUR/m^2, up from 90 EUR/m^2.

The most important changes were implemented for subsidising innovative designs. So far, this kind of subsidy was restricted to solar thermal installations with a collector area of between 20 and 40 m^2, whereas it will now cover systems from 20 to 100 m^2. There will also be new building types eligible for the innovative design subsidy: Besides the already approved multi-family houses with three flats or more and the non-residential buildings with a minimum floor space of 500 m^2, the subsidy for innovative designs has been extended to include single- and two-family homes as well, as long as their share in solar heat is above 50 %. [..]The three new building types will profit from the following subsidy levels:

Solar systems in new builds will receive funding again – 75 EUR/m^2 for domestic hot water and 150 EUR/m^2 for all other applications (combi, cooling, process heat).

The subsidy level for domestic hot water will increase from 90 to 100 EUR/m^2.

The subsidy level for all other applications (combi, cooling, process heat) will go up from EUR 180 to 200.

BMWi introduced a performance-based incentive for solar heat
In addition to the existing grants subsidising innovative designs per square

metre, the BMWi introduced a performance-based incentive to follow up on a request important to the solar thermal industry. Owners of installations of between 20 and 100 m^2 which meet the criteria of innovative design can apply for a subsidy of 45 Ct/kWh per year, based on the additional table of the Solar Keymark certificates, which includes the annual collector unit output for different solar radiation sites in Europe. [..]

The amendment of the national subsidy scheme has been welcomed by all renewable associations in Germany [..]. According the national 2015 budget, the total funds available for the MAP, including the clearing house for the feed-in tariff, add up to EUR 254 million, which is double as much as was spent last year.

France

Key elements:

- Market stagnating up to 2015. Some improvements since.
- Main scheme (Fonds de Chaleur) to double its budget up to 2017
- New scheme for large solar thermal systems introduced in 2015

Solar Heat Europe Market Statistics:

2014 proved to be yet another difficult year. The overall installed area of solar thermal collectors fell by 21% from 190 900 m^2 (133.6 MWth) to 150 500 m^2 (105.4 MWth). In the residential market, domestic solar water heaters took an 18% drop in terms of collector area (-15 000 m^2).

However, the number of units installed decreased less dramatically (-9%); this is because the average collector area per unit installed has been falling over recent years as new technologies have been developing. The market of "combined" solar water and space heaters contracted strongly both in terms of units (-36%) and area (-30%).

Non-domestic sales were also down by 22.6% with a total solar thermal collector area amounting to 75 500 m^2 (53 MWth). Expected changes in the current regulation for thermal requirements in new buildings were not implemented in 2015 as planned, it is therefore to be expected that the French solar thermal market will also be suffering in the coming months, although an action plan has been put together by Enerplan to enhance consumer trust and help with market structuring over the next three years.

From IEA-SHC:

Solar thermal systems for the existing building stock are subsidised either with a tax credit (for individual installations) or with subsidies (for collective systems). Building regulations for new buildings impose more or less a choice for renewable hot water supply.

Given the high cost of solar thermal in France, combined with low electricity prices, solar thermal systems are facing fierce competition from thermodynamic water heater systems. The latter are also perceived as easier to install.

The current French energy policy dates from 2007 ("Grenelle law"). A new law (Energy Transition for Green Growth) has been adopted by parliament in May 2015 [..]. One of its objectives is that renewables should represent 32% of final energy consumption by 2030.

Today, solar thermal is supported by the Government through financial incentives. Two types of financial support exist. One type of support for individual solar thermal systems and another for collective solar thermal systems (see below).

Tax credit

This financial measure is a tax credit for homeowners and is not an actual reduction of the tax. Therefore, people who do not pay taxes can still receive a payment. The tax credit has been revised and harmonised and is at 15-25% of eligible costs for 2014, depending on the family income and the number of energy related projects undertaken.
Renewable heat fund "Fonds chaleur"

The Heat Fund subsidizes projects for collective hot water systems in the collective housing sector, the tertiary sector and the agriculture and industry sector. The subsidy level should allow the costs of the exploitation of solar systems to be slightly below those of "classic systems". With the RT 2012 regulation now well in place, only projects for existing buildings are eligible to the Heat Fund. Furthermore, a minimum surface of 25 m^2 of collectors is required for a project to be eligible.

From SolarThermalWorld.org

The French energy agency Ademe has been supporting renewable heat production in the industry, the district heating sector and at multi-family buildings since 2009. The budget of the national subsidy scheme, Fonds Chaleur (Heat Fund), will double in amount from around EUR 240 million per year to EUR 420 million in 2017. During 2009 to 2014, solar installations accounted for as little as 6 % of Fonds Chaleur's EUR 1.2 billion (see the attached report). Despite the high subsidy amount, the number of solar thermal applications is declining, as is the French solar market in general. Ademe is trying to counter the negative trend by offering new incentive schemes to address the large solar systems segments.

Between 2009 and 2014, Fonds Chaleur helped finance a total of 1,514 solar installations – 1,377 in France and 137 in the French overseas territories – the equivalent of 123,000 m2 of solar collectors. Among the total are a small number of 17 industrial installations amounting to almost EUR 1.4 million [..].
Fonds Chaleur can cover between 20 % and 70 % of the solar installation costs. The number of financed projects was growing between 2009 and 2011, but demand has been decreasing since 2012 [..].

Since 2012, Fonds Chaleur has been complemented by another incentive scheme, the call for proposals, entitled New Emerging Technologies (Nouvelles Technologies Emergentes, also known as NTE). This program intends to support technologies that are mature but with which France has still little experience, such as solar heating in multi-family housing or solar cooling in the industry. Once these technologies have been monitored and evaluated, they can expect grant support by Fonds Chaleur just like other installations. Between 2012 and 2014, the NTE program has awarded grants of almost EUR 4.9 million.

Subsidy for large-scale systems

In March 2015, there was a second call for proposals, this time for large solar array projects (Grandes Installations solaires thermiques) of more than 300 m2 to be installed at multi-family buildings, on industry premises and at hospitals, as well as of more than 500 m2 in case of district heating. Public funds cover between 50 % and 70 % of the preliminary studies and between 45 % and 65 % of the total investment.

By early November, Ademe had received 5 proposals for large-scale systems, but the second application deadline is still far away, ending in April 2016. “The proposals we have received so far came mostly from the multi-family building sector,” Khebchache said. “The industry expects short ROIs, and the drop in natural gas prices makes it more difficult to convince the industrial sector of solar installations. We also hope that we will have more projects in the district heating segment by the end of the second application period.”

United Kingdom

Key elements

- Strong decline in the market in 2015.
- Main support scheme (RHI) maintained up to 2020.
- Cuts to RHI introduced in 2015 of up to 700m £.
- Uncertainty in the industry on the consequences of these cuts.

From IEA-SHC

The Renewable Heat Incentive has failed to stimulate the market for solar thermal, which continues to contract in the UK. There are technical issues in the regulations preventing the use of solar thermal with other renewable heating systems such as biomass and heat pumps. The subsidy rate is relatively low compared to the Feed in Tariff for solar photovoltaics. Consequently the main driver for solar thermal in the UK is people wanting to 'do the right thing'.

From SolarThermalWorld.org

Although the long-awaited Domestic Renewable Heat Incentive (Domestic RHI) came into force in April 2014, sales volume decreased again last year for the fourth time in a row, down to 36,552 m² (-15 %). [..] the three major barriers:

- Cheaper and rapidly falling PV prices compared to solar thermal
- Lack of demonstration projects by large building developers
- Lack of sector coordination to remove market barriers

The application figures of the Domestic RHI confirm [..] the imbalance between the different renewable heating technologies. Solar thermal is still lagging behind a great deal in this year`s statistic [..]. The growth in demand for newly installed solar water heaters is much lower than for biomass boilers or heat pumps.

The spending balance also shows an unequal distribution between technologies. According to the first year's balance covering 9 April 2014 to 31 March 2015 [..], Pound Sterling (GBP) 16.3 million were spent in total on renewable heat technologies, of which 55 % were spent on biomass, 41 % on both heat pump types and only 3 % on solar thermal. The administrators of the Domestic RHI responded to the unexpectedly high uptake of biomass boilers by using a so-called degression trigger. In April 2015, the tariff for biomass heat was reduced by 20 % to 0.0714 GBP/kWh, and it was planned to be reduced again by 10 % in October 2015 [..].

From STA

The Renewable Heat Incentive (RHI) will continue to be funded until 2020, contrary to rumours that it might be scrapped altogether.
The RHI will provide £1.15bn of funding in 2020/21 and will also be reformed with a focus on value for money, saving around £700m. However, it's not clear

yet exactly where these savings come from. There will also be budgetary caps providing a backstop on expenditure, meaning that if the forecast expenditure reaches the agreed budget, the Secretary of State will be able to take action to suspend the scheme to new applications. [..]The latest statistics for renewable heat show that in 2014 it provided 4.8% of the UK's heat, against a DECC target of 12% in 2020.

taly

Key elements

- Market contracting in 2014. Economic crisis, support schemes bottlenecks and building sector slowdown main causes.
- Two main incentives: tax deductions and support scheme (Conto Termico)
- User-friendly tax deductions have been gradually reduced from 2014 on (from 65% to 36%).
- Support scheme underperforming so far. Reviewed in 2015, scope and budget extended, red tape tackled.

Solar Heat Europe Market Statistics

The law No. 90 of 2013 (August) modified the tax deductions for energy efficiency measures in buildings, increasing the deductible share to 65% of the investment costs over 10 years. In November, the incentive was extended with gradually reduced deductible shares: 65% until 31 December 2014; 50% until 31 December 2015 and 36% from 2016 onwards.

The tax deduction scheme has been much appreciated by consumers, and has shown to be more effective and user-friendly than the incentive scheme for renewable heating, Conto Termico.

One year and a half after coming into force, the Conto Termico is struggling to take off, with less than 2% of the available total funds (900 mio euros) being used. However, solar thermal is by far the dominant technology in this scheme, with 5 443 applications approved over a total of 7 948, receiving 12.8 mio euros up to December 20141. The scheme supported the installation of 38 257 m2 gross area of solar thermal collectors, and represents therefore a relatively small fraction of the newly installed capacity. Of the installed collectors, 88% were flat plate, 12% evacuated tubes. Moreover, 58.5% were thermosiphon systems, 41.5% forced circulation systems. In 91.5% of the cases, the installations were for sanitary hot water.

An important reform of the scheme, streamlining and simplifying the application procedure (which remains the main barrier), is currently under negotiation. Expectations from the industry are high, as the potential of the fund rests largely unexploited.

In 2014, the Italian solar thermal market faced another difficult year, and the falling trend in newly installed capacity continued, with newly installed collector area down to 187.9 MWth (268 500 m2) due to the persistent economic crisis and bottlenecks in the support schemes. The market has consequently fallen by 25% compared with 2013.

This is a disappointing result in a market that is now at only 11% of its indicative targets for 2020. Although some efforts have been made to improve the situation, the fact is that they have not achieved the expected impact on the market.

From IEA-SHC

Building regulations for energy efficiency support the adoption of solar thermal systems in new buildings. But the market for new construction performed weakly in recent years (0.5-0.7% growth p.a.). As a consequence the technology penetration remains low.

In Italy two incentives support solar applications:

- The national tax deduction scheme has been active for several years and mainly addresses persons. The scheme started in 2008 with an impressive growth in applications, and it is considered by the industry as a major measure in these economically depressed phases. The schemes support energy efficiency measures, as well as the installation of solar thermal systems.From the 2013 it has increased the deduction to 65% of the investment costs over 10 year. It successfully supports energy efficiency and solar measures, in particular solar systems for DHW production.
- The new incentive scheme for renewable energy ("Conto Termico" or thermal account) started in early 2013 supports the adoption of energy efficiency and solar technologies for individuals and public buildings and is dedicated to private and public users. It supports other renewable technologies: solar heating and cooling systems, installation of solar protection devices (including automation), heat pumps (including ground coupling) and biomass. Also innovative solutions, like solar cooling and ground coupled heat pumps, are funded within the scheme. Because of the low success (only a minimum pecentage of the available fund were used) this incentive is currently in a phase of changing (in particular for the simplification of the application process).

National and local energy regulation are in force for new and renovated buildings in Italy. They fix performance targets mainly focused on space heating and domestic hot water consumption. Such regulation have a very limited impact on the penetration of solar buildings or solar technologies in energy efficient buildings.

Current energy prices and consumer bills are not yet helping the market transformation. Financial incentive schemes are more efficient in driving such transformation. [..]

Calls for energy efficiency and renewable integration in buildings are published by the Ministry of Environment, Ministry of Economic Development and local authorities based on availability of funds. Specific funds are dedicated to the depressed area of southern Italy.

Reform of 'Conto Termico'

The main changes introduced in the 2015 reform of the support scheme are the following:

- Red tape for local authorities applying for support is diminished;
- Social cooperatives included in support for local authoritie;

- Budget remains the same as previous edition (900m EUR, 700 ear-marked for private sector, 200 for public sector);
- 3 new intervention categories for public sector: transformation into NZEB, efficient lighting, building automation and smart metering;
- RES in heating & cooling maximum size supported growing from 1 MW to 2 MW;
- Energy efficiency for building investments covered up to 55% (from 40%) if combined with heating equipment modernization;
- Energy audits for transformation into NZEBs are covered up to 100% for public administrations and up to 50% for private sector;
- Amounts inferior to 5 000 EUR will be given in a single rate;
- Final rate after conclusion of the procedure to be given after max. 90 days (from previously 180 days).
- Application documents and procedures are to be standardized and simplified;
- A list of certified solar thermal collectors up to 35 kW and 50m2 is to be drawn, which will have a priority, semi-automatic standard procedure for the application to the fund. Applicants selecting a collector from the list will not need to indicate technical details of the product.

The Netherlands

Key elements

- Stagnating market for solar thermal. Strong barriers and competition.
- Large solar thermal systems supported under feed-in tariff premium scheme (SDE+) working with tenders putting all RES in competition. Solar thermal disadvantaged by scheme design.
- Building regulation code main market driver for solar thermal
- New subsidy scheme for solar thermal currently debated.

From IEA-SHC

The main market drivers is the building regulation for new buildings. The regulation requires a certain performance level and solar water heaters help to reach the requirement. There is a lot of competition from other technologies like PV. For existing buildings there is an energy label, but there are no demands to the required performance. Most installers are still not very active in selling solar water heaters. Hot water is mostly produced with efficient gas boilers and gas is cheap. It is therefore difficult for solar water heaters to be cost competitive. The main sales in existing buildings is with owners who specifically chose a solar water heater for environmental reasons.

Large systems (> 100 m2) can benefit from a feed-in tariff from the SDE+ scheme, but this has little effect up to now. The subsidy scheme for solar water heaters was ended in February 2011. Commercial businesses can still benefit from the tax-reduction for energy investments (EIA), which comes to about 15% of the investment costs.

A new support scheme is the SDE+. This is a feed-inn tariff that has been expanded to include large (>100 m2) solar heating systems. The feed-inn tariff works with a tender system. The tariff is between €0 and €20 per Gj produced useful heat. For solar buildings the main incentive is the building regulation and local climate policies.

From SolarThermalWorld.org

The newly installed collector area in the Netherlands has not grown by a significant margin since 2011, and it even decreased slightly in 2013 (see the chart on the left). According to the Dutch industry association Holland Solar, this is to be considered a fair outcome, as the number of new residential construction permits has declined in recent years. Residential construction is by far the most important market for solar thermal technology in the country. [..] Prospects for 2015 are quite good, as the first quarter revealed 90 % more building permits compared to the same period in 2014 and the number of newbuilds increased by 11 %. This recuperation of the residential construction sector might contribute to a growth in solar thermal sales. [..] But this potential is far from being ulfils properly. The experts believe that 20 % of the total heat demand could be provided by solar thermal, whereas today it accounts for only 1 %.

National subsidy scheme SDE+ disadvantages solar thermal

Holland Solar has often – but so far, unsuccessfully – called for an equal treatment of solar heating and cooling and photovoltaics in the national renewable energy promotion programme SDE+ 2015. SDE stands for Stimulering Duurzame Energieproductie (Stimulating Sustainable Energy Production), a national subsidy scheme which has been in force since 2008 and was amended several times.

The programme provides feed-in tariffs for all sorts of renewable technologies, as well as combined heat and power plants, but only includes solar thermal installations of more than 100 m^2. Most solar thermal heating installations in the Netherlands, however, do not meet the size requirement, but range from 20 to 100 m^2. Solar thermal installations must have a capacity of 70 kW in order to profit from SDE+, whereas photovoltaics installations only have to provide about 15 kWp. Hence, there are very few solar thermal applications within SDE+. In 2013, there were five solar thermal applications with a grant volume of EUR 1 million out of a total budget of EUR 3 billion. Regarding 2014, statistics show 14 solar heating projects with a total support of EUR 3 million as part of the EUR 3.5 billion funding.

If the Dutch government wants to meet the minimum targets for renewable energy, solar thermal technology will have to expand drastically over the coming years. [..] There have already been two stimulating factors: The foster growth in the construction sector and the regulation for energy efficiency in new construction which makes zero-energy houses obligatory by 2020.

Slovakia

Key elements

- Dormant market for solar thermal up until 2015
- New support scheme introduced in December 2015

From SolarThermalWorld

The long-awaited support scheme for the utilisation of renewable energy sources in residential buildings, Green Homes, was launched on 1 December 2015 [..]. With the EU-funded programme, the Slovak government intends to get homeowners to transform their energy supply ecologically. Any kind of small-scale renewable technology is eligible for the programme. Not only residential homeowners will get back up to 50% of their project costs, but also associations of flat owners are eligible for financial support, whereas companies are not entitled to any incentive. [..]

The delay in implementation was caused by a two-phase preparation period. According to the Slovak Innovation and Energy Agency (SIEA), the first phase had been used to register qualified products and the second phase to establish a list of qualified installers. [..]

The Green Homes programme will be implemented during several allocation periods. [..] the budget allocated during the first grant period was EUR 3.25 million, of which EUR 470,000 went to the region of Bratislava and EUR 2.78 million to the rest of the country. [The government] seems satisfied with Slovakians' great interest in the programme. In January 2016, the second round will be launched, and it will have a higher amount allocated [..]. Until 2018, a total for EUR 45 million should be granted to residential building owners who wish to install renewable energy systems, including solar collectors.

472 SWH vouchers issued after four-day allocation period

Before submitting their application, homeowners should already know what kind of installation they want and which size the system will have, since the amount of support depends on the installed solar thermal capacity of the individual installation [..]. Single-family homes receive 500 EUR per kW of solar thermal capacity, capped at EUR 1,750. Owners of blocks of flats receive 350 EUR/kW for systems of up to 20 kW and 450 EUR/kW for systems of more than 20 kW. The power of a particular collector in Watt is taken from the Solar Keymark certificate [..].

Applicants receive a voucher entitling them to buy and install a renewable energy system and can choose among the installers registered with SIEA. To obtain an accreditation as a supplier, companies have to be registered in Slovakia or another EU member country, whereas their solar collectors have to be certified by Solar Keymark. [..] According to the communications officer, the highest interest in the first round was sparked by photovoltaics. Solar collectors took second place, whereas heat pumps ranked third and biomass boilers last.

Austria

Key elements

- Declining market up until 2014
- New federal incentive programme launched in summer 2015
- Market decline gradually stabilising over second half 2015

Solar Heat Europe Market Statistics

The Austrian solar thermal market is one of the most developed markets in the EU but it suffered a further decline in 2014. Overall, the investments in renewable heating systems are facing competition from a strong and successful marketing campaign for gas and oil heating systems with attractive financial grants from the oil associations, the electricity lobby who supports heat pump (power to heat) and PV systems (as an attractive financial product). In addition, the national incentive programme does not fit in with the nine federal countries programmes, which are complicated and not attractive to investors.

The main challenge in 2015 will be to find new competitive business models, where the best production cost for solar thermal heating systems is a core argument. [..] in 2015 the market decreased further. The market development strategy should focus on two areas: process heat systems and large-scale solar thermal plants in district heating systems and industry

From IEA-SHC

The main market driver is still the environmental awareness of the population, but also subsidy schemes, which are in place in all provinces of Austria and also on federal level. For large-scale systems a special subsidy program has been in place since 2010.

From SolarThermalWorld.org

The market report 'Innovative Energy Technologies in Austria. Market Development 2014' published by the Austrian Federal Ministry for Transport, Innovation and Technology (bmvit) shows that in 2014, the national solar thermal industry had to deal with declining sales for the fifth time in a row.

The solar thermal market in Austria dropped by 15 % from 2013 to 2014, resulting in a total annual volume of 108.6 MWth (155,170 m^2) last year. [..] According to recent data by the industry association Austria Solar on the first two quarters of 2015, the decline seems to be slowing down, partly because of a new federal incentive programme.

According to the market report, flat plate collectors account for 97 % of Austria's market volume. The total production volume of solar collectors was 556.5 MWth (795,056 m^2), which is half of the production volume in 2009. With an 82 % share, export was still the main driver of the solar thermal industry. But deliveries to the main export markets (Germany, Italy, Spain, and Portugal) shrank, which means total export figures fell by 18 % versus 2013. [..] The solar thermal sector generated a turnover of EUR 255 million, of which EUR 134 million was made with solar thermal plants installed domestically (including system assembly and installation) and EUR 121 million with exports.

Despite the market decline, the round about 500 m^2 per 1,000 inhabitants is still leading in Europe in terms of total solar thermal collector area installed per capita. Regarding new installations per head, Austria had far surpassed any other country in Europe until 2012.

Best federal incentive for residential solar heat – ever

During the summer of 2015, the situation seems to have improved a bit. [..] Both quarters combined again showed a decline of 15 % compared to the same period last year. A national incentive scheme for solar thermal energy and industry efforts have slowed down market decline [..]

In Austria, incentives for solar thermal are often part of the housing subsidies, which are the responsibility of the nine federal states and vary widely from state to state. Still, it is the second time now that there exists a federal incentive.

From 24 February 2015 to 30 November 2015, Austrian consumers can apply for grants directly at the Austrian Climate and Energy Fund. The government calls it a "mass incentive programme". Conditions have significantly improved compared to the last federal incentive scheme back in 2012. Instead of EUR 350 for any kind of system, the current programme offers EUR 750 for solar water heaters (with at least 5 m^2 of collector area) and EUR 1,500 for solar heating systems. The programme budget is EUR 9.1 million, which would be enough money for more than 6,000 solar heating plants or more than 12,000 hot water systems. Based on hot water systems of 5 m^2, the budget would equal 60,000 m^2 of solar collectors.

There has not yet been any data on the current number of applications, but the programme has so far not run out of cash. The federal incentive can be combined with federal state and community incentives if the state allows it.

Greece

Key elements

- Booming market in 2014, despite the crisis.
- Stability in incentives measures.
- Opportunity for a new domestic tax reduction scheme being investigated.

Solar Heat Europe Market Statistics

In 2014, despite difficult economic conditions with the impact of the financial crisis and austerity measures, the Greek solar thermal market unexpectedly grew by almost 20% (18.9%). The newly installed capacity totalled 189 MWth, which represents 270 000 m² of newly installed collector area. These new installations were mainly for hot water supply in the tourism sector/ islands (hotels, holiday lets, etc.); a growing market segment thanks to an extra two million tourists visiting Greece during the year.

There has also been a welcome market upturn for the installation of new solar thermal systems in replacement of old ones. Greece reached a total installed capacity of 3 GWth (4.3 mio m²), representing an increase of 2.6% over the previous year. This installed capacity provides an estimated energy supply of 2 989 GWh, which corresponds to 52% of the indicative 2020 target. The outlook for 2015 is so far very encouraging and seems to be in line with the positive evolution in 2014.

From RES-Legal

RES-H&C is supported by a tax relief, a number of national programmes and a new investment law. Tax relief is granted for the installation of renewable boilers or the replacement of existing fossil heating boilers with renewable ones. The Programme "Exoikonomisi kat'oikon" supports measures to increase the energy performance of buildings through the provision of interest-free loans and subsidies for the installation of RES plants.

Apart from that, the new investment law (Law No. 3908/2011) supports the installation of RES- H plants. Law No. 3908/2011 (known as Investment Law) does not clearly state that RES related projects should be supported; however, support may be provided under the provisions of art. 6 (General Investment Plans). Art. 6 distinguishes between three types of general investment plans: General Entrepreneurship, Technological Development and Regional Convergence plans. RES projects are eligible for funding if they come under one of the categories below.

From SolarThermalWorld.org

Greece's solar water heater manufacturers have proved to be highly resilient at a time when the country is in economic crisis. The collector manufacturers were able to increase both domestic (+19 %) and export (+16 %) sales in 2014, according to the Greek Solar Industry Association, EBHE. The industry provides a high level of vertical integration and exports 50 % of its annual production volume. [..] At the beginning of the year, the association [..] commissioned [..] a survey on the economic impact of a domestic tax reduction scheme.

Poland

Key elements

- Declining market in last few years.
- Established support scheme (NFOSiGW) extinguished after 5 years of operation.
- Scheme replaced by new one (Prosument) running from 2014 to 2022.
- New scheme more restrictive and far less attracting for solar thermal, giving priority to electric sources.

Solar Heat Europe Market Statistics

According to the Polish Institute for Renewable Energy, the solar thermal market is the biggest microgeneration RES market in Poland, bigger than biomass, heat pumps, photovoltaics etc. Sales of solar collectors in 2014 were 182 MWth (260 000 m2). A reduction of ulfils. 5% compared with the previous year; when there had already been a decrease of the order of almost 10%. The total installed capacity reached 1.2 GWth (1.7 mio m^2).

The subsidies from the National Fund for Environmental Protection and Water Management (NFOSiGW) still had a great impact on the development of the solar thermal market. Over the five years duration of the subsidy programme, grants from NFOSGW contributed to 35% of all installations of solar collectors in Poland.

During the forthcoming years, it will be also possible to obtain subsidies under the programme Prosumer – NFOŚiGW. Following on the authoritative solar thermal roadmap up to 2030 (published in 2009), with the support of other organisations, the national solar energy industry, is developing a new renewable heating technology roadmap up to 2030. The roadmap with new targets for solar thermal goals have been published in September 2015.

From SolarThermalWorld.org

The Polish solar thermal industry is going through difficult times right now. At the end of December 2014, the National Fund for Environmental Protection and Water Management, NFOŚiGW, approved the last applications for the national residential incentive programme. The follow-up financial mechanism, Prosument, is a lot less attractive and has not really started yet for solar thermal. In contrast to the previous long-term subsidy scheme, which focused on solar heat, Prosument basically subsidises renewable sources of electricity. Solar thermal is only accepted in combination with an electric source, e.g., heat pump + PV or solar thermal collector + PV [..]. The programme was first introduced as a two-year interim programme, but has now been turned into a nine-year scheme running until 2022. Polish Zloty (PLN) 800 million (EUR 187 million) is available in funding [..].

The expiring solar thermal subsidy scheme had a budget of PLN 450 million for 2010 to 2014 (EUR 105 million). According to NFOŚiGW, only PLN 81 million was left for the year 2014, whereas the available budget had almost been twice as much in the year before [..].

The national fund supported 67,363 projects with a total grant volume of PLN 449.562 million during August 2010 and the end of December 2014. This includes 55 multi-family houses, whose owners received a total of PLN 2.5 million. The average bank loan of a residential solar water heater was PLN 14,759 (around EUR 3,440); the average project amount for a multi-family building was PLN 102,281 (around EUR 23,843). [..]

There have not yet been any statistics on the Prosument programme, because NFOŚiGW only started to process applications at the end of 2014. According to the NFOŚiGW press office, the scheme is being implemented in three ways:

- Via local communities: An official call for applications in April 2014 collected twelve applications with a total budget of PLN 62.5 million PLN (mostly for photovoltaics and not solar systems). No contract had been signed until the middle of December 2014.
- By using regional funds for environmental protection: Seven applications with a total budget of PLN 85 million have been signed, and the first regional funds started their call for applications at the end of the year. Only two of them decided to accept applications from individuals. The majority focuses on housing cooperatives.
- Through banks: This is how the previous solar water heater programme was executed. Banks are expected to start calling for applications in April or May 2015.

Spain

Key elements

- Declining market up until 2014, stabilisation since.
- New regional incentive programme launched in 2014 in Andalusia
- New national support scheme for energy efficiency in buildings (Pareer-Crece) in place in 2015
- New national support scheme for large RES heating & cooling systems (GIT)
- Main driver for solar thermal remains building codes.

Solar Heat Europe Market Statistics

The Spanish market has finally stabilised after four consecutive years of decline, when the market almost halved (-47%). The newly installed capacity reached 178.5 MWth, with an increase of 9.8%. In spite of the building sector crisis, the new build is still expected to represent between 100 to 125 MWth (143 000 to 178 500 m^2). The main reason behind the results achieved in the Spanish market in 2014 was the growth reported in Andalusia, the only region still actively supporting solar thermal. Aggressive marketing strategies applied by the region's major players have created a significant increase in demand, more than doubling the regional market (estimated to have represented 60 MWth in 2014). By the end of 2014, the installed capacity in Spain totalled 2.24 GWth, an increase of 9% over a one year period. This installed capacity represents an estimated 2.24 TWhth of heat generation, only 20% of the 2020 target for solar thermal set by the Spanish government.

From IEA-SHC

Since 2006, the Spanish Technical Building Code imposes the coverage of a portion of DHW in every building. This code is to be revised to include other forms of renewable heat and the inclusion of district heating and cooling networks.
In the Spanish Renewable Plan until 2020 it is also considered to develop some public incentives to the commercialization of renewable heat. A recent regional program for solar heat in Andalucía has produced an increase of the market during 2014 close to 9%.

The main strategic plan regarding solar thermal is performed by the Institute for Energy Savings and Diversification (Instituto para la Diversificación y el Ahorro de la Energía, IDEA). It is included in the National renewable plan (actually developed until 2020 and called "Plan de Energías Renovables 2011-2020").The most important support measure for solar buildings comes from the Spanish Building Technical Code. Building energy labelling will be mandatory starting the 1st of June of 2013 for all buildings to be sold or rented.

From SolarThermalWorld.org

On 5 May 2015, the Ministry of Industry, Energy and Tourism approved the so-called PAREER-CRECE programme (Programa de Ayudas para la Rehabilitación Energética de Edificios existents), a support scheme for increasing the energy efficiency of existing buildings. Since this very day, investors of solar thermal systems can apply for grants of up to 20 % of their investment costs.

Norway

Key elements

- Dormant market up until 2015. Strong barriers and competition.
- Existing support scheme improved
- Increased market interest for solar thermal in 2015

From SolarThermalWorld.org

In January 2015, the Norwegian energy agency ENOVA improved the national subsidy scheme that grants energy efficiency technologies as well as renewable energies in the residential sector since 2008. Since 2015 the applicant has a legal right for the funding if the household fulfils all eligible criteria. This is called "rettighetsbasert" in Norwegian, which could be translated to „rights-based". Households enjoy a financial support of 25 % of the documented total expenses (including VAT). For a solar heating system a maximum refund of NOK 10,000 can be given, plus NOK 200 NOK/m^2 up to 25 m^2 collector area.

From IEA-SHC

Hydropower has been the main source of electricity generation in Norway, meeting roughly more than 95% of the demand. Electricity is also widely used for heating purposes, both space heating and DHW. A relatively low electricity price level is the main explanation for why the market for solar thermal systems is relatively limited, although increased market interest and activity is noted since early 2013.

An important competitor in the small segment, especially for single family houses, are heat pumps (mainly air/air) and in some instances small biomass fueled systems.

Enova SF, a public agency established to improve energy system efficiency and increase renewable energy production, has offered households financial support for investments in solar thermal energy since 2008.

Norway has goals to increase renewable energy production, energy efficiency and reduction of greenhouse gas emissions. [..] Revised energy regulations for new buildings are being developed (TEK 2015). Incentive programs are mostly technology neutral. Consequently, there is no particular target for solar energy.

- Financial support schemes: Enova SF is a public agency established to improve energy system efficiency and increase renewable energy production. Since 2008, Enova has offered households financial support for investments in solar thermal energy

- (Building) regulation: Through the national building codes, new and refurbished buildings are required to have a certain heating capacity based on renewable energy aside from (hydro) electricity. This means in practice some solutions based on biomass or heat pumps. But in some cases solar energy is utilized. There is increased interest in solutions where heat pumps and solar thermal capacity are linked to make use of seasonal heat storage.

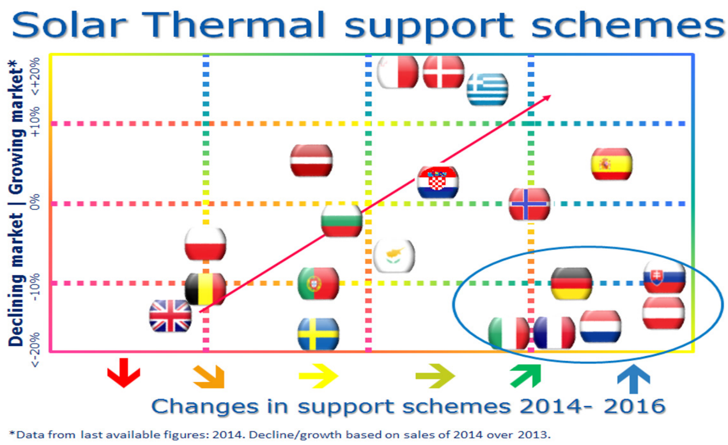
4. Comparative Analysis

Across Europe, the solar thermal markets are behaving in very different ways. Factors influencing this diversity are many. The persistence and depth of the economic crisis, the slowdown in the building sector, uncertainties and step backs in support schemes, the competition with alternative RES technology and dominant traditional fuels in a period of low oil prices are just a few of them. The interrelation between such factors are even more complicated.

In some countries such as Italy and Portugal, the economic crisis is severely impacting the market, while in other countries equally hit by the crisis, such as Greece and Malta, the solar thermal market managed nonetheless to grow significantly. Some countries with established support schemes and policies did perform badly in the last few years (such as Austria), while other countries thrived while maintaining their policies and incentives at a constant level (Denmark, Malta). Several countries did upgrade or expand their support schemes during the period 2014- 2016 (France, Italy, Germany most notably), while being affected by severe market conditions.

The decision to improve and expand specific support schemes for solar thermal can be linked both to market performance of the technology, or of the whole renewable heating and cooling sector when support schemes address those multiple technologies altogether. Such decisions should also be seen in the light of the more general economic performance of a country, whereas new austerity measures and budget restraints following the economic crisis might severely impact governments' capacity to increase or even maintain a particular support scheme. It is also to be taken into consideration that some austerity-bound countries might have had the need to reduce their incentives before 2014, and then decided to react to several years of market decline by changing direction and increasing support. It may well be the case of Spain, for instance.

Moreover, policy choices in terms of supporting solar thermal technology must also be read in the light of countries' own energy resources, existing infrastructure and strategic priorities, as well as in the light of political parties dynamics and citizens' preferences, level of information and sensitivity to environmental issues.



↑	New scheme introduced
↗	Existing scheme increased
→	Existing scheme maintained
→	No scheme in place
↘	Existing scheme reduced
↓	Existing scheme eliminated

It is therefore interesting to compare countries according to their different market situation and approaches towards solar thermal support schemes. The above graph depicts such comparison: on the vertical axis, countries are rated according to their market performance in 2014, as evolution vis-à-vis the previous year, while on the horizontal axis countries are rated according to their policy interventions to support solar thermal, during the years from 2014 until now.

Some observations are clearly noteworthy:

- The majority of the countries are in the 'declining market' half of the graph according to the vertical axis.
- The majority of the countries are in the positive half of the graph according to the horizontal axis.
- Countries can be grouped into two groups: the 'red arrow' group and the 'blue circle' group.
- Countries on the red arrow group show a tendency to gradually perform better in one axis the more they also perform better on the other axis.
- Countries on the blue circle show a tendency contrary to the previous observation, whereas such countries are badly performing in the market and also improving their support schemes.
- Countries with positive market performances in 2014 tend to react by keeping their incentives stable or increasing them.

- Countries with negative market performances in 2014 are equally split between those reacting positively the following years (increasing incentives or creating new support schemes, such as France and Italy in 2015) and those reacting negatively (still without incentives, or decreasing the existing support schemes, such as UK in 2015).

- Blue circle countries' support increase could be read as a tentative from national government to redress a particularly negative situation in the market.

- Countries' distribution do not match exactly with an 'austerity' cleavage: there are austerity-bound countries both diminishing their incentives or with no incentive in place (Portugal), and increasing their support schemes or creating new ones (Italy, Spain). Similarly, there are less austerity-constrained countries both in the negative part of the axis (UK, Sweden), and in the positive part (Germany, Austria, the Netherlands). Countries in the 'existing scheme maintained' column are those performing the best.

In light of these observations, it would be interesting to compare these results with the following years market trends (2015-2016), and assess if 'blue circle' countries' tentative to improve their market performance, via increased support schemes, has delivered. It will be also important to assess whether the market performance of countries on the bottom of the 'red arrow' group has further reacted to the negatively changed incentive framework.

5. Analysis of selected European countries

This section assessed the current situation and recent trends of support schemes for solar thermal across Europe, focusing on a selected number of countries which witnessed policy changes in the period 2014-2016. It demonstrated that, after several years of set-backs and support schemes downsizing, since 2014 some new support schemes and reinforced existing incentives are being promoted across Europe. The majority of the analysed countries are either keeping their incentives at a stable level, or they are increasing the scope and budget of their support schemes, or else are creating new ones.

This positive trend in terms of increasing support for solar thermal can be linked to two major circumstances. The first one is the current mostly negative situation in the market, which pushes concerned governments towards prompt reaction. The European solar thermal market is mostly covered by European industries, hence European jobs and European added value. Governments are increasingly recognising the potential benefits of having a solid and growing national solar thermal industry in place.

The second one is the overall EU political framework, whereas the achievement of the EU Climate and Energy 2020 goals and the international commitments in the follow up of COP21 in December 2015 are demanding to European countries a step further in their action in favour of a wide decarbonisation of all economic sectors. European countries are thus reacting to the changed EU landscape: heating and cooling has vigorously entered the EU debate, the European Commission has launched a Strategy on Heating and Cooling, with decarbonisation of the sector as the main goal. The role of renewables in this debate, together with energy efficiency, is prominent.

If this improved policy landscape for solar thermal is providing a 'pull' dynamic for European countries, there is also a 'push' dynamic in place, provided by the compelling need to comply with the RES 2020 targets, which, as stated by the Commission in its RES Progress Report, are still way far below the planned trajectories as far as solar thermal is concerned. Member States are thus recognising the need to increase the path towards the decarbonisation of their heating and cooling sector, providing a growing share of renewables in the sector. Solar thermal is increasingly seen as an effective way to fully reach the EU climate and energy targets, as it will be impossible to meet them without a proper decarbonisation of the heating and cooling sector and an increased share of RES production from solar thermal.

Hopefully, countries which suffered from very negative solar thermal market performances, but took decisive and swift actions to restore their conditions improving their support policies, will manage to reboot growth for their solar thermal industries in the next few years. The worst ideal situation in which a country could find itself would be the one where a contracting market is met with further downsizing of the incentives and support measures. Such an outcome is likely to lead the market further backwards, depriving such a country from the benefits the solar thermal industry can bring to each European country, in terms of growth, local jobs, energy security and decarbonisation of the economy. Moreover, it would leave such countries short of achieving their 2020 energy and climate targets.

The increasing support for solar thermal across Europe shows that this technology is entrusted to deliver its full potential: markets need public support in order to tackle the existing barriers and uneven playing field in the heating and cooling sector, thus starting to grow again; while governments need functioning and dynamic solar thermal markets in order to deliver on their EU energy and climate targets.

Solar Heat Europe's Members

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