Courtesy of Abora Solar

# Ensuring a successful implementation of Article 10 in EPBD for « Solar energy in buildings »

## Guidance from the solar heat sector to Member States for their transposition in national law

**May 2025**

Credits: Georg Bechter Licht

# Table of contents

# Key messages from the EU Solar Heat sector

- **Solar Heat Europe and its members welcome the EPBD** and wish to contribute to its successful implementation in all 27 Member States. The EPBD text **rightly acknowledges the key role that renewables overall and all solar technologies have** – including solar photovoltaics AND solar heat/thermal to achieve progress towards the EU climate ambition of 2050 climate neutrality.
- **Heat represents half** of our total energy needs and, on average in Europe, 80% of our needs in buildings. Access to affordable domestic hot water (15% of our needs) and heating (65% of our needs) is an essential need, enabling access to hygiene, well-being and comfort. It is therefore key to meet this need with efficient and reliable solutions.
- **Solar thermal is a proven technology**. Established on 11 million rooftops in Europe, it provided in 2023 about 41GWth to millions of users. Solar heat is mainly used on residential buildings and tertiary buildings, but it can easily meet the heat needs of district heating and industry.
- **Solar thermal systematically comes with cost efficient Thermal Energy Storage (TES).** Over 200 GWh of combined thermal storage capacity is available in Europe. The cost of thermal energy storage is by far much more affordable now than power storage.
- **Solar thermal technologies are manufactured in Europe** by hundreds of companies, many of them being SMEs. Encouraging the use of solar heat technologies (including solar thermal, hybrid PVT) helps develop the creation of local job, local wealth and skills. Whilst their lifetime is long (more than 25 years), solar heat technologies are easily dismantlable and recyclable, using no rare-earth metal and making optimal use of resources.
- **Solar heat is a no-regret solution** which can easily be combined with any other technology. It also promotes energy efficiency and reduces burden on the grid **as it works "off-grid**", and helps gas boiler reduce their consumption and heat pumps reduce their electricity needs.
- **Solar heat works from the North to the South of Europe**: Whilst Germany has currently the largest installed capacity in operation, Greece, Cyprus or Austria have very high per capita consumption.

## As a consequence, Solar Heat Europe advises Member States to:

- Make sure that the national transpositions adequately reflect the spirit of EPBD and promote the uptake of ALL solar technologies in an even level playing field.
- Ensure that the guidance encourages landlords/architects/municipalities to identify the buildings' energy needs first and then, use the most suitable solar technology(ies) according to these needs.
- Encourage the use of EU-based clean technologies, in the spirit of the Net Zero Industry Act - including solar thermal, eg in their public procurement tenders (including non-price criteria).
- Ensure that access to finances and potential related incentives is organised also in a fair way across technologies.
- Draft the transposition into national law according to 3 different options as outlined below:

| OPTION 1 | OPTION 2 | OPTION 3 |
|---|---|---|
| Referring to a minimum coverage of energy needs | Based on minimum energy generation capacity from solar technologies | Based on minimum percentages of the rooftop to be used by the different solar technologies (PV, ST and PVT) |

*These three options promote EU-based manufacturing of renewable technologies. They are in line with the purpose of article 25 of NZIA (Sustainability and resilience contribution in public procurement).*

# Introduction

## The Energy Performance of Buildings Directive: A legislation giving a clear role to all solar technologies

The text of the directive is fair and positions all solar technologies on an equal footing: solar thermal and photovoltaic – especially in the definition of solar energies (article 2, subparagraph 14). The national transpositions of EPBD must also be technology-neutral, enabling stakeholders to have access to all relevant technologies. It is therefore critical that Member States respect the spirit of the EU text, not putting any bias for the adoption of one technology rather than another.

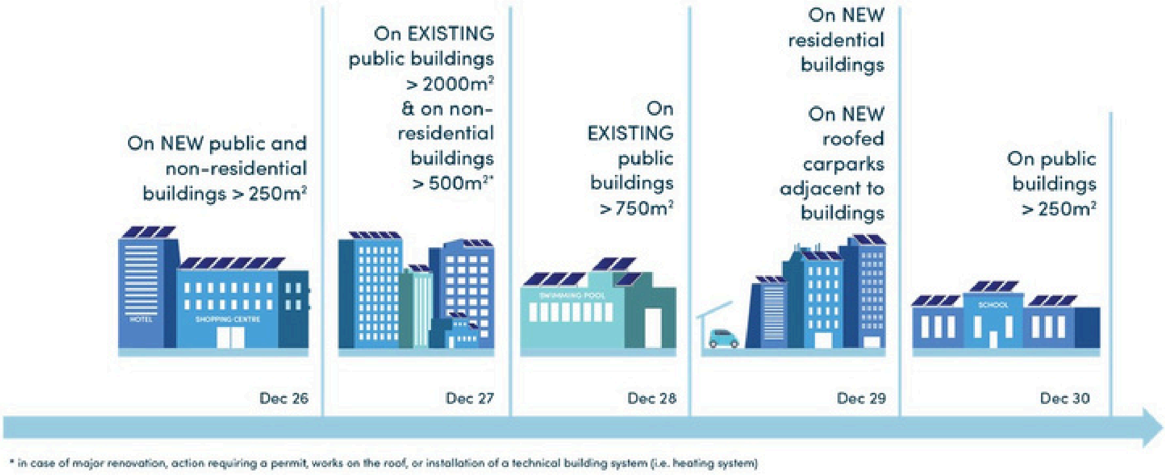
*Art.2, (14): "'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic), and geothermal energy, osmotic energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas storage treatment plant gas, and biogas"*

### Article 10 "Solar Energy in buildings": Optimising buildings' use and their capacity to generate energy from the sun

*Member States shall ensure that all new buildings are designed to optimise their solar energy generation potential on the basis of the solar irradiance of the site, enabling the subsequent cost-effective installation of solar technologies.*

This article provides several provisions for Member States to ensure the adequate installation of solar technologies to specific building types, by specific deadlines. The graph below developed by Solar Heat Europe visualises the buildings in the scope of this article.

**Legal requirements to install solar thermal and / or photovoltaics on buildings**



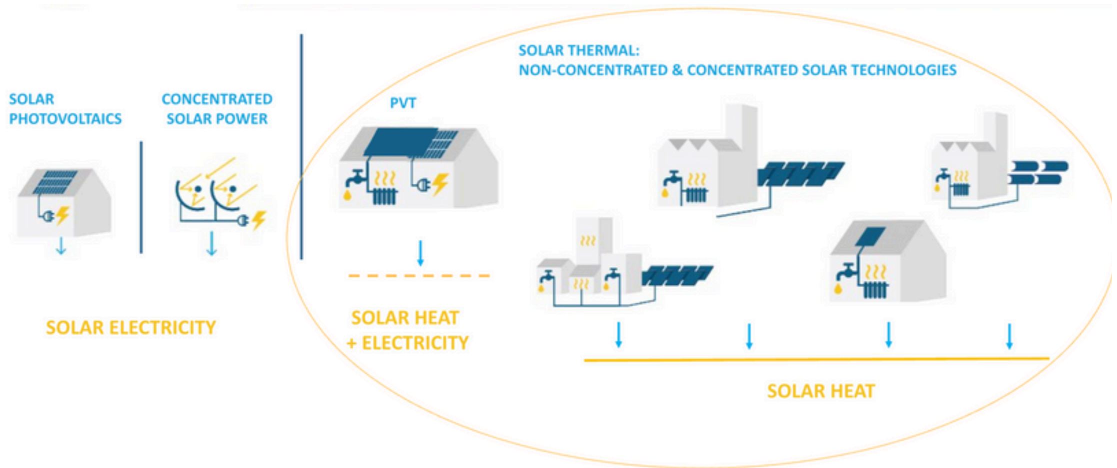

### Article 3 "National Building renovation plans"

Among other elements, these national building renovation plans shall include an overview of implemented and planned policies and measures regarding the deployment of solar energy installations on buildings. Member States shall submit the first draft building renovation plan to the Commission by 31 December 2025.

*Each member state shall establish a national building renovation plan to ensure the renovation of the national stock of residential and non-residential buildings.*

## What is solar thermal and how does it contribute to EPBD?

- A **direct renewable heat** technology providing hot water and/or space heating (and also electricity with PVT);
- **Decentralised** solution that improves **energy security** and alleviates the pressure on the power grid;
- **Made in Europe**;
- Over **11 million systems** already installed in Europe today;
- **Can easily hybridize** with any other technologies (heat pumps, biomass, (bio)gas);
- Thermal **storage** is always included;
- **Works from North to South of Europe**: the largest solar thermal installed capacity can be found in Germany, Greece, Italy, Spain, Austria.




*The abundant and free sun's energy can be harnessed for different energy needs, thanks to different technologies. Whilst **solar photovoltaics** are focused on the provision of electricity/power, **solar heat** technologies can be used to capture the sun's energy to produce heat. The hybrid technology **PVT**, also exists and can produce both heat and power. <u>**It is important to note that all can co-exist and share the rooftop space.**</u>*

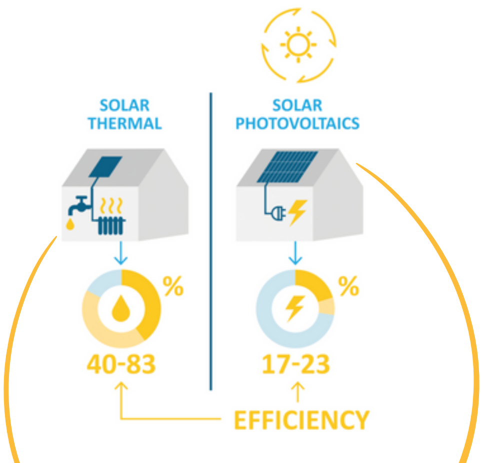
## Solar thermal provides the best energy density on rooftops

**Solar thermal provides the best energy density**: Solar thermal is optimal in terms of space efficiency, producing 3 to 4 times more energy for the same area than solar PV. For instance, a small installation of 4 $m^2$ of solar thermal panels has a capacity of 2,8 kWth, being able to cover over 10% of the total energy needs of a European household.

The percentage of roof coverage says nothing about the efficiency of that coverage. This is why national governments have to consider the energy density of solar panels when transposing article 10 of the Energy Performance of Buildings Directive.

A **solar thermal panel is on average three times more efficient in terms of energy output than a photovoltaic panel.** In order to comply with Article 10 and be **technology-neutral,** governments must take this difference into account while transposing.

***As a conclusion, the transposition should not only focus on rooftop coverage, but on energy production and buildings needs***





Courtesy of Abora Solar

# 1. Summary of Solar Heat Europe's recommendations (on technical criteria)

As part of the implementation of the Energy Performance of Buildings Directive, Solar Heat Europe proposes three options to the Member States for the adequate transposition of Article 10 of EPBD in to national law. **These three options are diverse and technology-neutral, as required by the directive**. They also are targeted at meeting with the most efficient technology the actual energy needs of the buildings, hot water and heat being often the most relevant ones. Thus, the guideline behind these options respects the spirit of an equal treatment between solar technologies and draws an approach based on "energy generation" rather than simple roof covering.

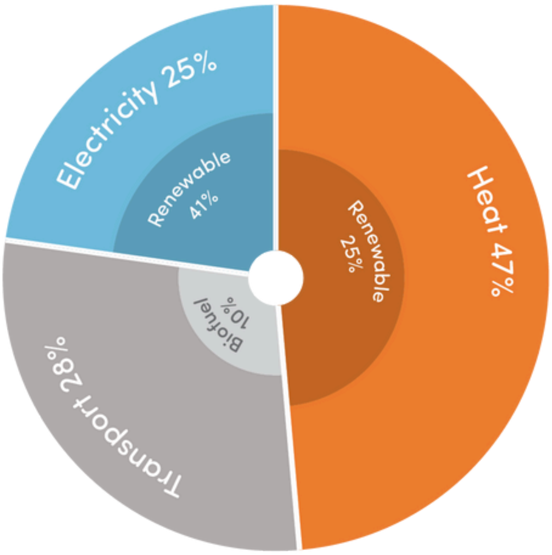
To achieve the energy transition and comply with EPBD, **Member States should match buildings' energy needs**. Favouring EU made solar technologies should also be taken into account when transposing EPBD into national laws (eg in public tender calls).

| | OPTION 1<br>**MEETING THE HEATING NEEDS OF BUILDINGS** | OPTION 2<br>**ENERGY DENSITY APPROACH (in W per $sqm^2$)** | OPTION 3<br>**PROPORTIONALITY APPROACH** |
|---|---|---|---|
| | **These three options promote EU-based manufacturing of renewable technologies which is a key characteristic of Solar Thermal technologies.** They are in line with the purpose of Article 25 of NZIA (Sustainability and resilience contribution in public procurement): IT IS A DOUBLE WIN! | | |
| Criteria | Referring to a minimum coverage of energy needs | Based on minimum energy generation capacity from solar technologies | Based on minimum percentages of the rooftop to be used by the different solar technologies (PV, ST and PVT), using the "1=3" concept (see page 13). |
| Wording | 1.1. On average, over the period of a year, solar thermal systems should **cover at least 60% of the hot water needs of buildings: domestic hot water (DHW), process water...**<br><br>1.2 Solar energy technologies used on buildings should be tailored to the energy needs of the building or its area (e.g.: possibility for rooftop to supply heat needs of district heating or industry). | 2. The installed capacity of solar technologies (solar thermal or PVT and/or solar photovoltaics) should be equivalent to **at least XX W per square meter** of usable rooftop area<br>(*This figure is obtained by aggregating the theoretical annual production of installed panels, divided by the size of the usable rooftop area).*<br><br>*« Usable » = roof surface potentially usable for all solar technologies | 3. Solar energy installations should **meet one of the following minimum thresholds:**<br>- A solar thermal installation should cover at least X/3 % of the usable rooftop space;<br>- A solar photovoltaic installation should cover at least X % of the usable rooftop space.<br><br>In case of a combination between technologies (ST and/or PVT and PV), the ⅓ ratio between ST and/or PVT and PV must be considered. |
| Recommended thresholds | 1.1. at least 60% of the DHW | 2 > 70 $W/m^2$ | If PV requirement is to cover 30% of the rooftop space, then:<br>ST and/or PVT: 10% |

# 2. Heat is half our energy needs

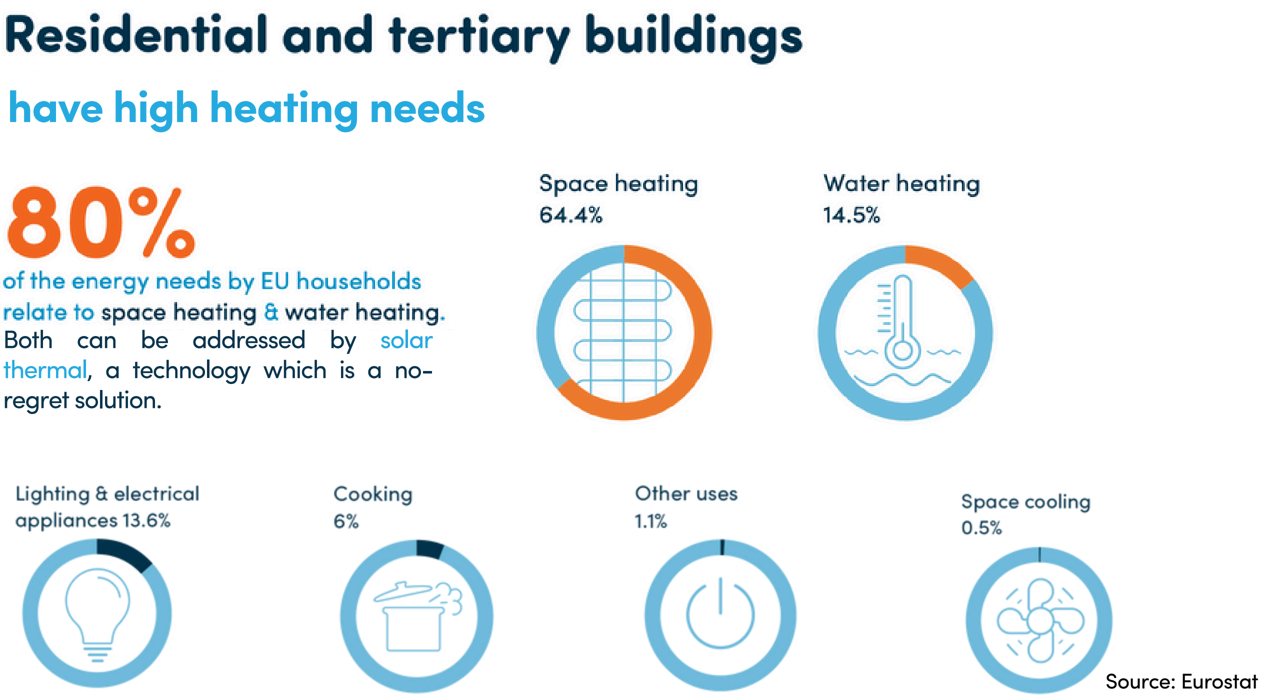
## Using the right technology for the relevant energy needs therefore makes absolute sense

Total final energy and total modern renewable energy share, by energy carrier, European data (Source: Eurostat for year 2022)




Heat is half of the total energy that we need – far more than the energy required for fuel/transport and electricity. Despite this, only 25% of our heat in Europe is generated from renewable sources with very big differences between countries from less than 10% in Ireland, up to more than 70% in Sweden. To date, the vast majority of that share is met with biomass. **Accelerating the decarbonisation of the heating sector is therefore of priority importance, particularly when readily-available for the provision of direct renewable heat sources exist, which is the case of Solar Heat!**

**Solar thermal panels produce heat,** which accounts for 80% of the energy needs of European households in buildings: access to hot water and heating represents a basic yet critical need for people's health and well-being. It is therefore obvious to tap into the potential that solar thermal can offer to meet such needs, thanks to the free energy from the sun.



# 3. Various buildings imply various energy needs

The graph herewith provides an illustration of the Article 10 requirements, including deadlines for the installation of solar technologies. Based on the definitions provided by the directive, we illustrate below different building types and their heating needs.

This demonstrates that, for some buildings, e.g. swimming pools, using solar thermal makes a lot of sense.


## Buildings in scope

| | Buildings heating needs | Dec 26 | Dec 27 |
|---|---|---|---|
| **Residential buildings**: Single family houses, multi-family apartment blocks, social houses, elderly houses... | +++ | | |
| **Non-residential buildings**: private hospitals, hotels, leisure centers (private or public) | +++ | ✓ | ✓ |
| **Non-residential buildings**: Supermarkets, office buildings... | + | ✓ | ✓ |
| **Non-residential buildings**: Agricultural buildings, office buildings, warehouses, manufacturing sites... | + | ✓ | ✓ |
| **Public buildings**: Office buildings, schools, universities, publics transport infrastructures... | ++ | ✓ | ✓ |
| **Public buildings**: Swimming pools, sport centers, elderly houses, public hospitals, prisons... | +++ | ✓ | ✓ |
| **Roofed carparks adjacent to buildings** | - | | |

**Deadlines**

## Solar thermal case studies


**Zaragoza's hospital: High heating needs (2023, ES)**

In 2023, the MAZ hospital in Zaragoza switched to a renewable energy system in line with its sustainability goals. 137.320 kWh of heat and 51.881 kWh of electricity.

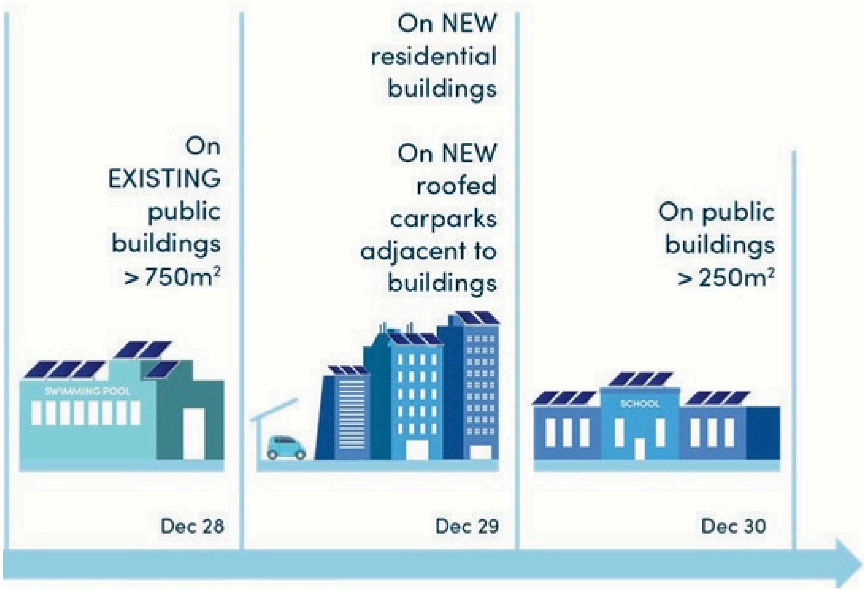

**Racibórz multi-family buildings (2011, PL)**

After 14 years of project continuity, a total of 36 multi-family buildings are benefitting from a clean and cheap energy supply.


**Barcelona's swimming club (2023, ES)**

Annual energy delivery: 1.641.095 kWh of heat and 543.438 kWh of electricity
Solar collectors area: 1.041 PVT panels

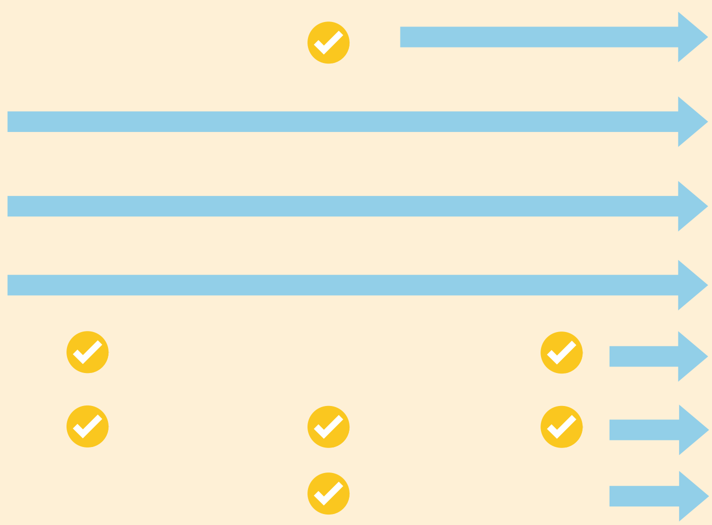
## Legal requirements to install solar thermal and/or photovoltaic on buildings




### Did you know?

Companies and public bodies can sell their surplus heat to district heating and neighbouring heat users. Using rooftops not only for the building energy uses, but also for local heat users can be a relevant economic option.

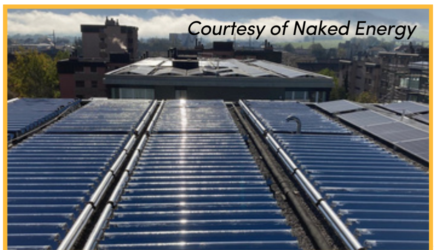
### for implementation




*Courtesy of DualSun*

**Allauch's family hone renovation project (2022, FR)**

Solar thermal collectors area: 6 hybrid solar PVT panels
Solar thermal capacity: 6 kWp
Thanks to this renewable energy system in their home, this family has reduced its annual energy bill from 4.200€ to 1.500€.


*Courtesy of Naked Energy*

**Delémont's carbon neutral apartment buildings (2021, CH)**

Solar collectors area: 1.411m²
Solar thermal capacity: 140.000 kWth
Annual energy delivery: 113.050 kWh
1000 people benefit from the sun's free energy.

*Courtesy of Austria Solar*

**Göllersdorf's hardware store (2017, AT)**

This building is heated and cooled exclusively by the sun.
Solar collectors area: 105m²
Storage capacity: 7.000m³
Annual energy delivery: 45.000 kWh


*Courtesy of Abora Solar*

**Paris' OECD headquarters (2021, FR)**

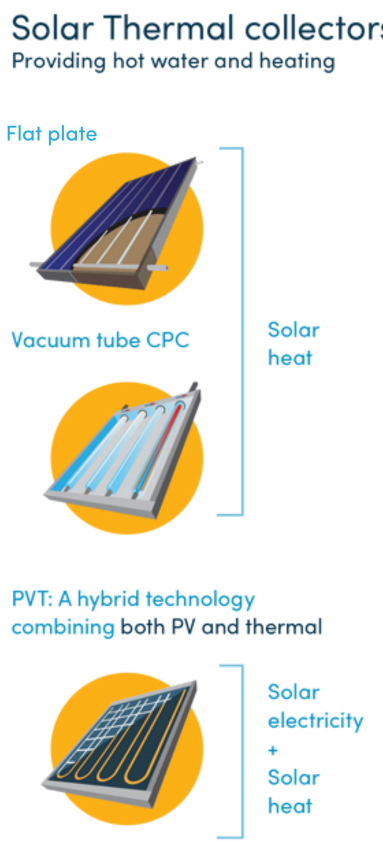
Solar collectors area: 140 PVT panels
Rooftop surface: 280m²
Annual energy delivery: 70.421 kWh of heat and 81.003 kWh of electricity

# 4. Solar thermal technologies: main features

## Solar Thermal and/or solar PVT:
## An obvious technology to implement the Solar Mandate

- Made in Europe
- 3 X more efficient than PV in terms of space
- A one-off capital investment, free energy for > 25 years and independence from energy price inflation
- Off grid
- Efficient heat storage comes as standard with every installed system
- Can hybridise easily with other energy supply or storage solutions

- **41GWth** of solar heat was installed in Europe in 2023.
- **90% of the yearly demand is met by EU-based companies**, manufacturing from Finland to Greece, Austria, France etc (see map of local producers in Appendix 1).

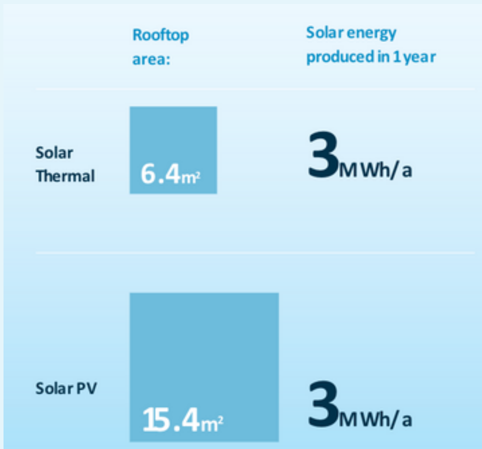



Solar heat technologies include essentially 3 different panels:

1. Flat plate (evacuated or non-evacuated)
2. Vacuum tube
3. The hybrid PVT technology combining both PV and thermal on one same panel

For more details about the technologies, please consult Solar Heat Europe website.

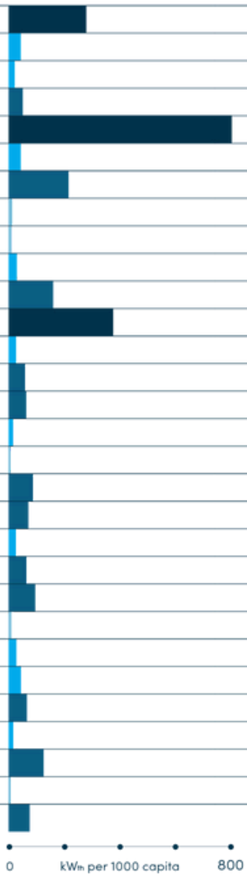
## Did you know?




Thermal solar panels require **three times less space than photovoltaic panels to produce the same amount of energy**. Both technologies can share the rooftop space, providing different and complementary energy needs.

# 5. Solar thermal market & growth potential

## Current installed capacity in European countries (2023)




| Country | Cumulative Installed Capacity in Operation ($MW_{th}$) | Annual evolution Total Installed Capacity 2023/2022 | New installed capacity in 2023 (in $m^2$) | New installed capacity in 2023 ($MW_{th}$) | Annual Evolution New Installed Capacity |
|---|---|---|---|---|---|
| AT | 2 471 | -4% | 38 711 | 27 | -20% |
| BE | 504 | 1% | 13 000 | 9 | -30% |
| BG+ | 156 | 4% | 13 800 | 10 | -25% |
| HR | 208 | 3% | 12 473 | 9 | -8% |
| CY | 701 | 4% | 66 740 | 47 | -10% |
| CZ+ | 468 | 2% | 22 472 | 16 | -12% |
| DK+ | 1 249 | -1% | 2 451 | 2 | -8% |
| EE* | 17 | 5% | 1 354 | 1 | -5% |
| FI+ | 58 | 8% | 7 360 | 5 | -8% |
| FR | 2 009 | 3% | 114 669 | 80 | 8% |
| DE | 13 285 | -2% | 376 000 | 263 | -47% |
| GR | 4 024 | 6% | 469 280 | 328 | 12% |
| HU* | 263 | 2% | 12 880 | 9 | -8% |
| IE+ | 292 | 0% | 1 027 | 1 | -8% |
| IT | 3 829 | 3% | 232 728 | 163 | -31% |
| LV* | 31 | 3% | 1 564 | 1 | -8% |
| LT* | 20 | 6% | 1 698 | 1 | -3% |
| LU+ | 54 | 3% | 3 387 | 2 | -8% |
| MT+ | 35 | -3% | 1 238 | 1 | -7% |
| NL | 454 | 2% | 43 360 | 30 | 3% |
| PL | 2 427 | 3% | 130 800 | 92 | -38% |
| PT | 985 | 2% | 41 659 | 29 | -37% |
| RO* | 196 | 5% | 15 577 | 11 | -8% |
| SK* | 153 | 5% | 15 456 | 11 | -8% |
| SI | 93 | 0% | 1 269 | 1 | -14% |
| ES | 3 089 | 1% | 128 357 | 90 | -7% |
| SE | 174 | -6% | 4 600 | 3 | -8% |
| CH | 1 076 | 0% | 23 708 | 17 | -28% |
| UK | 494 | -1% | 15 394 | 11 | 69% |
| **EU27 + CH + UK** | **40 816** | **0.6%** | **1 813 012** | **1 269** | **-22.7%** |

* Solar Heat Europe estimations
\+ Based on the EurObserv'ER "Solar thermal and CSP Barometer" (2022).

*This table is extracted from the Solar Heat Europe 2023 market report. It highlights the cumulative installed capacity, in operation now in the various EU countries, as well as the per capita consumption.*

**Did you know?**

*If most Europeans would equip themselves as well as Austrians, Danes, or Greeks currently do, the installed capacity would easily move from **41 Gwth** to **154 GWth**!!*

## Growth potential, building on countries' best practices

As outlined in the graph above, the use of solar thermal across Europe varies a lot, with countries such as Cyprus, Greece, Austria and Denmark having a much better use on a per capita basis. Building on these good practices, Solar Heat Europe has estimated how much the penetration of solar heat could grow, by establishing three climate groups (South of Europe, temperate climates and North of Europe), extrapolating the best practices to the countries in these regions.

*Southern countries*

| Country | Multiplication rate | Benchmark |
|---|---|---|
| PT | x4 | Greece |
| IT, MT, ES | x6 | |
| HR | x7 | |
| BG | x15 | |
| RO | x36 | |

*Temperate climate*

| Country | Multiplication rate | Benchmark |
|---|---|---|
| CH, DE | x2 | Austria |
| SI, LU | x3 | |
| PL | x4 | |
| BE, CZ | x6 | |
| FR | x9 | |
| HU, SK | x10 | |
| NL | x11 | |

*Northern countries*

| Country | Multiplication rate | Benchmark |
|---|---|---|
| IE | x4 | Denmark |
| SE, LV | x13 | |
| EE | x16 | |
| FI | x20 | |
| UK | x29 | |

*How to use these charts: If French were as well equipped as Austrians with solar heat, they would multiply their use of solar thermal technologies by 9!*
*(Source: Solar Heat Europe estimations)*

# 6. Detailed Solar Heat Europe's guidance

Article 10 (solar energy in buildings) of the Energy Performance of Buildings Directive (EPBD) is crucial for the deployment of solar thermal energy in the EU. Solar Heat Europe has taken the initiative to provide its members with informative guidelines to ensure the proper implementation of this article. We have identified 3 main aspects to ensure a fair solar mandate.

In the European Union, not all buildings have the same needs (water heating, space heating, cooling, electricity, etc.). This is why Solar Heat Europe has decided to separate its technical criteria into two, with residential buildings on one side, and non-residential buildings on the other.

Some buildings, such as apartment blocks, swimming pools, hotel complexes and prisons, require hot water every day. **Solar Heat Europe therefore calls on member states to put technologies on an equal footing so that they can meet the specific needs of households and institutions.**

### 1. Legal text: A national transposition which must be legally compliant with the EU text

The transposition law **must clearly state that the mandate refers to "all solar technologies" (PV, ST, and PVT) and put them on an equal footing.**

Positive example: Styria in Austria (For more information, see **Appendix 5: Fair national solar mandate – the Styrian example in Austria**).

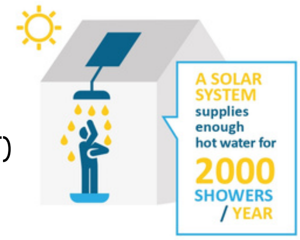
Negative example: some German Landers already have solar PV mandates in place but only refer to solar thermal energy as an EXCEPTION. Such cases are clearly not compliant with the EPBD text.

### 2. Technical criteria: A national transposition which must promote all technologies equally

According to the way they may be drafted, the concrete technical criteria for complying with the mandate could favour one technology over the other, which is not in the spirit of the legislation nor fair competition practices. Generally speaking, and as examples, technical criteria based on a minimum share of the rooftop area to be used would favour solar PV, which tends to be cheaper per square meter; on the other hand, technical criteria based on a minimum energy capacity per rooftop area/$m^2$ might favour solar thermal, which tends to be more energy dense and hence cheaper per kW installed.

Below are some suggestions on how to translate these technical considerations into concrete text proposals for the national transposition laws, following exchanges among the experts of the Solar Heat Europe network:

**TAILOR-MADE APPROACH: MEETING THE ENERGY NEEDS OF BUILDINGS**




**1st option: Solar Mandate criteria referring to coverage of hot water needs:**

1. On average, over the period of a year, solar thermal systems (ST and/or PVT) should cover at least 60% of the domestic hot water needs of buildings.

**OR**

2. Relevant solar energy technologies should be used to match the energy needs of the building or its area (e.g.: possibility for rooftop to supply heat needs of district heating or industry).

**Share of water heating in households heating needs in 27 Member States (source: Eurostat, 2022):**

| BE | BG | CZ | DK | DE | EE | IE | EL | ES | FR | HR | IT | CY | LV | LT | LU | HU | MT | NL | AT | PL | PT | RO | SI | SK | FI | SE | EU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17% | 29% | 18% | 30% | 20% | 14% | 27% | 21% | 33% | 13% | 13% | 13% | 38% | 23% | 15% | 9% | 15% | 52% | 24% | 17% | 22% | 33% | 18% | 21% | 16% | 19% | 20% | 17% |

**ENERGY DENSITY APPROACH: IN LINE WITH TECHNOLOGICAL NEUTRALITY**

**2nd option: Solar Mandate criteria (or national guidelines) based on minimum energy generation capacity from solar technologies:**

The installed capacity of solar technologies (solar thermal and/or PVT and/or solar photovoltaics) should be equivalent to at least 70 W per square meter of the usable rooftop area. This figure is obtained by aggregating the theoretical annual production of all installed panels, divided by the size of the usable rooftop area.

**PROPORTIONALITY APPROACH: IN LINE WITH TECHNOLOGICAL NEUTRALITY**

**3rd option: Solar Mandate criteria based on proportionality and minimum percentages of the rooftop to be used by the different solar technologies (PV, ST and PVT):**

Given that the energy output from ST/PVT is 3 times higher per square meter compared to PV, the solar energy installations should be sized according to this ratio and meet one of the following minimum thresholds:

For example:
1. If a solar photovoltaic installation should cover at least 30 % of the usable rooftop space, then:
2. A solar thermal installation (ST and/or PVT) should cover at least 10 % of the usable rooftop space. In case of a combination between technologies (ST and/or PVT and PV), the ⅓ ratio between ST and/or PVT and PV must be considered (see examples below).

| ST or PVT | | PV |
|---|---|---|
| 1 $m^2$ | = | 3 $m^2$ |
| Examples for 100 $m^2$ of roof:<br>To validate an equivalent of 30% minimum of the roof in PV:<br>• PV only: 30 $m^2$ of photovoltaic collectors<br>• ST and/or PVT: 10 $m^2$ of thermal and/or hybrid collectors [10 $m^2$ x3 = 30 $m^2$]<br>• ST + PV: 4 $m^2$ ST and/or PVT + 18 $m^2$ PV [4$m^2$ x3 + 18 $m^2$ = 30 $m^2$]<br>• ST + PV: 8 $m^2$ ST and/or PVT + 6 $m^2$ PV [8$m^2$ x3 + 6$m^2$ = 30 $m^2$] | | |

## 3. Financial incentives: A national transposition which should be adequately accompanied by financial support

Fair and efficient transposition of the solar mandate requires appropriate support mechanisms to assist consumers, public and professional users, in complying with the regulations. A particular attention should also be paid to those most affected by energy poverty. For public authorities, public procurement rules must be in line with green procurement principles, enhancing also security of supply, namely prioritising the sourcing of EU made solar systems (solar thermal or PVT and/or solar photovoltaics), in line with NZIA requirements (Art. 25).

# Conclusion: Solar thermal deployment will help contribution to various EU targets

The Fit for 55 EU legislative package sets a number of targets to be met by 2030. To do so, various measures are needed to achieve these targets, to be delivered by relevant renewable and clean technologies. Thanks to the accelerated adoption of **solar thermal technologies, which are EU-manufactured, Member States will be able to meet several targets set by the European Union such as the ones in EED, RED, NZIA, as well as EPBD, thanks, notably to the successful adoption of the Article 10 of the Solar mandate**. The network of Solar Heat Europe remains available to provide Member States support for the successful implementation of the package.

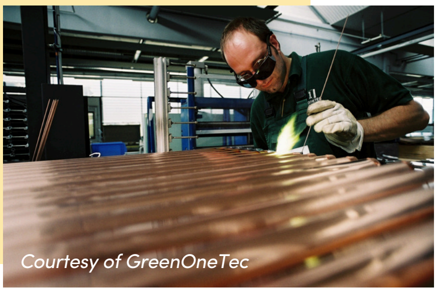
For other implementation measures, such as, EED for district heating, the potential of solar thermal for industry, please do not hesitate to contact Solar Heat Europe.

*Courtesy of TVP*

*Use of solar heat in:*

- *Residential buildings*
- *Tertiary buildings*
- *District heating*
- *Industrial buildings*

*Courtesy of Calpak*



*Courtesy of GreenOneTec*

→ ***ENERGY EFFICIENCY DIRECTIVE***

*11.7% reduction of energy consumption by 2030 (vs. 2020)*

→ ***RENEWABLE ENERGY DIRECTIVE***

*Total share of RES sources in 2030: 42.5% aiming for 45% (Art.3).*

*Binding target of RES for heating and cooling: Member States to increase by at least 1.1 percentage points annually (Art. 24, 4).*

*Indicative sub-sectoral targets:*

- *for the share of RES in buildings: 49% in 2030 (Art. 15a)*
- *for industry*
- *for district heating (Art. 22a, 24)*

→ ***ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE***

*Art. 10: Solar mandate*

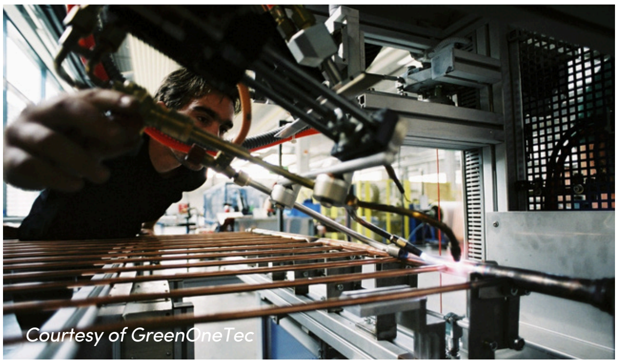
→ ***NET-ZERO INDUSTRY ACT***

*Art. 25: Sustainability and resilience contribution in public procurement*

# Appendices

# Appendix 1: Solar thermal is EU-made

**Solar thermal is made in Europe and creates European jobs**: solar thermal equipment is manufactured all over Europe, from Finland to Cyprus and SMEs based in Europe currently supply 90% of the EU demand, with high capacities to increase their production. Installing these systems on European rooftops means creating value at local level, replacing fossil fuel imports with new local jobs.


*Courtesy of GreenOneTec*

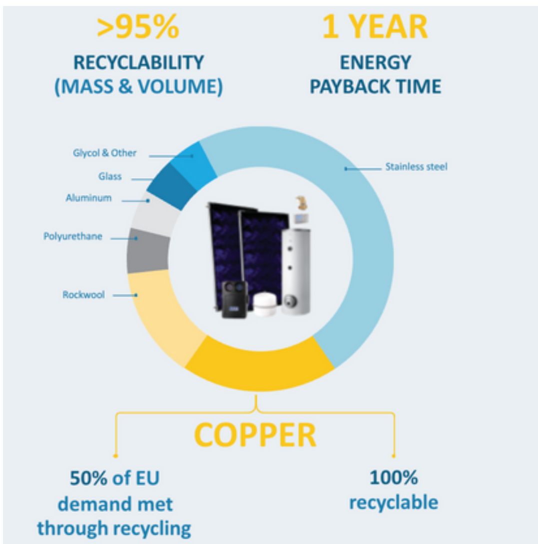

*Manufacturing from Finland to Greece: overview of Solar Heat Europe's direct members and their manufacturing sites*

**European solar thermal companies currently meet over 90% of the EU demand and have the capacity to expand their production processes.** This means reliable supply of energy generation equipment, free from sensitive supply chains. Some of these companies are already expanding their production lines (eg Abora Solar, TVP Solar, Sammler), **and can also expand night shifts.**

*The full list of direct and indirect members of Solar Heat Europe*

Solar thermal does not depend on rare earth or critical raw materials and has an easy access to components. In addition, **Solar thermal contributes to the European circular economy**, as it uses abundant and recyclable materials, such as glass, aluminium, metal, and copper. 100% of solar thermal technologies components are available within Europe, ensuring a supply independent from economic shocks. This approach enhances Europe's independence from geopolitical shocks, especially during periods of instability.

For more details on its circularity potential, please view Appendix 2.



# Appendix 2: Solar thermal has a higher recycling potential compared to PV

Solar thermal collectors have a simpler mechanical design, which enables easier recovery of materials like copper and aluminum without needing complex processing.

### 1. Primary function and materials

| **Aspect** | **PV panels** | **Solar thermal collectors** |
|---|---|---|
| **Purpose** | Convert sunlight into electricity | Convert sunlight into heat |
| **Core materials** | Silicon, silver, copper, glass, plastics | Copper, aluminum, steel, glass, insulation |
| **Metal focus** | Copper in wiring, silver in contacts | Copper in absorber plates and piping |

### 2. Disassembly and material separation

| **Aspect** | **PV panels** | **Solar thermal collectors** |
|---|---|---|
| **Disassembly complexity** | Higher due to encapsulated layers and use of EVA | Simpler with more mechanical fasteners |
| **Glass** | Large glass layer with embedded cells | Removable glass covers |
| **Metal recovery** | Involves copper, aluminum, silver (PV cells) | Involves copper (key), aluminum, steel |

### 3. Processing techniques

| **Aspect** | **PV panels** | **Solar thermal collectors** |
|---|---|---|
| **Thermal/Chemical Treatment** | Required for EVA removal and silicon/silver recovery | Rarely needed; mechanical separation suffices |
| **Copper Recovery** | Extracted from wiring and junction boxes | Extracted from absorbers and internal piping |

### 4. Environmental considerations

| **Aspect** | **PV panels** | **Solar thermal collectors** |
|---|---|---|
| **Hazardous materials** | Potential for lead, cadmium in thin-film panels | Old units may contain glycol or other fluids |
| **Recyclability** | Technically complex, but evolving | High due to metal content and ease of separation |

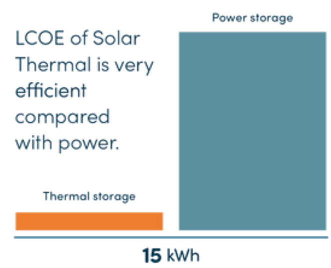
### 5. ESG and regulatory context

| **Aspect** | **PV panels** | **Solar thermal collectors** |
|---|---|---|
| **Regulation** | Covered under EU WEEE Directive | Often treated as industrial metal waste |
| **Circular Economy Role** | Important in recovering critical materials | Supports reuse of common metals, especially copper |

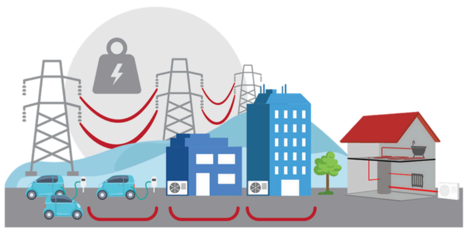
# Appendix 3: Solar thermal provides energy security and increases the value to buildings

**Solar heat systematically comes with cost efficient Thermal Energy Storage,** whether in buildings with, for example, 300 liters water tanks or for large scale district heating networks or industries. The cost of thermal energy storage is by far much more efficient now than the one compared to power storage.

### Comparative storage costs




**Solar thermal is off-grid.** As such, it operates independently from the power grid, reducing the dependency on fossil fuels and avoiding unnecessary extra burden on power grids.

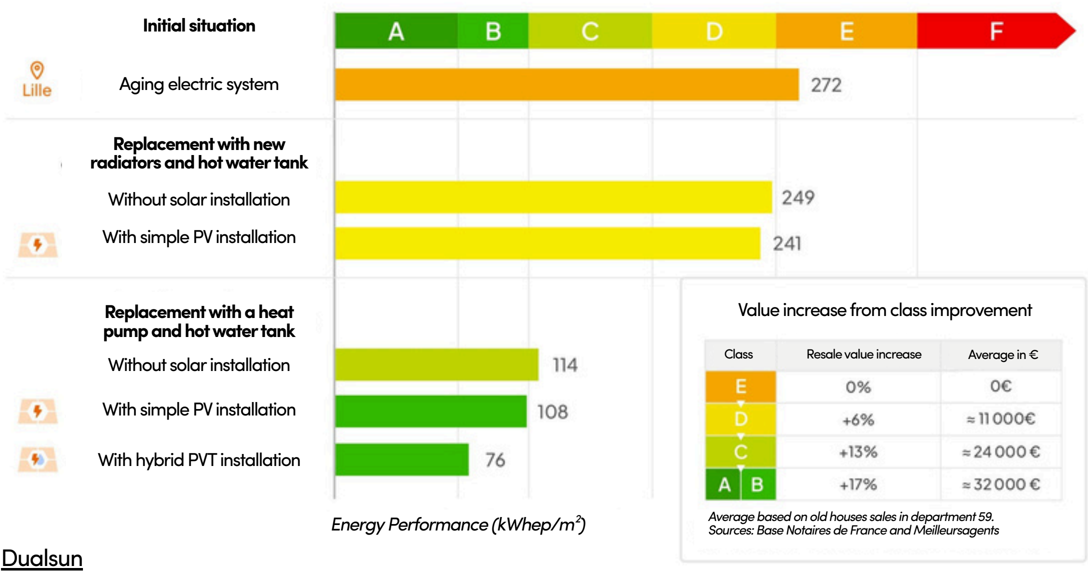


Excessive load on the grid


A more resilient approach

**Solar thermal offers long-term security of supply for consumers.** Once installed, solar thermal collectors only rely on the free solar irradiation to deliver their heat, with extremely low maintenance costs. This means that households and industries can benefit from the free energy of the sun during more than 25 years. In addition, their CO2 footprint is extremely low, with 8 g $CO_2$/kWh (source Ademe). This makes it a no-regret solution!

Installing solar thermal technologies (ST and/or PVT) can lead to **an improvement by up to 3 energy classes for the building, eg moving from class D to class B or A** (as illustrated with the example below, in the north of France). This move can give a real added value and improve by 10% the economic value of the building !




| Class | Resale value increase | Average in € |
|---|---|---|
| E | 0% | 0€ |
| D | +6% | ≈ 11 000€ |
| C | +13% | ≈ 24 000 € |
| A B | +17% | ≈ 32 000 € |

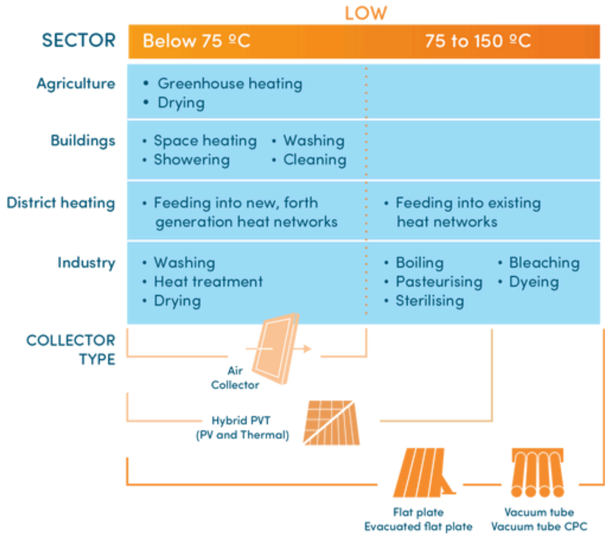
*Average based on old houses sales in department 59.*
*Sources: Base Notaires de France and Meilleursagents*

Source: Dualsun

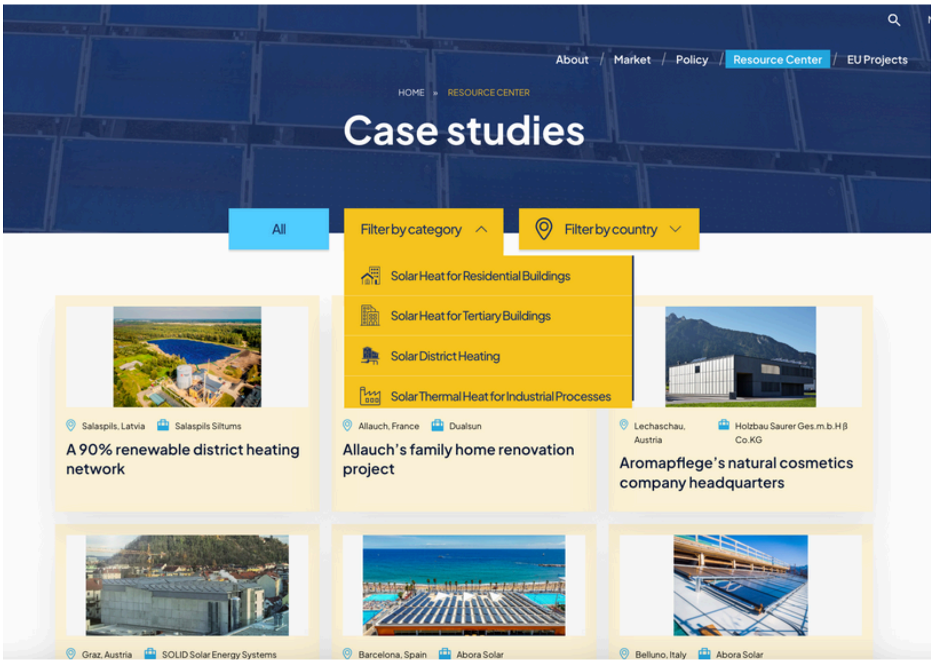
# Appendix 4: Solar thermal meets the heating needs of households and businesses

**Solar thermal offers a diversity of services:** In the Energy Performance of Buildings Directive context, solar thermal can provide domestic hot water, space heating and even cooling, for residential houses but also commercial, tertiary buildings and agriculture (e.g. warehouses). In addition to the buildings market (directly in the scope of EPBD), Solar thermal offers lots of potential to decarbonise district heating networks and also industrial customers for their heat needs.

Synergies between the use of buildings rooftops and such market applications can be steered thanks to the Solar Mandate, for example "selling the heat" produced on a building to a neighbouring user (eg district heating or industry).




To access various case studies on Solar thermal applications in its four market segments, visit Solar Heat Europe's website.




*Solar Heat Europe's website*

# Appendix 5: Solar thermal is a no-regret technology which can be hybridized with other energy sources, including heat pumps

**Solar thermal is complementary to other solar technologies, it can share rooftops' space:** Currently, many rooftops in Europe already carry both solar thermal and solar PV panels. Combining the two solutions on the same rooftop or even using hybrid solar panels (PVT – PV & Thermal), allows for effective solutions providing both heat and electricity, making the best use of the available space.

*Courtesy of Abora Solar*

**Belluno's student residence - Hybrid PVT panels and biomass hybridization**

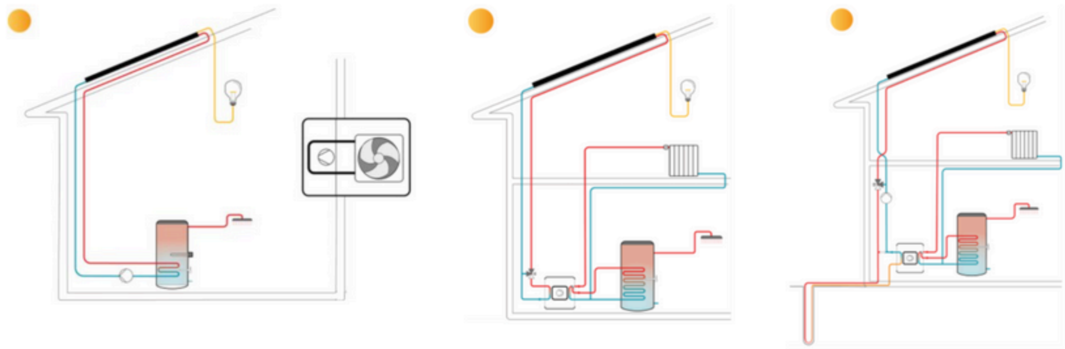
32 hybrid PVT panels supply the student residence with clean heat and electricity all year round. Additionally, they work in combination with biomass boiler.

*Credits: Georg Bechter Licht*

**GEORG BECHTER LICHT think tank - Solar thermal, PV and heat pump hybridization**

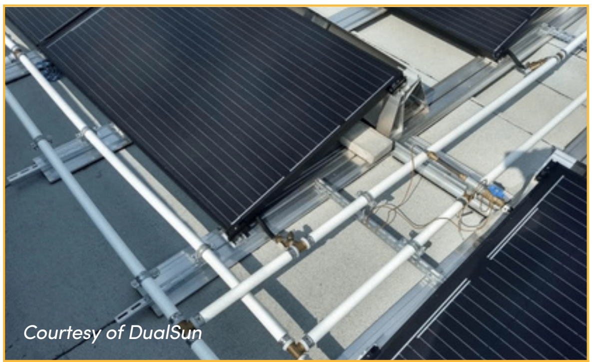
The building is heated by a 13.4 kW heat pump and a solar thermal system on the façade. This project is also composed of a 36 kW photovoltaic system on the roof.

**Solar thermal is flexible and can hybridize with many energy sources**: solar thermal can be combined with other renewable energy sources, such as biomass, heat pumps, or district heating. Such symbiosis helps achieving higher levels of decarbonisation and optimal energy efficiencies.




As this illustration shows, solar thermal energy can be combined with all kinds of heat pumps, making it a perfect combination in all the climates found in Europe. The picture above is featuring a PVT panel on the rooftop but the same principle would apply with a classical solar thermal collector in terms of heat supply.

Hybridization between solar thermal energy and heat pumps is not just a theory! It is being used in a number of places: See concrete case studies herebelow in Nantes (FR), Kringsjå (NOR), and Belluno (IT, on previous page).



*Courtesy of DualSun*

**Kringsjå's student village - Hybrid PVT and ground source heat pump hybridization**

100 hybrid solar panels installed linked to a geothermal ground source heat pump. Thus, solar energy is stored on the ground thanks to geothermal energy.

**La Marseillaise, 39 flats in Nantes - Solar thermal and heat pumps**

The 66 m$^2$ of hybrid PVT collectors are combined to 2000 liters Thermal Energy Storage, and a large heat pump. Smart and connected regulation.

# Appendix 6: Solar fraction of various building types & scenarios

The two cases below provide indicative examples of different building types (half/apartment) and their “solar fraction“, i.e. the share of energy which can be met thanks to the sun.

Different scenarios are proposed according to the age of the building (and its expected insulation) and their geographical location (Source: BDR Thermea).

## USE CASE 1: DOMESTIC HOT WATER (DHW) + SPACE HEATING/SINGLE HOUSE

**1) Detached or semi detached house**
- 4 people family house.
- DHW 60l /per person at 48ºC, in accordance with EN12831-3
- DHW Profile: EN12831-3 Single Family Dwelling
- Building inhabitable area: 150 $m^2$

***Solution: Solar for DHW only- Hybridation with HP***
- 2 solar thermal panels (4$m^2$)
- DHW Tank: 300L
- HP: 8 kW

| **Age of buildings** | **Geographical area**<br>(and solar faction covered for DHW or DHW+SH and potential technology alternatives to cover the rest) | | |
|---|---|---|---|
| | **South:<br>Athens** | **Central/West:<br>Strasbourg** | **North:<br>Helsinki** |
| Retrofit<br>- U-value: 0,5 W/K/$m^2$<br>- Specific heating energy demand: 150kWh/$m^2$ | - DHW demand: 3026 kWh/yr.<br>- SH demand: 1045 kWh/yr<br>**- Solar Fraction: 64,5%**<br>**- Solar thermal production: 3524 kWh**<br>**- Electricity Imported from grid: 763 kWh.** | - DHW demand: 3745 kWh/yr<br>- SH demand: 12569 kWh/yr<br>**- Solar Fraction: 14,6%**<br>**- Solar thermal production: 2527 kWh**<br>**- Electricity Imported from grid: 5545 kWh.** | |
| New (Low-Energy)<br>- U-value: 0,35 W/K/$m^2$<br>- Specific heating energy demand: 30kWh/$m^2$ | - DHW demand: 3026 kWh/yr<br>- SH demand: 154 kWh/yr<br>**- Solar Fraction: 75,3%**<br>**- Solar thermal production: 3524 kWh**<br>**- Electricity Imported from grid: 469 kWh.** | - DHW demand: 3745 kWh/yr<br>- SH demand: 6161 kWh/yr<br>**- Solar Fraction: 22,7%**<br>**- Solar thermal production: 2524 kWh**<br>**- Electricity Imported from grid: 3378 kWh.** | - DHW demand: 4235 kWh/yr<br>- SH demand: 14188 kWh/yr<br>**- Solar Fraction: 11,5%**<br>**- Solar thermal production: 2237 kWh**<br>**- Electricity Imported from grid: 7240 kWh.** |
| New (Passive)<br>- U-value: 0,15 W/K/$m^2$<br>- Specific heating energy demand: 15kWh/$m^2$ | | | - DHW demand: 4235 kWh/yr<br>- SH demand:9356 kWh/yr<br>**- Solar Fraction: 15,2%**<br>**- Solar thermal production: 2237 kWh**<br>**- Electricity Imported from grid: 5451 kWh.** |

## USE CASE 2: DOMESTIC HOT WATER (DHW) + SPACE HEATING/APARTMENT BUILDING

**2) Apartment building**
- 120 people.
- DHW 30l/per person at 48ºC, in accordance with EN12831-3
- DHW Profile: EN12831-3 Apartment Dwelling
- Building inhabitable area: 5000 $m^2$
- Roof area: 625 $m^2$

***Solution: Solar for DHW only- Hybridation with HP***
- 30 solar thermal panels ($2m^2$)= $60m^2$
- Tank DHW: 4000 liters; Tank SH: 4000-6000 liters
- HP: 100-250 kW, depending on scenario

| Age of buildings | Geographical area<br>(and solar faction covered for DHW or DHW+SH and potential technology alternatives to cover the rest) | | |
|---|---|---|---|
| | **South:<br>Athens** | **Central/West:<br>Strasbourg** | **North:<br>Helsinki** |
| Retrofit<br>- U-value: 0,5 $W/K/m^2$<br>- Specific heating energy demand: $150kWh/m^2$ | - DHW demand: 45424 kWh/yr<br>- SH demand: 115607 kWh/yr<br>**- Solar fraction: 24%**<br>**- Solar thermal production (kWh): 38981**<br>**- Electricity imported from grid (kWh): 28184** | -DHW demand: 56178 kWh/yr<br>- SH demand: 379517 kWh/yr<br>**- Solar fraction: 6.1%**<br>**- Solar thermal production (kWh): 26642**<br>**- Electricity imported from grid (kWh): 105650** | |
| New (Low-Energy)<br>- U-value: 0,35 $W/K/m^2$<br>- Specific heating energy demand: $30kWh/m^2$ | - DHW demand: 45424 kWh/yr<br>- SH demand: 43956 kWh/yr<br>**- Solar fraction: 42.9%**<br>**- Solar thermal production (kWh): 39045**<br>**- Electricity imported from grid (kWh): 12577** | - DHW demand: 56178 kWh/yr<br>- SH demand: 210884 kWh/yr<br>**- Solar fraction: 10.1%**<br>**- Solar thermal production (kWh): 27053**<br>**- Electricity imported from grid (kWh): 63249** | - DHW demand: 63532 kWh/yr<br>- SH demand: 359446 kWh/yr<br>**- Solar fraction: 5.2%**<br>**- Solar thermal production (kWh): 22093**<br>**- Electricity imported from grid (kWh): 114973** |
| New (Passive)<br>- U-value: 0,15 $W/K/m^2$<br>- Specific heating energy demand: $15kWh/m^2$ | | | - DHW demand: 63532 kWh/yr<br>- SH demand: 352295 kWh/yr<br>**- Solar fraction: 5.4%**<br>**- Solar thermal production (kWh): 22322**<br>**- Electricity imported from grid (kWh): 112919** |

# Appendix 7: Solar thermal and heat pump hybridization benefits


More info on: Effizientes Heizen project, Potential Benefit of Combining Heat Pumps with Solar Thermal for Heating and Domestic Hot Water Preparation and Dualsun study

**Improved Efficiency**

One of the main benefits of integrating solar thermal collectors with a heat pump is improved overall efficiency. While heat pumps are already efficient—producing up to four units of heat for every unit of electricity used—their performance can be enhanced further when paired with solar thermal collectors. These collectors are capable of converting up to 80% of solar thermal energy into usable heat, significantly boosting the system's total efficiency.

**Lower Operating Expenses**

Using solar thermal collectors alongside a heat pump can also lead to lower operating costs. Since solar thermal collectors produce heat from sunlight at no cost, and the heat pump only requires electricity to function, the combined system reduces the need for electricity to heat a space. This results in noticeable savings on energy bills.

**Smaller Environmental Impact**

Another significant advantage of this combined system is its reduced environmental impact. Solar thermal collectors generate heat without emitting greenhouse gases, and the efficient nature of heat pumps means they consume less electricity overall. Together, these systems contribute to lower carbon emissions compared to conventional heating methods.

**Extended System Longevity**

Pairing a heat pump with solar thermal collectors can also enhance the longevity of the entire heating setup. Solar thermal systems typically require little maintenance and can last up to 30 years, while heat pumps can operate efficiently for up to 20 years with regular care. This combination can help extend the overall lifespan of the heating system compared to using a heat pump alone.

# Appendix 8: Fair national solar mandate - the Styrian example in Austria

As part of the implementation of the Energy Performance of Buildings Directive, the Austrian state of Styria opted in 2024 to introduce a fair system that accounts for the differences in energy production between various technologies.

***Styrian Building Law, Section 80b Highly efficient alternative systems and use of renewable energy systems***
*For new buildings, with the exception of residential buildings, with a gross floor area of more than 250 $m^2$, solar energy systems must be built on the building surfaces or on other structures on the building site. For every 100 $m^2$ of gross floor area, photovoltaic systems with a gross area of at leat 6 $m^2$ or solar thermal systems with a gross area of at leat 2 $m^2$ must be installed.*

Austria, one of the leading countries in solar thermal energy, has introduced **fair legislation in line with the energy efficiency of its technologies**. However, solar thermal panels have three times the density of photovoltaic panels. That's why **the surface area to be covered is three times less for solar thermal than for photovoltaic**.

Austria Solar's campaign to promote the installation of solar thermal energy in Styria:


*Courtesy of Austria Solar*

# Appendix 9: List of National Associations members of Solar Heat Europe

| | | | |
|---|---|---|---|
| **AFIQ.ER** (Portugal) | **Oscar Araujo** | oscar.araujo@hiperclima.pt | |
| **ASIT** (Spain) | **Pascual Polo** | info@asit-solar.com | |
| **BELSOLAR** (Belgium) | **Wim Persoons** | wim.persoons@thema-sa.be | |
| **Aurinkoenergiayhdistys** (Finland) | **Christer Nyman** | tj@sary.fi | |
| **AUSTRIA SOLAR** (Austria) | **Roger Hackstock** | roger.hackstock@austriasolar.at | |
| **BSW** (Germany) | **Charlotte Brauns** | brauns@bsw-solar.de | |
| **ENERPLAN** (France) | **Edwige Porcheyre** | edwige.porcheyre@enerplan.asso.fr | |
| **Holland Solar** (Netherlands) | **Floor Maassen** | floor.maassen@hollandsolar.nl | |
| **EBHE** (Greece) | **Costas Travasaros, Christos Travasaros** | ctravasaros@primelasertech.gr, chtravasaros@primelasertech.gr | |

| | | | |
|---|---|---|---|
| **EBHEK**<br>(Cyprus) | **Panayiotis Kastanias** | pkastanias@oeb.org.cy | |
| **Solterm Italia**<br>(Italy) | **Adriano Desideri** | adriano@solho.eu | |
| **SPIUG**<br>(Poland) | **Janusz Staroscik** | janusz.staroscik@spiug.pl | |
| **Swissolar**<br>(Switzerland) | **David Stickelberger** | stickelberger@swissolar.ch | |
| **Solar Macedonia**<br>(North Macedonia) | **Stefan Trajkov**<br>**Ilija Nasov** | trajkov-stefan@live.com, ilija.nasov@yahoo.com | |

# Solar Heat Europe

- The voice of the solar thermal sector
- Established in 1992
- Members from the whole value chain (suppliers, manufacturers, project developers, research institutes) and National Associations across Europe
- A technology providing clean, renewable heat for buildings, district heating and industry
- Meeting 90% of the EU demand with a strong EU SME manufacturing base
- A growing installed capacity for over 3 decades, reaching >41GWth, across 11 million rooftops
- Exporting worldwide


*Courtesy of Austria Solar*


*Courtesy of Velux*

Solar Heat Europe

**Solar Heat Europe**
Place du Champ du Mars 2
BE-1050 Brussels

+32 2 318 40 60
info@solarheateurope.eu
**www.solarheateurope.eu**