Decarbonising heat with Solar thermal

Market outlook 2023/2024

Solar Heat Europe
ESTIF

41 GW_{th}

Cumulative capacity in operation in Europe

+ 0.6%

total installed capacity in operation in 2023 vs 2022 with very different country variations year on year

4 Main Market Segments:

- Residential Buildings
- Tertiary Buildings
- District Heating
- Industry

Heat is half of our current energy needs

We need to give heat the priority it deserves...

Heat is half of the total energy that we need – far more than the energy required for fuel/ transport and electricity.

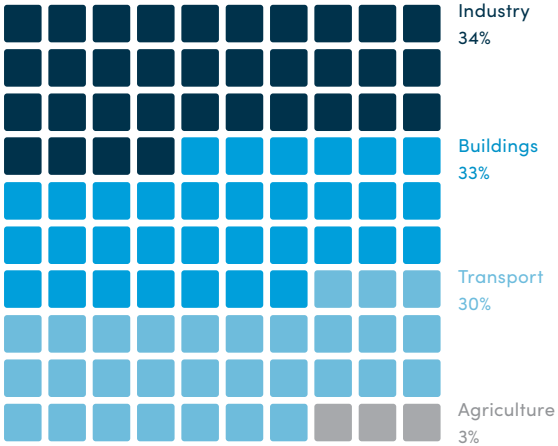
Despite this, only 25% of our heat in Europe is generated from renewable sources.*

* Essentially biomass

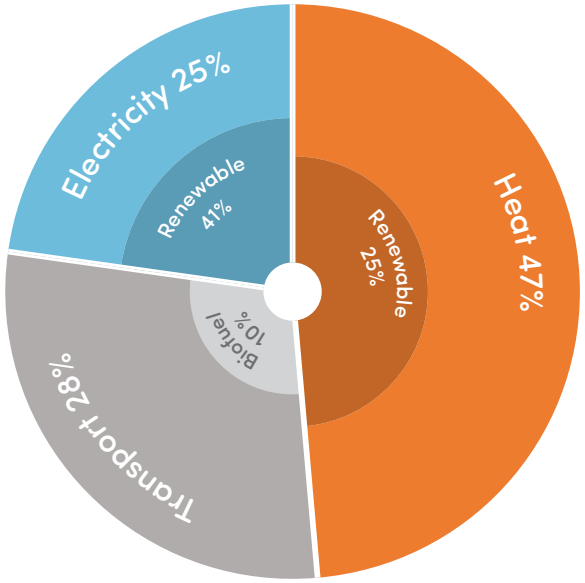
#Heatishalf

Energy users

Source REN 21 (2021)



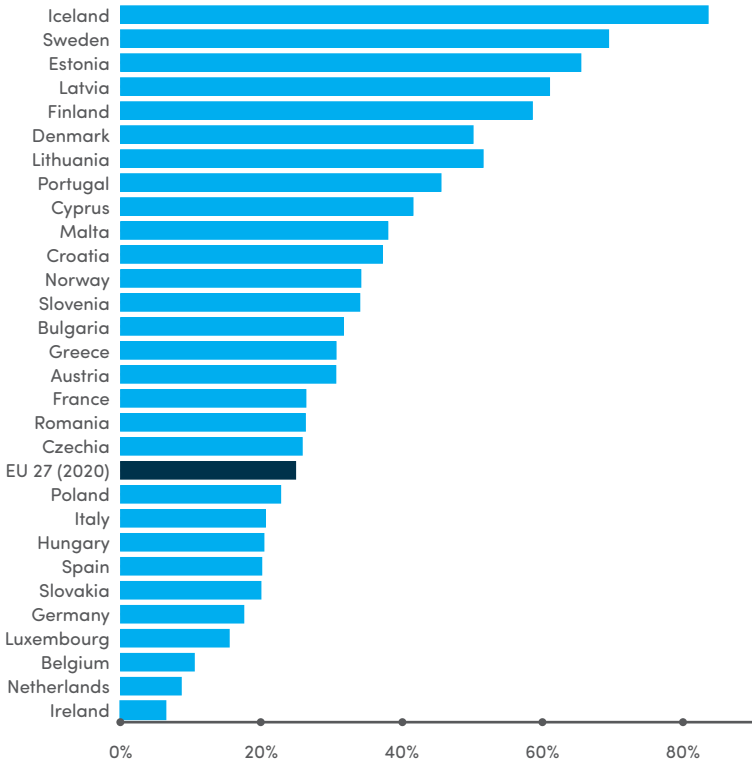
Total final energy and total modern renewable energy share, by energy carrier, European data (Source: Eurostat for year 2022)



EU Renewable Energy Directive (RED) targets (2023):

- Art. 3: Total share of RES sources in 2030: 42.5%, aiming for 45%
- Art. 23: Binding target for the share of RES for heating and cooling: Member States to increase by at least 0.8 percentage points annually (for 2021-2025) and by at least 1.1 percentage points annually (for 2026-2030)

Share of energy from renewable sources for heating and cooling 2022 (Source: Eurostat)



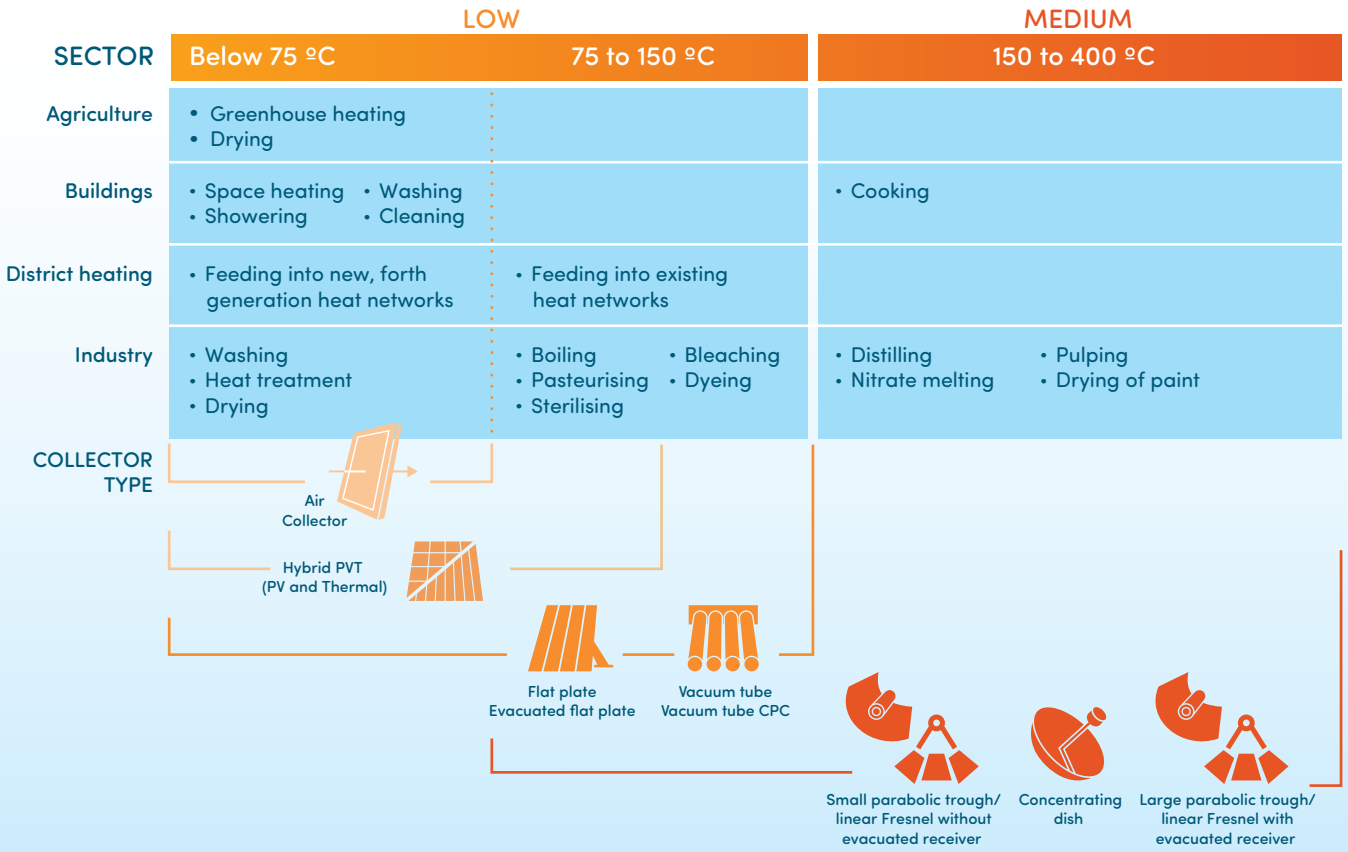
Giving more priority to heat and its decarbonisation, notably through direct RES heat sources such as Solar Thermal, is therefore urgent and of utmost importance to:

- **relieve pressure on the grid**
- **create a level playing field for all technologies.**

Solar Thermal:
An obvious source of energy to provide hot water and heating for millions of applications, from residential to commercial and industrial users...

Solar thermal is based on a simple principle: capturing the free energy of the sun to deliver hot water and heat.

Technological innovation has resulted in various ways to harness solar heat for domestic and industrial use. Certification, including the Solar Keymark, provides quality assurance to consumers and public authorities.



The Solar Keymark
CEN Keymark Scheme

- Over 20 years of certification standards
- More than 1 150 certificates granted
- CEN scheme
- Transparent and open
- More than 300 stakeholders

Solar Thermal:

A ready-to-deploy technology, from

30°C to **400°C**

A strong European manufacturing base:

- able to meet the EU demand for solar thermal systems
- net exporter worldwide
- able to triple EU based manufacturing by 2030, provided proper incentives are in place

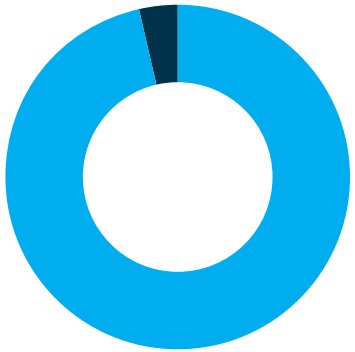
150.7 million tons of CO_2 saved per year thanks to 122 million solar thermal systems installed worldwide

> 90% recyclable (copper, glass, stainless steel, aluminium)

Recap: Solar Thermal 2023

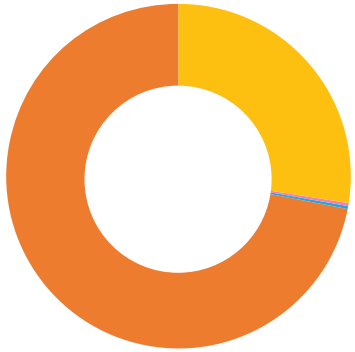
Market overview - All market segments

Solar thermal in volume, in Europe, by market segment
(Source: Solar Heat Europe)



96%
of solar thermal volume
is installed on buildings

Distribution of the newly installed capacity by collector type in 2022 - Europe
Source: IEA Solar Heating and Cooling Programme - Solar Heat Worldwide



Europe: EU27, Albania, North Macedonia, Norway, Russia, Switzerland, Turkey, United Kingdom

Country	Use of Solar thermal per capita	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%**

0 kW_{th} per 1000 capita 800

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

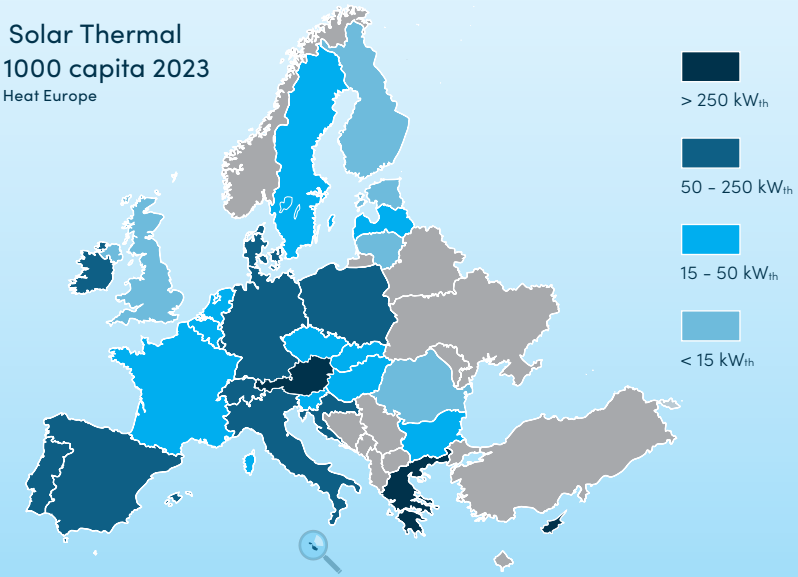
1) The relation between collector area and capacity is $1m^2 = 0.7kW_{th}$ (kilowatt-thermal)
2) Capacity "in operation" refers to the solar thermal capacity built in the past and deemed to be still in use. Solar Heat Europe/ESTIF assumes a 20 year product life for all systems installed since 1990. Most products today would last considerably longer, but they often cease to be used earlier, e.g. because the building was demolished, or there has been a change of building use.
3) The figures shown here relate to Metropolitan France (mainland). As a reference, in 2022 the newly installed capacity in overseas departments is estimated to be around 60 MW_{th} (86 000 m^2).

Key learnings from 2023

2023 was marked by:

- Lower investments due to higher interest rates leading also to a lower-than-expected pace of heat modernisation across Europe
- Unstable policy signals regarding fossil fuels and the decarbonisation of heating and cooling
- Stop and go market effect in some countries, due to inconsistent public policies and subventions
- A reduction of the gas prices and of the ETS carbon price (for industry), hampering the transition towards more sustainable supplies
- A fierce competition amongst heating and cooling technologies
- Dumping practices of solar PV panels, with very low prices indirectly affecting solar thermal sales
- Yet, a growing installed capacity for all Solar Thermal market segments and great new large scale projects commissioned, including growing share of some innovative technologies (e.g. solar PVT)

Installed Solar Thermal kW_{th} per 1000 capita 2023
Source: Solar Heat Europe



Our call to support Solar Thermal market growth is to:

- Prioritise the decarbonisation of heating and cooling, focusing on the decentralised supply of heat
- Give clear political signals to market players calling for a faster transition to renewable energy sources
- Recognise and raise awareness of the value of Solar Thermal to balance the grid (i.e. every system comes with heat storage built-in)
- Stop incentivising new fossil-fuel only systems
- Ensure Solar Thermal is granted with similar incentive conditions as other RES technologies (e.g. VAT rebate, building obligations/ solar mandate, access to funding, etc.)
- Have stable, predictive financial support for Solar Thermal, both for new systems in buildings and in industry
- Support EU Solar Thermal manufacturers on new investments to help protect them from unfair competition from Asian manufacturers, mainly those supplying solar PV and, in some cases, Solar Thermal
- Ensure Solar Thermal and hybrid solar PVT are well covered within one-stop shops (EPBD) and single contact points (NZIA)
- Ensure the development and availability of skilled workforce at local level on heating and cooling, including Solar Thermal, for public entities, consultancies and installation companies

Europe Market growth trends	2021 (vs 2020)	2022 (vs 2021)	2023 (vs 2022)
Newly installed capacity	+ 8%	+ 12%	- 22%
Total installed capacity	+ 1%	+ 2%	+ 0.6%

Residential and tertiary buildings

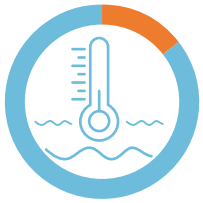
The needs

80%

of the energy needs by EU households relate to space heating & water heating. Both can be addressed by Solar Thermal but only a fraction (1.5%) currently are.

Space heating
64.4%

Water heating
14.5%



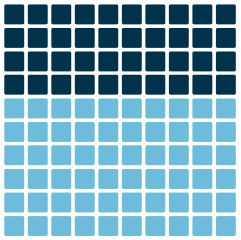
Lighting & electrical appliances 13.6%

Cooking
6%

Other uses
1.1%

Space cooling
0.5%

Around 40% of energy consumed in the EU is used in buildings



Over 1/3 of the EU's energy-related GHG emissions come from buildings

Energy consumption for heating in buildings by source, global data, 2022 (Source REN 21)

63%
fossil fuels & other

26%
traditional biomass

11.5%
renewables

- **0.4%** Renewable district heat
- **1.0 %** Geothermal heat
- **1.6%** **Solar heat**
- **3.6%** Renewable electricity
- **3.6%** Ambient heat
- **4.8%** Modern bioenergy

EU Renewable Energy Directive (RED) targets (2023):

- Art. 15a (new): sub-sectoral target for the share of RES in buildings: 49% in 2030
- Art. 15c: introduction of renewable acceleration areas, where permit-granting shall be further streamlined
- Art. 16d: specific provisions regarding permitting for the installation of solar energy equipment and co-located energy storage assets

Energy Performance of Buildings Directive (2024):

- Solar Mandate applicable as from Dec. 26
- Minimum energy performance standards (MEPS)
- Zero emissions buildings
- Phase out financial incentives for stand-alone fossil boilers by end 2024

Emission Trading Scheme for Buildings (ETS 2- 2023):

- Buildings will fall under the ETS and will have to report about their emissions as from 2027
- Member States shall use their revenues for activities that contribute to addressing social aspects, e.g. measures to decarbonise heating and cooling or reduce energy consumption in buildings, particularly for low-income households and worst-performing buildings

Energy Efficiency Directive (2023):

- 11.7% reduction of energy consumption by 2030 (vs 2020)
- National comprehensive assessments for efficient Heating & Cooling (H&C)
- Mandatory H&C plans for cities above 45 000 inhabitants
- Efficient District Heating & Cooling criteria

Residential and tertiary buildings

The solution: Providing hot water and heat directly from the sun's energy with Solar Thermal

11 million
rooftops in Europe are equipped with solar thermal & thermal storage

Total installed capacity in Europe (mainland): **41 GW_{th}**
That's **58 million m²** of collectors

Newly installed capacity in 2023: **+ 1.27 GW_{th}**
- 22.7 % of newly installed capacity vs 2022
+ 0.6% of increase of the **total** installed capacity
An increase of + 1.8 million m²

All is relative – Varying countries dynamics in Europe in 2023 vs 2022:

UK + 70%
+ 15 394 new m²
A new market in growth

GR + 12%*
+ 469 280 new m²
Constant supportive scheme for renovation

FR + 8%*
+ 114 669 new m²
"Ma Prime Rénove" ongoing financing support scheme for various clean heat options notably solar thermal

NL + 3%*
+ 43 360 new m²
Supportive schemes include Sustainable Energy Incentive Measure (SDE++) for large scale projects and Sustainable Energy Investment Subsidy (ISDE) for buildings

DE - 47%
+ 367 000 new m²
An unfortunate counter effect of the Heating Law (requiring 65% RES heat supplies), with increases of sales of heat pumps and... gas boilers

* estimations

Solar Photovoltaic Thermal (PVT):

Total installed capacity in Europe:
1.01 million m²
= 64% of all PVT installed worldwide

FR	DE	NL
616 551 m²	162 549 m²	127 303 m²

2023 vs 2022:
Spain: + 34% (+ 7 382 m²)
Belgium: + 20% (+ 1 018 m²)
Germany: - 20%

Lighthouse projects delivered in 2023:
The British Library, Central London: 617 m²
Olympic Swimming Club, Barcelona: 2 082 m²

Countries with the largest Solar Thermal installed capacity (in operation):

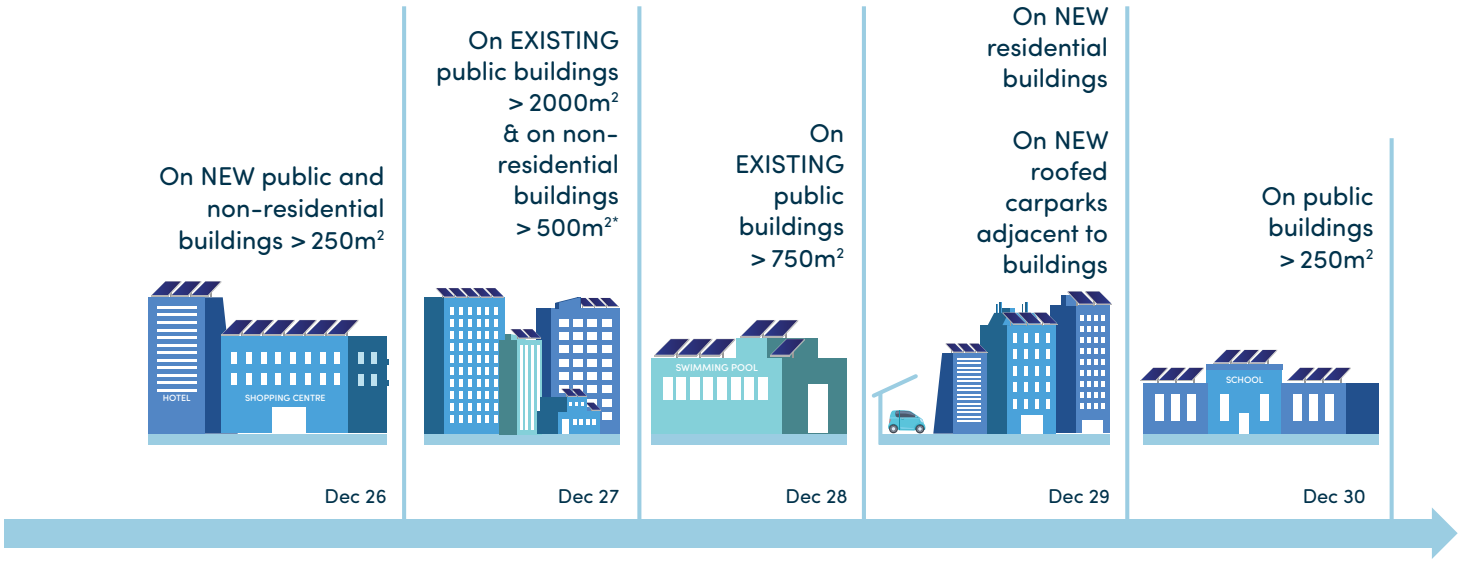
DE **13 285** MW_{th}
GR **4 204** MW_{th}
IT **3 829** MW_{th}
ES **3 089** MW_{th}
AT **2 471** MW_{th}

Buildings: The opportunity of the Solar Mandate (in EPBD) for Solar Thermal and PVT

The Energy Performance of Buildings Directive, published in May 2024, foresees the requirement that:

"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".

Member States shall ensure the deployment of suitable solar energy installations, if technically suitable and economically and functionally feasible, as follows:



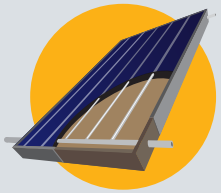
* in case of major renovation, action requiring a permit, works on the roof, or installation of a technical building system (i.e. heating system)

Capacity of the Solar Thermal sector in Europe X 3:
From
41 GW_{th}
to
> 120 GW_{th}
by 2030

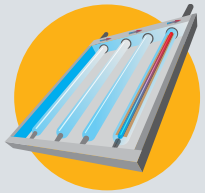
Solar Thermal collectors

Providing hot water and heating

Evacuated flat plate

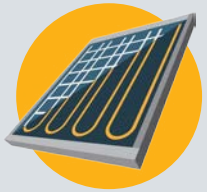


Vacuum tube CPC



Solar heat

PVT: A hybrid technology combining both PV and thermal



Solar electricity + Solar heat

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

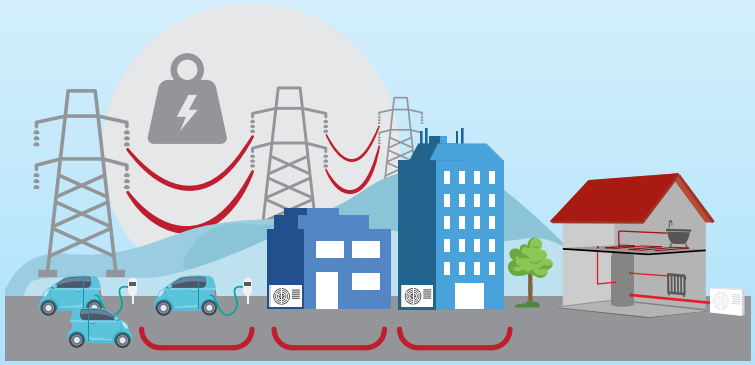
- Made in Europe
- 3 X more efficient than PV in terms of space
- A one-off capital investment, free energy for > 25 years and independence from energy price inflation
- Off grid
- Efficient heat storage comes as standard with every installed system
- Can hybridise easily with other energy supply or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

An adequate energy transition should foster a balanced approach including:

- Energy Efficiency
- Insulation
- **Solar Thermal & Thermal Energy Storage**
- Other RES, clean and efficient heat sources, etc
- Efficient district heating

Solar thermal can easily hybridise with a Heat Pump:

- Hybrid HP + ST has more efficiency than a standalone heat pump
- Reduces the electricity consumption of a heat pump
- Solar thermal produces zero carbon (or CO_2) energy, reducing the impact of the carbon content in the electricity supplied to the heat pump
- Reduces the stress on the heat pump, hence increasing its lifetime



Excessive load on the grid

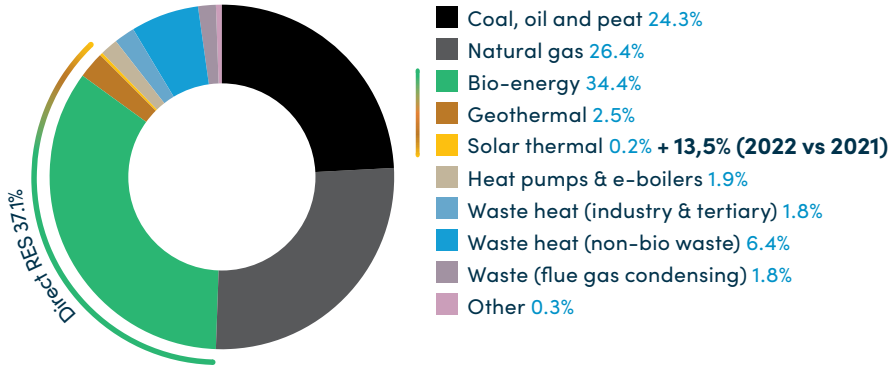
A more resilient approach

HP + ST =

- Higher efficiency
- Lower operating costs
- CO_2 reduction
- Higher longevity

19 000* district heating networks now in Europe, looking for decarbonisation solutions & new ones keen to be developed

Energy sources in European district heating
(2022- Source EHP)



Share of DH heat demands from residential and service sectors
(Source: EHP and Eurostat):

> 50%

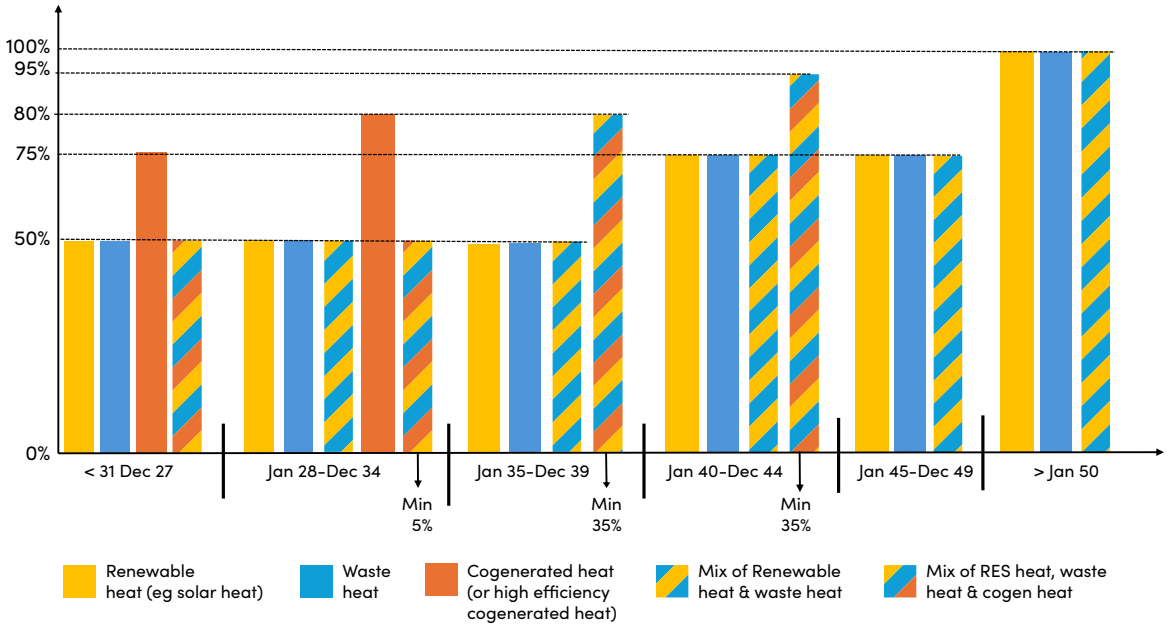
10 - 50%

< 10%

In 2023, the total number of District Heating networks existing in the EU reached 19 000. In the previous year, solar heat supply to the district heating fuel mix increased by 13.5%, with increases notably in Denmark, Germany and Poland.

*Source EHP 2024 Market report, in all these countries AT, BE, BO, BU, HR, CZ, DK, FI, FR, DE, GR, HU, IS, IT, KO, LT, LV EE , NO, PL, PT, RO, SK, RS, SI, ES, SE, CH, NL, UK.

The path towards "efficient district heating", as per the requirements of the 2023 Energy Efficiency Directive



By specific deadlines, district heating networks will need to comply with any of the above options i.e. containing an increasing minimum share of RES heat (or others), reaching 100% in 2050

Energy Efficiency Directive (2023):

- 11.7% reduction of energy consumption by 2030 (vs 2020)
- National comprehensive assessments for efficient district heating & cooling
- Mandatory H&C plans for cities above 45 000 inhabitants
- Efficient District Heating & Cooling criteria for new or substantially refurbished systems

(See also ETS for buildings as from 2027)

Solar Thermal District Heating (SDH)

Solar Thermal has great potential to be the route towards district heating decarbonisation.

256

towns and cities in Europe use solar heat[1], with

1 372 MW_{th}

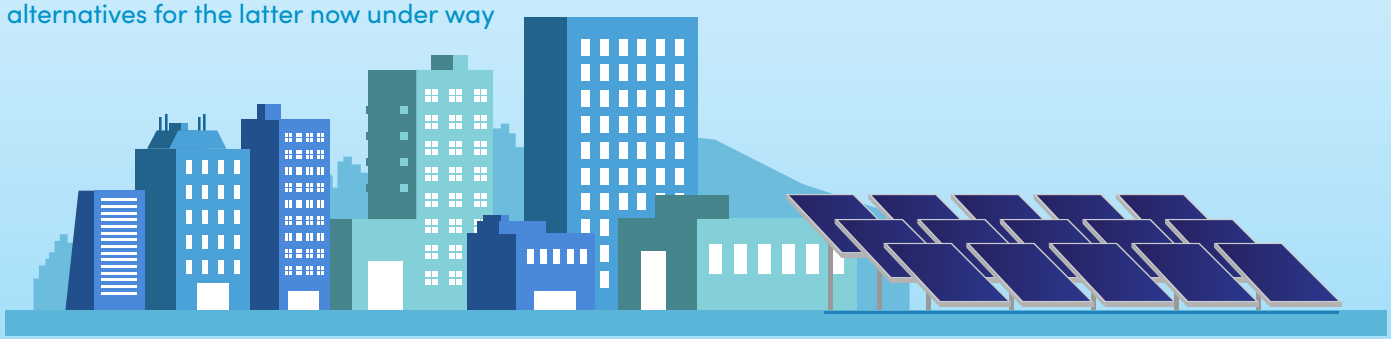
in operation

Of the 20 largest solar district heating systems in the world....

The **biggest is in Denmark**, Silkeborg (**110 MW_{th}**)

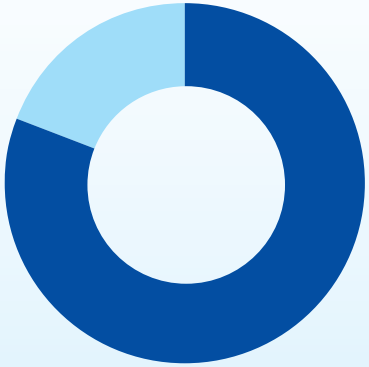
11 are in Denmark, **7** in China, **1** in Saudi Arabia, **1** in Latvia

The one in Latvia is based at 90% on renewables with 20% solar heat, 70% biomass, with current alternatives for the latter now under way



81%

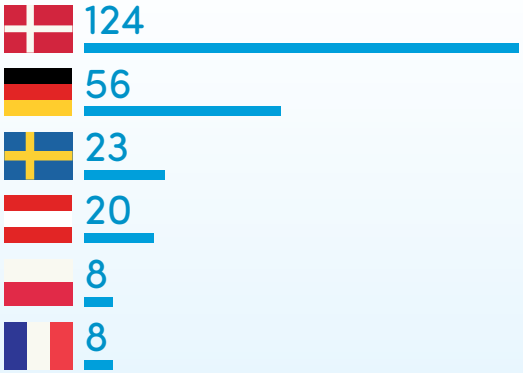
of the total Solar District Heating networks in the world are in Europe



More than

2 million m^2 solar collectors installed in total for Solar District heating

Solar thermal district heating networks in operation by European country (> 350 kW_{th}, 500 m^2)*:



Did you know?

In Germany:

- 56 SDH systems exist
- 8 projects are under development
- 70 projects in the pipeline totalling around 380k m^2
- 6 SDH systems were commissioned in 2023 totalling 13 995 m^2

In Austria:

2 expansions of existing systems in 2023 (newly installed collector area totalled 2 173 m^2 - 1.5 MW_{th})

In the Netherlands:

The fourth biggest SDH system in the world (48 000m^2) is currently under finalisation in Groningen

1 source IEA SHC, based on district heating definition above*

Industry Decarbonisation
Heat/Thermal requirements

Industry represents

33%

of the energy needs globally

60%

of these needs apply to **heat in the EU**

Source: REN 21

Decarbonising industrial heat will play a key role in achieving net-zero targets

EU Corporate Sustainability Reporting Directive (CSRD):

- Entered into force in Jan. 2023
- Objective: investors and other stakeholders to have access to the information they need to assess the impact of companies on people and the environment and for investors to assess financial risks and opportunities arising from climate change and other sustainability issues
- In scope: large companies, listed SMEs, some non-EU companies
- Reporting will start with new rules gradually as from the 2024 financial year, for reports published in 2025

Emission Trading Scheme:

- Covers greenhouse gas emissions from around 10,000 installations in the energy sector and manufacturing industry as well as aircraft operators and maritime transport
- Includes notably carbon dioxide (CO_2) from electricity and heat generation, from energy-intensive industry sectors, including oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals

EU Renewable Energy Directive (RED) targets (2023):

- Art.22a: new sub-sectoral target for industry: average increase of 1.6 percentage points for the share of RES (for the periods 2021-25 and 2026-30)

Industrial process heating in 2016 emitted 7.5 metric gigatons of CO_2

That's the equivalent to:

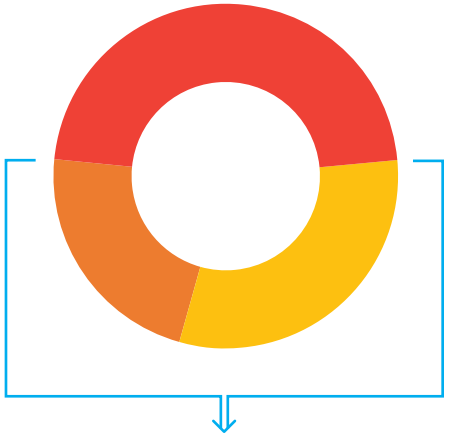
15% of all greenhouse gas emissions

About the same as the total emissions from the transport sector

IEA reported that only 9% of the total industrial energy uses were based on renewables sources. 45% from Coal, 30% from Natural Gas, 15% from Oil.

Source: WBCSD/Bloomberg NEF report "Hotspots for Renewable Heat", Sep. 21

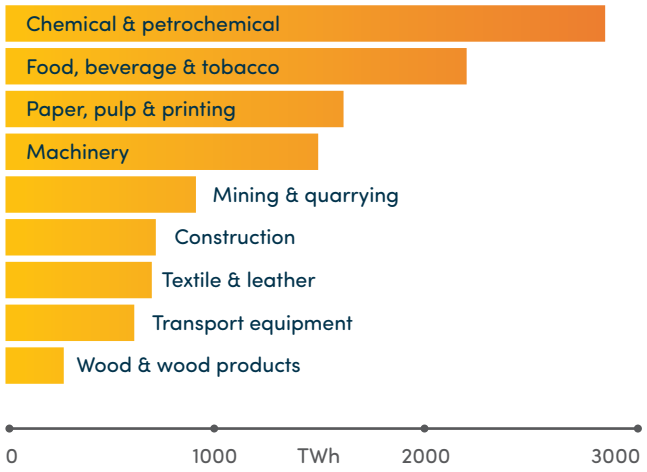
Global industrial heat demand by temperature (2018)
(Source: IRENA, IEA)



50%

of the heat needs by temperature **can** be met by solar thermal applications i.e. from low- to medium-temperature

Demand for low- to medium-temperature heat in selected industries globally 2018 (TWh):



Source: IEA. Note: Demand for low- to medium-temperature heat in energy-intensive industry is excluded since it represents a small portion of the total and is usually available as a by-product of high-temperature heat.

Industry Decarbonisation

The transition, with Solar Thermal for heating and/or cooling needs

Worldwide data:

1 209

Solar Thermal systems in operation (of at least 50 m² collector area or 35 kW_{th})

Covering

1.36

million m²

Representing a capacity of

951 MW_{th}

In 2023:

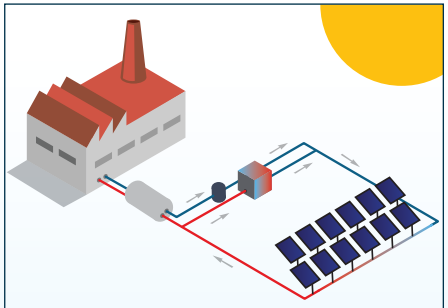
116

new systems were installed worldwide with a capacity of

94 MW_{th}

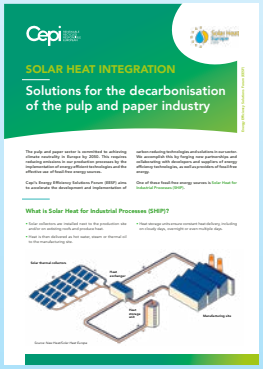
More details on 615 of these systems (incl. 197 ie 40% from Europe) via ship-plants.info

Sources: IEA SHC, Solar Heat Worldwide



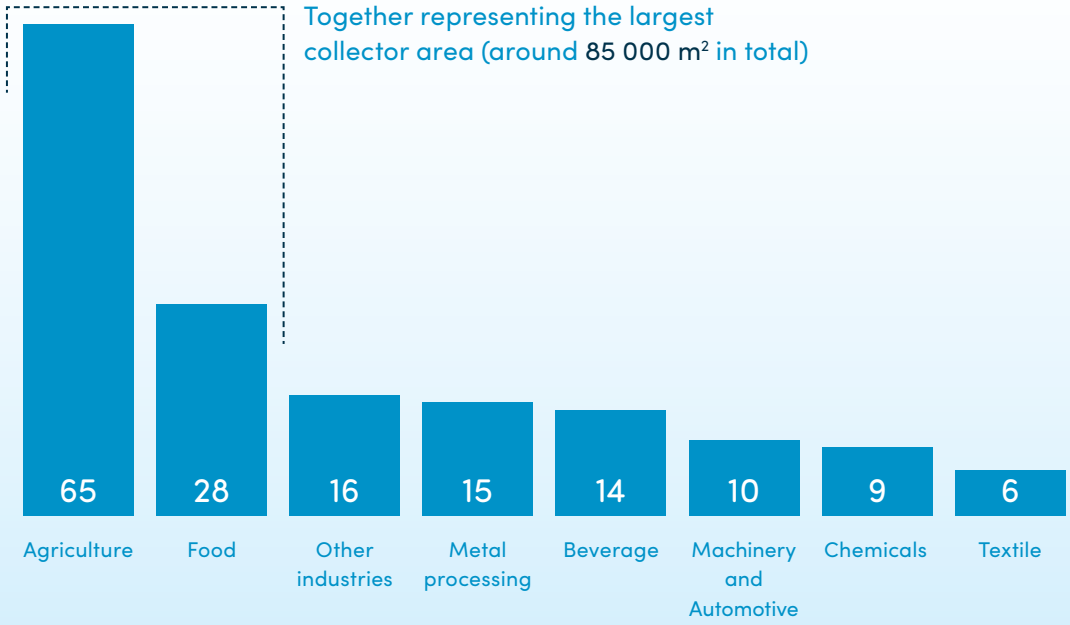
What is SHIP?

Solar Heat for Industrial Processes (SHIP) are systems which provide solar heat in a factory. A collector field heats a process fluid, and a heat exchanger transfers this heat as hot water, air flow, or steam. Storage units enable this heat to be used when required.



Did you know that Solar Heat Europe developed a joint brochure in April 2024 with Cepi, the European association representing the pulp and paper sector.

Europe - SHIP top 5 sectors:



Examples of Large Scale SHIP projects commissioned in 2023:

Heineken

Heineken, Sevilla, ES
43 000 m² (concentrating) solar collectors,
30 MW_{th} / 800 m³ storage tank

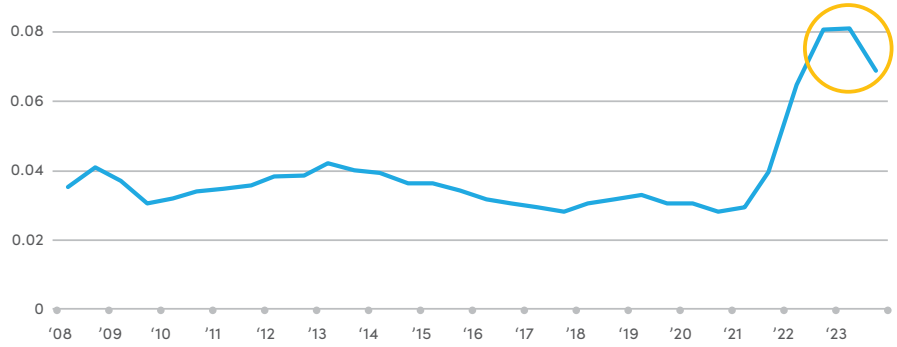
LACTALIS ingredients

Lactalis Ingredients, Verdun, FR
15 000 m² (flat plate) solar collectors
11 MW_{th} / 3 000m³ storage tank

Learnings from 2023 for the Large Scale Projects

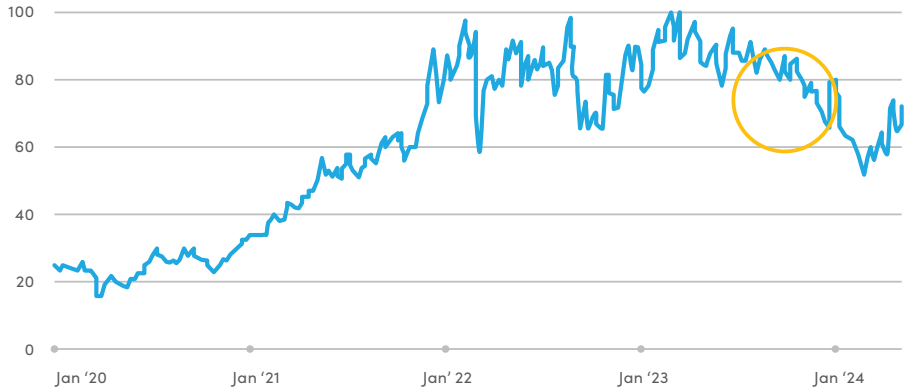
What didn't help

Development of natural gas prices for non-household consumers, EU, 2008-2023 (€ per kWh) Source: Eurostat



A serious diminution of the gas prices (vs 2022)

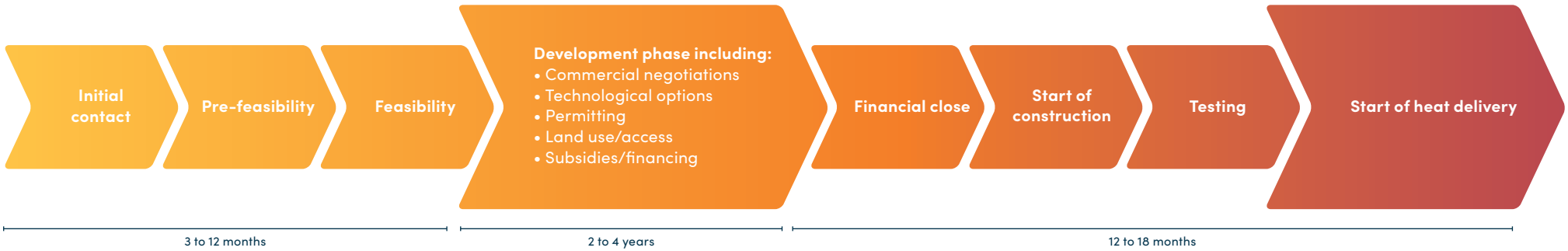
The price of emissions allowance in the EU
Cost per tonne of carbon dioxide produced (€) Source: Montel



A counterproductive trend/diminution of the carbon prices (ETS) (vs 2022)

Key phases of a "typical" Large Scale Solar Heat project (district heating or industry) and indicative timings:

Lengthy permitting (and financing) procedures, escalated from local, regional or national levels are delaying the projects.

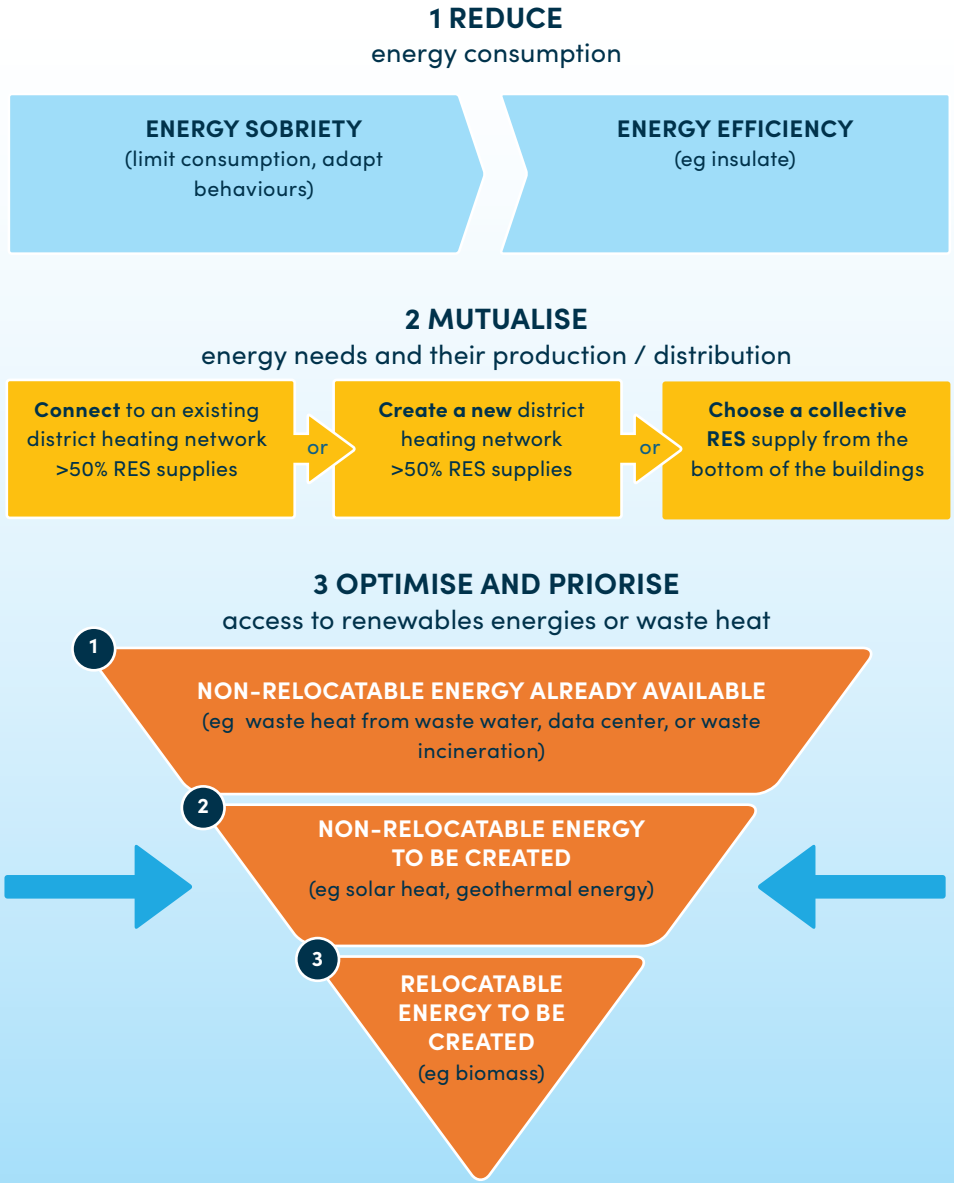


Learnings from 2023
What helped

A good precedent comes from the French Energy Agency ADEME, who published a hierarchy of measures and renewable heat sources that should be prioritised and followed when planning a new installation.

Developed under the “Fonds Chaleur”, these guidelines can apply to any collective installation, be it residential, tertiary, district heating or industry above 25 m².

This merit order in ENR’CHOIX (FR) gives:
- A clear political signal to municipalities and end-users for their decarbonisation options
- The corresponding financing support available in the country



*EnR’CHOIX - Le bon choix thermique pour votre territoire (ademe.fr)

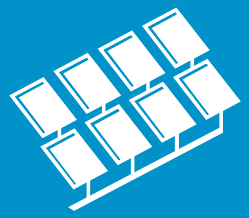
Solar heating & cooling
The Potential

By 2030, solar heat in Europe aims to provide:

Cumulative capacity in operation from **41 GW_{th}** (2023)

X3

to **140 GW_{th}** in 2030



Sector turnover **€24.3 billion**

Solar thermal systems in buildings **21 million**

Number of jobs **250 000**

Annual CO_2 Emissions savings **33.3 Mt CO_2**

Annual Gas consumption avoided **12.1 BCM**

Annual energy savings **125TWh$_{th}$**

Estimated energy storage capacity **750 GWh**

Source: Solar Heat Europe Roadmap, June 2022

For more information on solar heating & cooling:

Global: **International Energy Agency - Solar Heating & Cooling Programme**
www.iea-shc.org

EU: **Solar Heat Europe**
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