



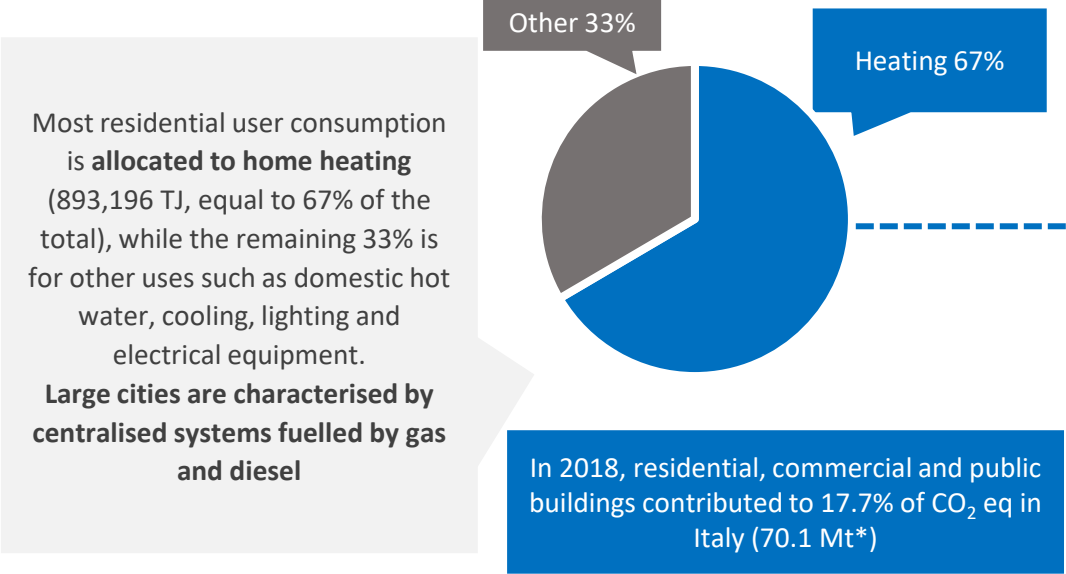
## A strategy for the decarbonisation of building heating systems in Italy

2021

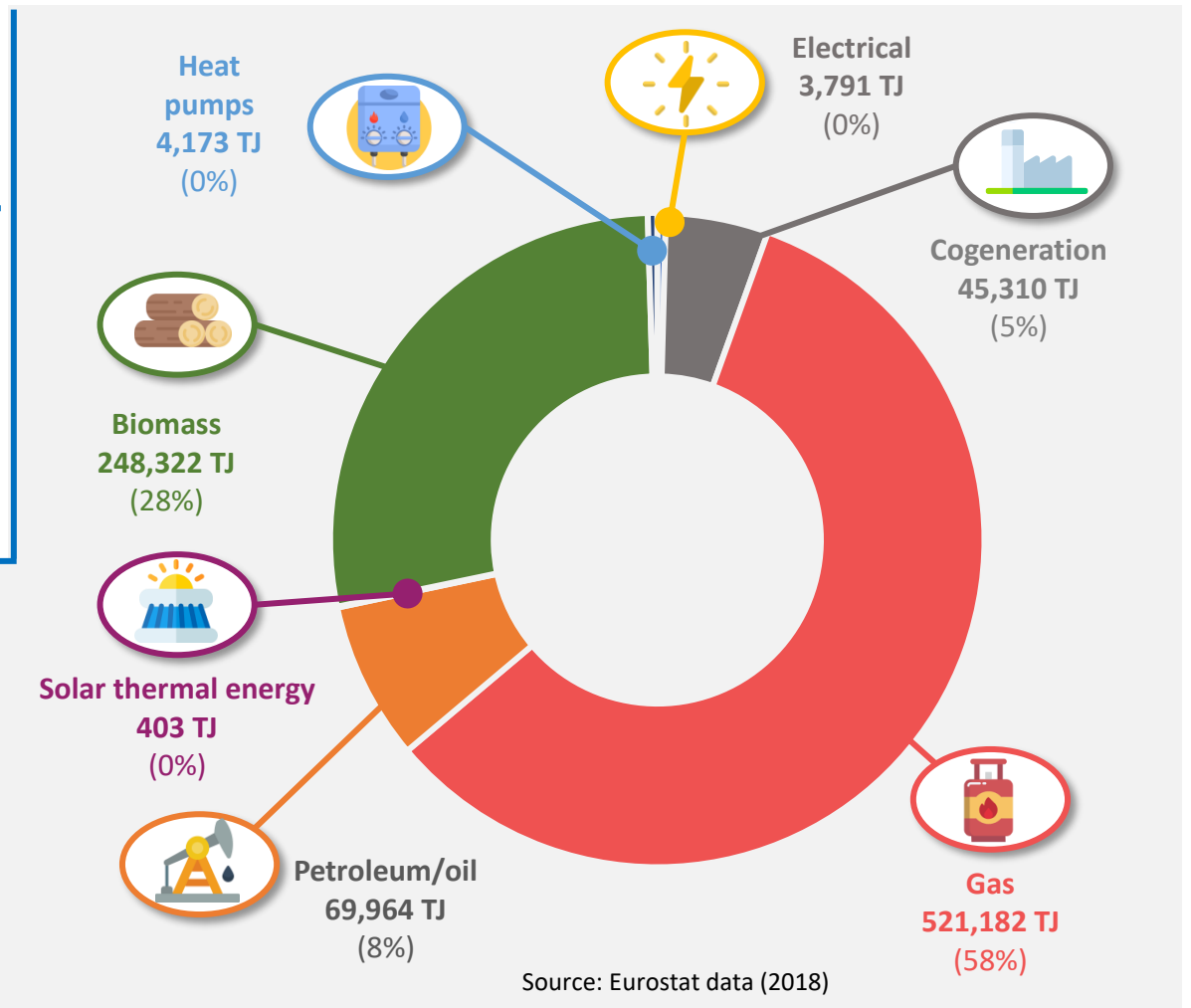
A study for



## Residential energy consumption



## Breakdown of energy consumption for heating by source



The main fuel used for residential heating is natural gas (50% of the energy supplied), typically used by traditional boilers.

This is followed by solid biomass, which accounts for 28% of the total (mainly wood and wood chips) and petroleum products (8%), such as oil-fired boilers, still widely used today in some large cities and non-methanised mountain areas.

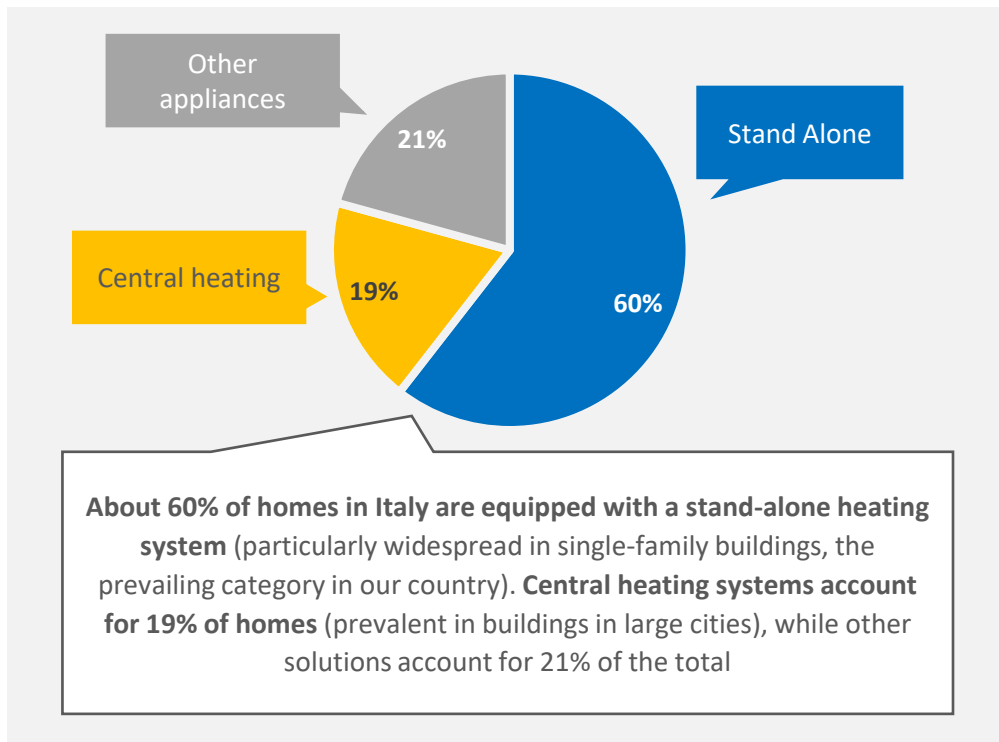
Cogeneration accounts for 5%, while solutions such as heat pumps, electric heating (boiler) and solar thermal (1% of the total) are marginal

\* Source: analysis of ISPRA data on emissions from the residential, commercial and institutional sectors

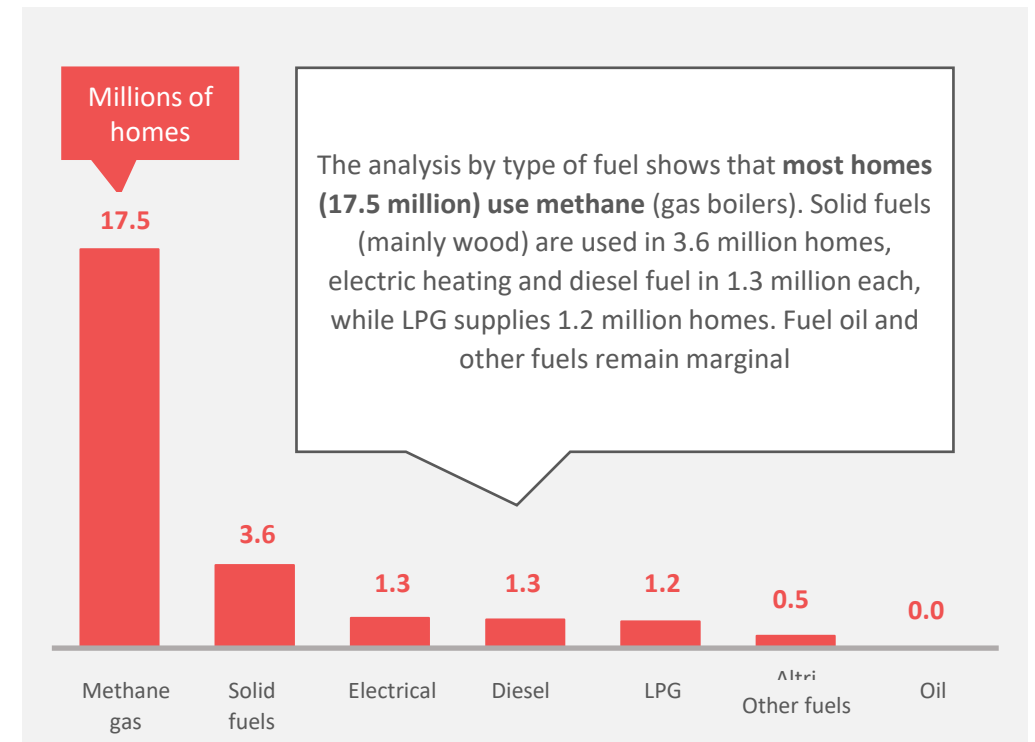
# Types of heating in homes

- To complete the analysis conducted on energy consumption, we evaluated the spectrum of heating solutions adopted in 25.5 million Italian homes (source: ISTAT 2011 census).
- Below is a breakdown of the heating systems in homes with at least one resident, both by type (stand-alone system, central heating or other appliances – such as electric stoves) – and by fuel or energy carrier used.

## Homes by type of heating



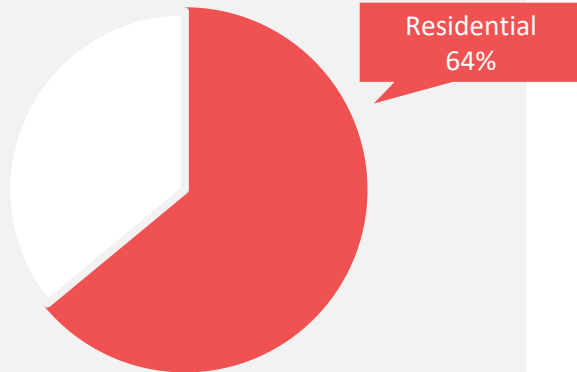
## Homes by type of fuel



# The contribution of residential heating to air pollution

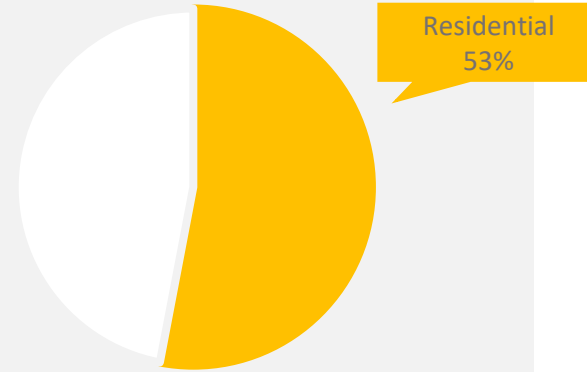
- According to the statistics published by ISPRA, the Residential sector – mainly due to heating – is one of the main causes of many of the polluting emissions monitored every year in our country.
- The role of domestic heating in atmospheric pollution was recently confirmed during the first lockdown enforced to deal with the health emergency: despite the shutdown of production activities and most of transport, PM<sub>10</sub> emissions in Lombardy decreased by only 17%, also due to an increase in the use of domestic heating (study by ARPA Lombardia).

## PM<sub>2.5</sub> emissions



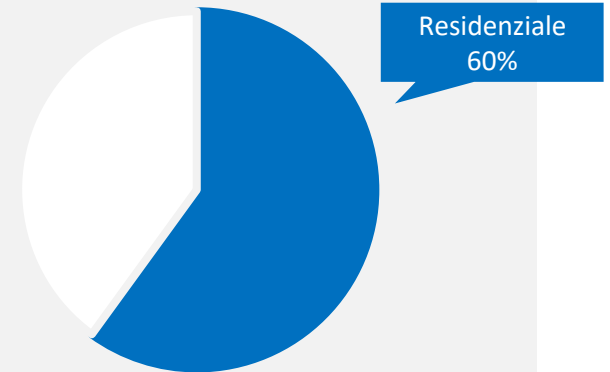
Of the 143.4 kt of PM<sub>2.5</sub> emitted into the atmosphere in 2018, **the residential sector is responsible for 64%, equal to 91.7 kt.** The remaining sectors cover the remaining 36%, with production activities representing the second category for emissions (16%)

## PM<sub>10</sub> emissions



Of the 177.5 kt of PM<sub>10</sub> emitted into the atmosphere in 2018, **the residential sector is responsible for 53%, equal to 94.1 kt.** The remaining sectors cover the remaining 47%, with production activities representing the second category for emissions (18%)

## CO emissions



Of the 2,081.5 kt of CO emitted into the atmosphere in 2018, **the residential sector is responsible for 60%, equal to 1,248.9 kt.** The remaining sectors cover the remaining 40%, with transport representing the second category for emissions (20%)

## AIR QUALITY

As seen above, heating contributes significantly to the worsening of air quality, particularly in the cities of Northern and Central Italy.

An analysis of air quality data published by ISPRA reveals that PM<sub>10</sub> readings in 47% of monitoring stations exceeded the regulatory threshold (50 µg/m<sup>3</sup>) on average for more than ten days in 2018, with Milan, Padua and Lodi recording more than 60 days above the permitted limits.

A similar scenario emerges in relation to other emissions, such as PM<sub>2.5</sub> and NO<sub>2</sub>: in both cases, among the municipalities with the highest emissions, the cities of the North stand out – Padua, Rovigo and Venice for PM<sub>2.5</sub> and Cinisello, Milan and Como for NO<sub>2</sub>.



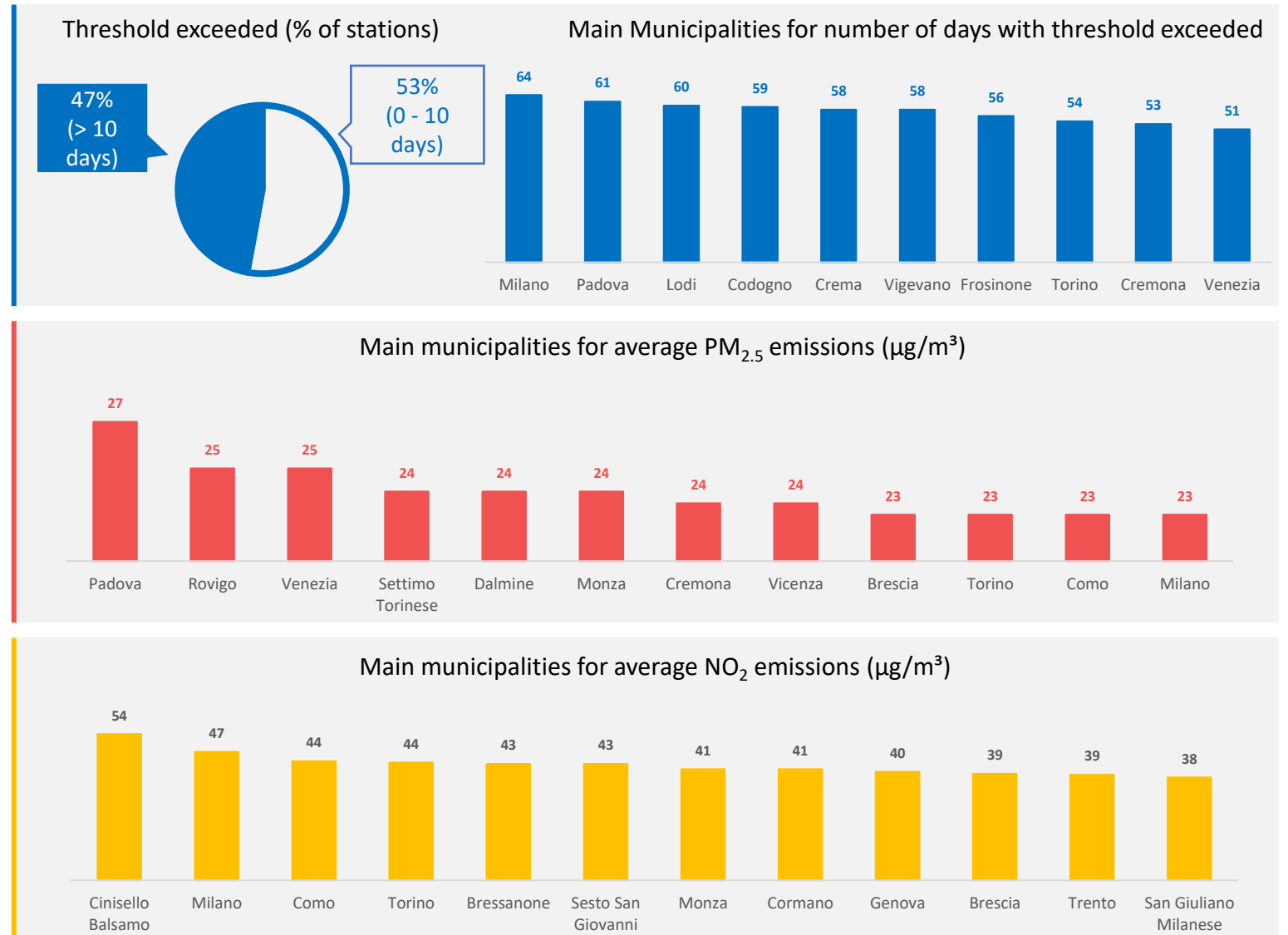
PM<sub>10</sub>



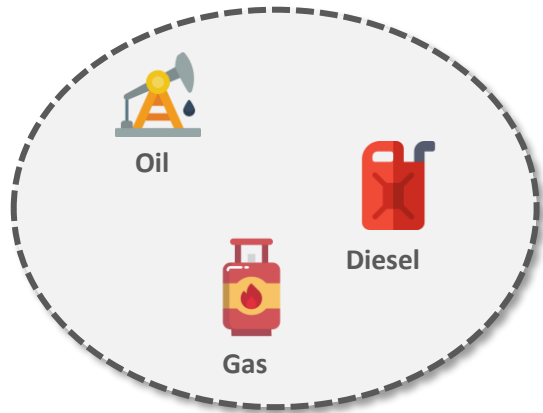
PM<sub>2,5</sub>



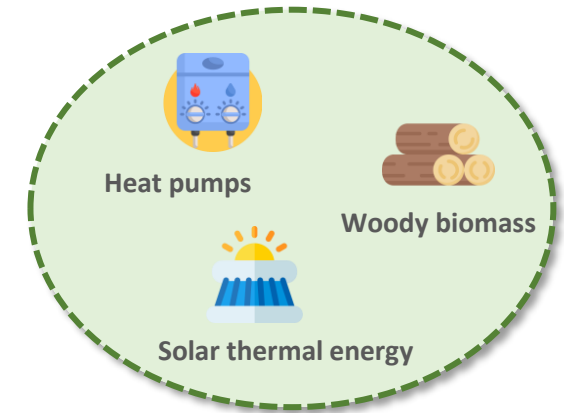
NO<sub>2</sub>



From fossil sources ...



...to renewables



*Mechanisms and proposals*



**MATTM**

- Analysis of environmentally harmful energy subsidies
- Main incentives for heating buildings from fossil sources



**Legambiente**

- Elimination of fossil fuel subsidies
- Review of incentive systems based on technology emissions
- Early phase-out of natural gas boilers



**Elemens**

- Potential of Geothermal Heat Pumps (ARSE – Associazione Riscaldamento Senza Emissioni)
- The potential of solar thermal
- Potential of renovation in woody biomass heating (AIEL – Associazione Italiana Energie Agroforestali)

## ENVIRONMENTALLY HARMFUL SUBSIDIES

For some years now, the Ministry of the Environment has been publishing a list of direct and indirect government subsidies benefiting the consumption of fossil fuels or related practices with negative environmental impact. For each facilitation, the type of instrument, the sector of impact and the financial consistency of the incentive are described. Total subsidies broken down by sector (2018) is shown below.



|                           |                        |
|---------------------------|------------------------|
| Agriculture and fisheries | 6,627.37 mln €         |
| <b>Energy</b>             | <b>24,885.93 mln €</b> |
| Transport                 | 1,724.20 mln €         |
| Other subsidies           | 5,014.31 mln €         |
| Reduced VAT               | 5,452.10 mln €         |

## Focus on residential heating

In economic terms, the energy sector is the one that derives the greatest benefits from environmentally harmful subsidies. In general, we can identify certain concessions that directly impact the residential heating sector:

**63,757**  
Boilers  
installed  
(2018)

**Ecobonus for  
gas boilers**

The Italian eco-bonus mechanism – recently upgraded with the 110% rate (superbonus) – encourages not only renewable technologies (e.g. geothermal heat pumps) but also solutions that use fossil fuels such as natural gas (condensing boilers)

**152.8**  
mln €

**Diesel and  
LPG in non-  
methanised  
areas**

This is the subsidy aimed at reducing the price for the purchase of diesel and LPG in non-methanised areas (mountain areas, Sardinia and smaller islands). This incentive, particularly diesel subsidies, contributes to slowing down the spread of thermal renewables in these parts of Italy

**10%**

**Reduced VAT  
on gas  
consumption**

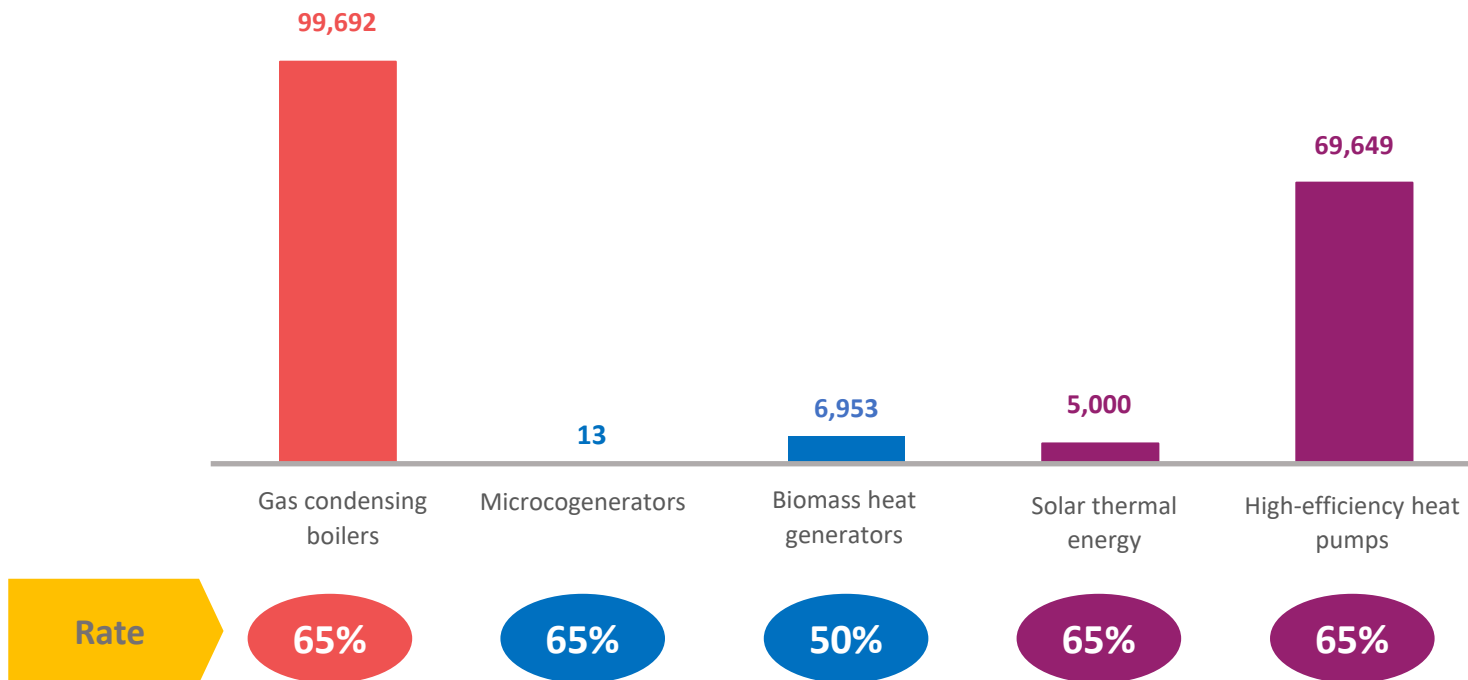
This is the reduced VAT rate (equal to 10%) intended for consumption for civil use for heating buildings; it is applied only to the first 480 cubic metres of gas consumed in the year

Source: List of Environmentally Harmful Subsidies, Italian Ministry of the Environment (2018)

# Focus on tax deductions: the results obtained by the Ecobonus

- To date, the main support mechanism for the installation of thermal renewable energy systems in the residential sector is the Ecobonus tax deduction – with the possibility, in the case of interventions considered to be “drivers”, to access the increased rate of 110% and the invoice discount
- However, the range of technological solutions facilitated by the Ecobonus includes certain technologies (such as gas condensing boilers) that have greater environmental impact compared to renewable source systems (such as geothermal heat pumps and solar thermal systems) which benefit from deduction rates equal to those used for zero-emission solutions

*Main interventions on heating systems (Ecobonus - 2019)*



On analysing the results of the Ecobonus mechanism with regard to the replacement of heating systems, it emerges that the installation of gas condensing boilers represents the prevalent category in terms of number of interventions (almost 100 thousand), followed by Heat Pumps (69 thousand, including those in the geothermal category).

The deployment of thermal solar panels remains marginal, with about 5,000 installations.

The installation of condensing boilers – to the detriment of renewables such as heat pumps and solar thermal systems – enables consumers to benefit from the same rate obtainable by installing zero-emission systems on site.



# A first proposal from Legambiente/Kyoto Club: switch subsidies from fossil fuels to renewables

- As previously examined, to date, some fossil-based technologies enjoy support mechanisms that encourage their uptake to the detriment of renewable energy systems.
- To encourage the spread of heating solutions characterised by zero emissions – such as heat pumps and solar thermal – Legambiente and Kyoto Club propose to eliminate or modify the subsidies currently granted in favour of fossil fuels.
- It will also be necessary to approve a support plan for companies to receive support in the transition phase: for example, the Minister of Economic Development issuing of a decree in favour of companies in the zero-emission conversion sector.

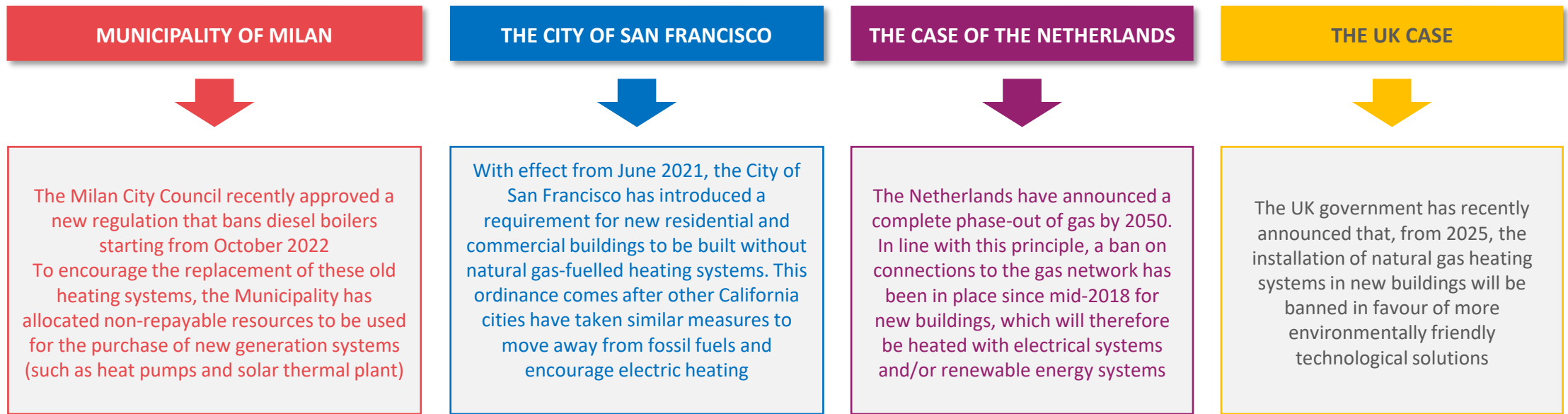
## Main changes advocated by Legambiente/Kyoto Club on subsidies benefiting fossil fuel consumption in domestic heating

| Subsidy   | Negative impact on renewables  | LA KC proposals  | Description of changes  |
|---|--|--|---|
| <b>Tax deductions for gas condensing boilers</b>                  | Technology competing with renewable and zero-emission sources, subject to the same deduction rate                      | <b>Removal/<br/>increased incentives for renewable energy technologies</b> | Elimination of access to the superbonus for fossil fuel systems. These technologies will be eligible for 50% deductions for plant replacement until 2025                    |
| <b>Reduced VAT exemption for gas</b>                              | Competitive advantage of gas systems compared to solutions with zero (or lower) emissions on site                      | <b>Removal</b>   | Since this incentive supports heating with fossil fuels (methane) to the detriment of solutions with a lower environmental impact, we propose a return to the ordinary rate |
| <b>Discount for the purchase of diesel and LPG mountain areas</b> | In non-methanised areas, residents are encouraged to buy diesel and LPG instead of installing renewable energy systems | <b>Switching subsidy targets</b>   | To encourage the spread of renewable and zero-emission systems, we propose a review of the incentives and reallocation to heat pumps and solar thermal or hybrid systems    |

# A second proposal from Legambiente/Kyoto Club: the “phase-out”

- In addition to support mechanisms for thermal renewables, a further boost to the uptake of solar thermal and heat pumps in the residential sector can be provided by measures to eliminate the most environmentally damaging heating systems.
- In this regard, some Italian municipalities have already planned to phase-out diesel boilers by 2022; at international level, some countries (such as the Netherlands) have gone further, announcing a complete switch away from gas by 2050.
- The proposal of Legambiente and Kyoto Club is to introduce a ban on the installation of heating systems powered by fossil fuels in newly constructed buildings from 2025. At the same time, the obligation to replace existing fossil fuel systems with heat pumps and renewables should be introduced, starting in urban areas and total building renovations.

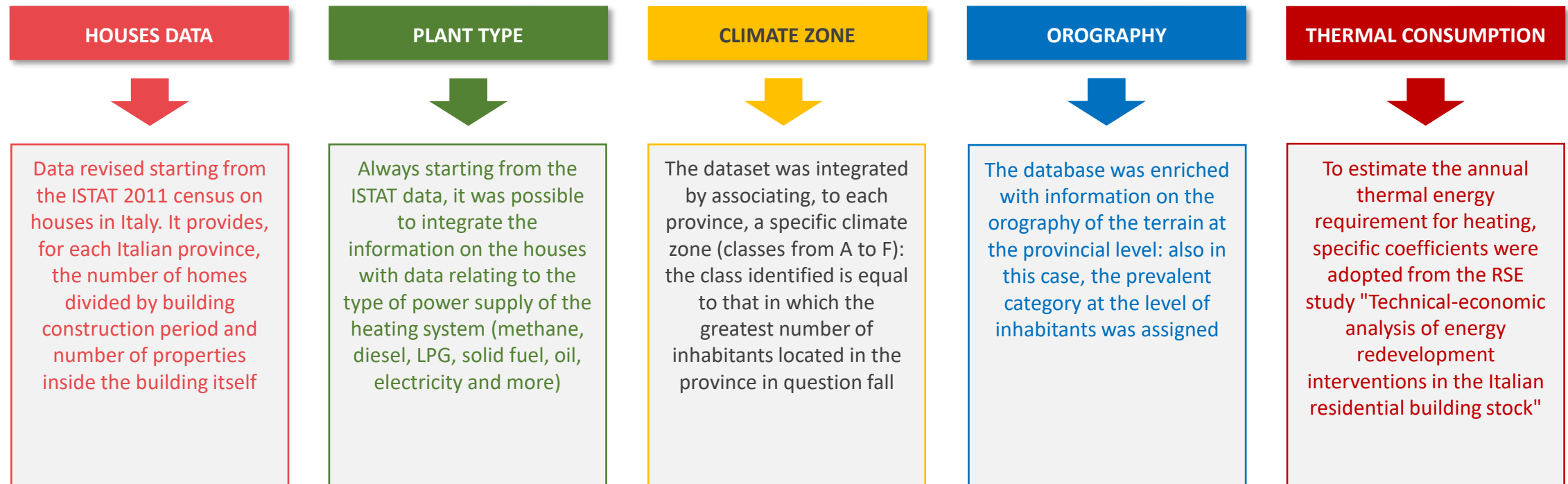
## SOME EXAMPLES IN ITALY AND IN THE WORLD



# The potential of geothermal heat pumps in the residential sector

- To estimate the market potential in the residential sector relating to geothermal heat pumps and solar thermal, Elemens relied on a dataset (based on ISTAT data) which includes all the houses in Italy at the provincial level, with detailed information on the type of building (number of houses per building), the construction period, the climate zone to which it belongs, the terrain orography and the type of power supply of the heating system, all data necessary for the assessment of the annual needs for heating of individual houses.
- The analyzes on the potential of geothermal heat pumps are taken from the study conducted for ARSE « Heat pumps for decarbonisation in heating ».

## MAIN INFORMATION DATASET CASE



# The potential of geothermal heat pumps in the residential sector



## Geothermal heat pumps\*

From heating demands...

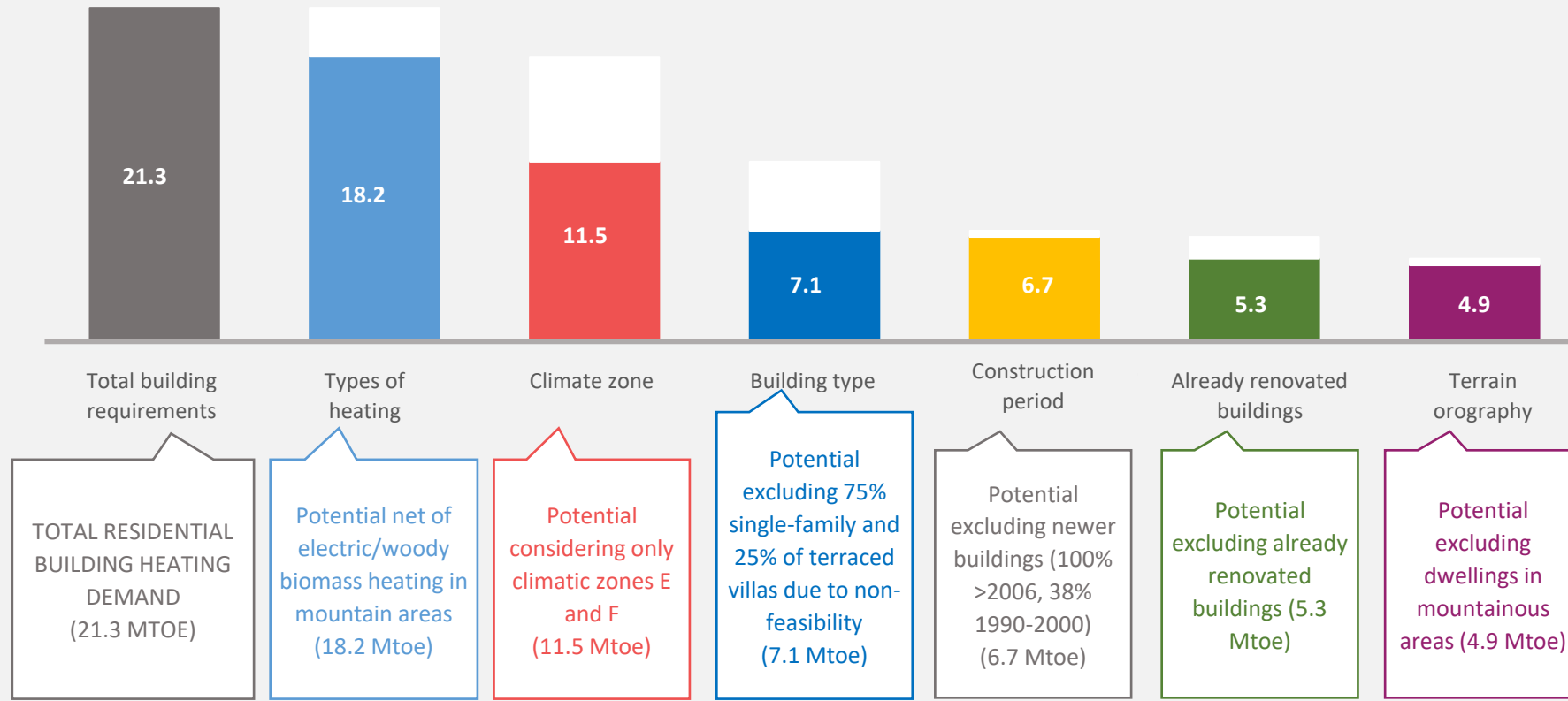


...to the potential of geothermal heat pumps

Geothermal heat pumps can serve heating demand to the extent of 4.9 Mtoe



**+ 1 million potentially installable geothermal heat pumps, corresponding to approximately 56 GW of power**



TOTAL RESIDENTIAL BUILDING HEATING DEMAND (21.3 MTOE)

Potential net of electric/woody biomass heating in mountain areas (18.2 Mtoe)

Potential considering only climatic zones E and F (11.5 Mtoe)

Potential excluding 75% single-family and 25% of terraced villas due to non-feasibility (7.1 Mtoe)

Potential excluding newer buildings (100% >2006, 38% 1990-2000) (6.7 Mtoe)

Potential excluding already renovated buildings (5.3 Mtoe)

Potential excluding dwellings in mountainous areas (4.9 Mtoe)

\* Elemens study for ARSE "Heat pumps for decarbonisation in heating"

## Benefits of geothermal heat pumps in the residential sector\*



### Financial

**+24.7**

billion € of added value

**+19.4**

billion € of tax revenue

**+33,000**

jobs per year

**3.1 bn €**

annual savings for families



### Environmental

**-12,774**

kton of CO<sub>2</sub>  
(the 2019 production of all coal plants in Italy)

Other emissions from heating:

NO<sub>x</sub>: **-19%**

CO: **-8,9%**

PM<sub>10</sub>: **-8,5%**

PM<sub>2,5</sub>: **-8,6%**



### Energy consumption

**-5.0**

Mtoe

(primary energy saving from fossil sources)

**-5.0**

billion standard cubic metres

(7% reduction in gas imports, equal to the consumption of 11 GW of power plants)

Diesel fuel for heating :

**-42%**

LPG: **-11%**



### Health

**Improvement of air quality**  
thanks to geothermal heat pumps

**76,200**

premature deaths in 2016 from air pollution

(national cost of € 115 billion)

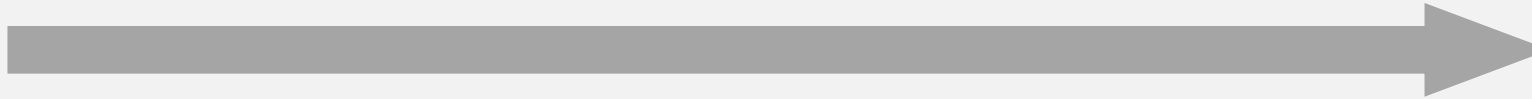
\* Elemens study for ARSE "Heat pumps for decarbonisation in heating"

# The potential of solar thermal in the residential sector



## Solar thermal energy

From heating demands...



... to the potential of solar thermal



21.3

Total building requirements



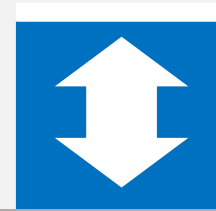
Climate zone

With respect to the feasibility of heat pumps, for solar thermal – considering the specific technology characteristics – climatic zone D was also included



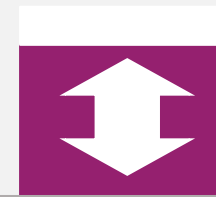
Building type

In this estimate, all single-family buildings and terraced houses were considered, 75% of medium-sized condominiums and 50% of large condominiums



Construction period

In line with the heat pump assessment, buildings with a recent construction period were excluded from the estimate of potential



Already renovated buildings

Also in this case, already renovated houses were excluded from the estimate of potential

About 1–2 million buildings on which solar thermal systems can be installed (demand between 3 and 8 Mtoe\*)

\*Conservative estimate compared to other studies

TOTAL RESIDENTIAL BUILDING HEATING DEMAND (21.3 MTOE)



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