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POLICY PAPER FOR FOSSIL-FREE DISTRICTS AND CITIES

WHY AND HOW FOSSIL FUELS IN BUILDINGS WILL BE HISTORY BY 2050

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AUTHORS
MÉLANIE BOURGEOIS
DAVID DONNERER
JULIEN JOUBERT

REVIEWER
MARIE ROYER

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EXECUTIVE SUMMARY

By 2050, fossil fuels in cities will hopefully be history. Renewable technologies that are already available, such as heat pumps and heat networks, will make it possible to use a wide range of renewable resources to heat cities. Renewable electricity, waste heat, geothermal and solar thermal energy will replace fossil fuels such as natural gas. Cities will have been empowered and supported to achieve this energy transition.

While this transformation is possible, there still is a long way to go. Fossil fuels currently account for ***75%*** of the energy produced for heating the residential sector and buildings are responsible for ***36%*** of greenhouse gas (GHG) emissions from energy in the EU. Moreover, cities face numerous barriers limiting their capacity to lead this transition.

In this paper we analyse the barriers that currently prevent local governments from implementing the heat transition and we highlight the technologies and local know-how that are already available to drive the energy transition. We also propose a set of key drivers for local stakeholders and policy makers at all levels to achieve a fast and successful transition to fossil-free cities and neighbourhoods.

This paper is the result of discussions with our members and other European cities.

KEY DRIVERS IDENTIFIED

Design a national and European framework to empower cities and citizens to drive the heating transition:

- ✓ Create a **level playing field** for the development of renewable energy and heating technologies
- ✓ Set **clear national and European targets** to support cities
- ✓ Provide **technical and financial support** to the local level
- ✓ Facilitate **access to data**

Follow these pathways to achieve a successful heat transition at the local level:

- ✓ Ensure a **just and citizen-led transition**
- ✓ **Inform and support citizens** in the transition to renewable energy sources
- ✓ Consider **buildings in the context of their streets, blocks and neighbourhoods**
- ✓ Use the **zoning methodology** to adapt solutions to the local context
- ✓ Adopt the **heat hierarchy principle**
- ✓ Set some **ambitious construction rules** for future-proof buildings
- ✓ Develop a **data policy and platform**

I. WHERE DO WE STAND TODAY?

In the residential sector, more than ***75%*** of the energy consumed for heating comes from fossil fuels, most of which is natural gas. What are the reasons for the continued use of natural gas? And which barriers slow the deployment of renewable heat?

A series of positions and regulations encourage the use of gas and fossil fuels for heating:

» **Unfair pricing** still puts gas at a major advantage compared to zero-emission heating solutions, as the negative externalities (air pollution, climate mitigation) are not taken into consideration. The gas industry is boosted by subsidies and financed by ***public institutions***, which makes it difficult to redirect investments away from fossil gas to renewable heating infrastructure.

» There is a **lack of awareness of the environmental damage of gas.** Natural gas is perceived as less harmful than it really is and is often presented as a good alternative to coal for heating (see ***our Myth buster on gases***). Industries and policy makers **have long pushed for burning the cheapest fuel without looking at the consequences for the climate** (see our briefing ***Hydrogen: everything a city needs to know***). Energy policies must change from supporting the burning of any fuel to being climate-friendly if we are to meet the Paris Agreement target of becoming climate neutral by 2050.

» There is a **lack of awareness of the alternatives to gas** among energy and urban planners, consultancy companies and experts, but also among the general public. At the European level, for example, ***until early 2021***, officials were talking about the upcoming “gas package” that was finally turned into a “gas decarbonisation package” expected this year. It would be much more coherent and appropriate to work on a “heat package” which includes a reflection on all available heating solutions and their interactions, not only fossil fuels.

» Due to this lack of awareness, an issue arises regarding the **planning of the transition to renewable technologies and the life span of gas installations.** All too often people change their installation when it is no longer working, in an emergency, and replace it with the same solution without seeking alternatives.

These different reasons encourage the use of natural gas for heating and are delaying the development of renewable heating technologies. In the meantime, cities are often facing **additional specific barriers to the development of renewable solutions such as:**

» Local governments themselves sometimes **lack knowledge about the best technologies available and the know-how to implement this transition.** City planners and policymakers are confronted by a fundamental issue: where and when to start, and how to drive the transition to fossil-free heating in the built environment?

And even when they are aware of the potential of zero-emission alternatives, complexity at different levels – in terms of **governance, planning, or the interplay with building renovation** – stands in the way.

» **The urgency to act and transform heating systems is often underestimated by policy makers and citizens**. But reaching a climate-neutral heating and energy system can take years or decades, as it requires the transformation of huge infrastructure (gas, power and heat networks, buildings). This means that cities need to be empowered now to drive the energy transition.

» Smaller cities lack the **technical capacity, human skills and funding** to map the energy system, plan actions and implement them. According to ***a study evaluating the*** implementation costs of the Dutch Climate Agreement for local governments over the 2022–2030 period, the heat transition in buildings (implementing a gas-free district approach) will require, in 2024, 65 full-time-equivalent (FTE) employees in the biggest cities (such as Rotterdam) and 4 FTE in the smallest cities. In 2030, this could be up to 125 FTE for bigger cities and 10 FTE for smaller ones. Today, **most cities, especially small- and medium-size ones, are far from having the capacity to employ the staff required to complete the biggest tasks** such as preparation and implementation of the district implementation plan and community-wide communications to engage and support citizens. The lack of financing and human resources are the main barriers that remain even when cities commit to driving the transition.

» Sustainable heating technologies have **high upfront costs.** Despite their very competitive operating costs, it can therefore be difficult to raise the funds to start the transition, both for citizens and for cities. This is a major barrier for cities involved in a transitioning process.

» Heating is mainly a private affair, and local and public authorities find it **hard to engage citizens and building owners** in the heat transition. Citizens need to be supported on the journey to co-create solutions which correspond to the local context, as the transition cannot be done without them.

» Finally, most cities **lack data** on heat needs, buildings' characteristics, heating systems, renewable and waste heat potentials, and current and future costs of technologies to provide heat and resource mapping and planning.

Thus, cities are keen to embark on the fossil-free heat transition but they still face multiple barriers preventing them from transitioning to fossil-free districts. **Cities lack the knowledge and know-how needed to effectively get this transition off the ground.** Sharing good practices and solutions developed by local governments is therefore key to driving this transition.

II. THE TECHNICAL SOLUTIONS AND KNOW-HOW DEVELOPED BY LOCAL GOVERNMENTS TO DECARBONISE HEATING

A WIDE RANGE OF RENEWABLE TECHNOLOGIES AVAILABLE TO HEAT CITIES

Renewable technologies for heating and cooling already exist and are ready for deployment.

These **technologies are multiple:** collective/individual and air/ground source heat pumps; district heating (DH), heat or electricity storage, energy efficiency via retrofitting of buildings, etc.

They use **a wide range of resources such** as geothermal energy, wind, sun, waste heat from industries, data centres, sewage water, biomass etc. The choice of technology and resource depends on local factors:

- The available resources (good solar exposure, possible sources of geothermal energy, data centre nearby, etc.)
- The needs according to the users and the types of buildings (schools, offices, hospital, municipal buildings, collective or individual housing etc.)
- The urban density (city-centre, periphery, countryside, etc.)
- The infrastructure already available (existing heat networks, grid capacity, the heat pumps or power plant already in place, etc.)
- The location and geographical characteristics of the city (different climates and surroundings: next to a river, mountains, ocean, lowland, etc.).

TOOL BOX FOR CITIES

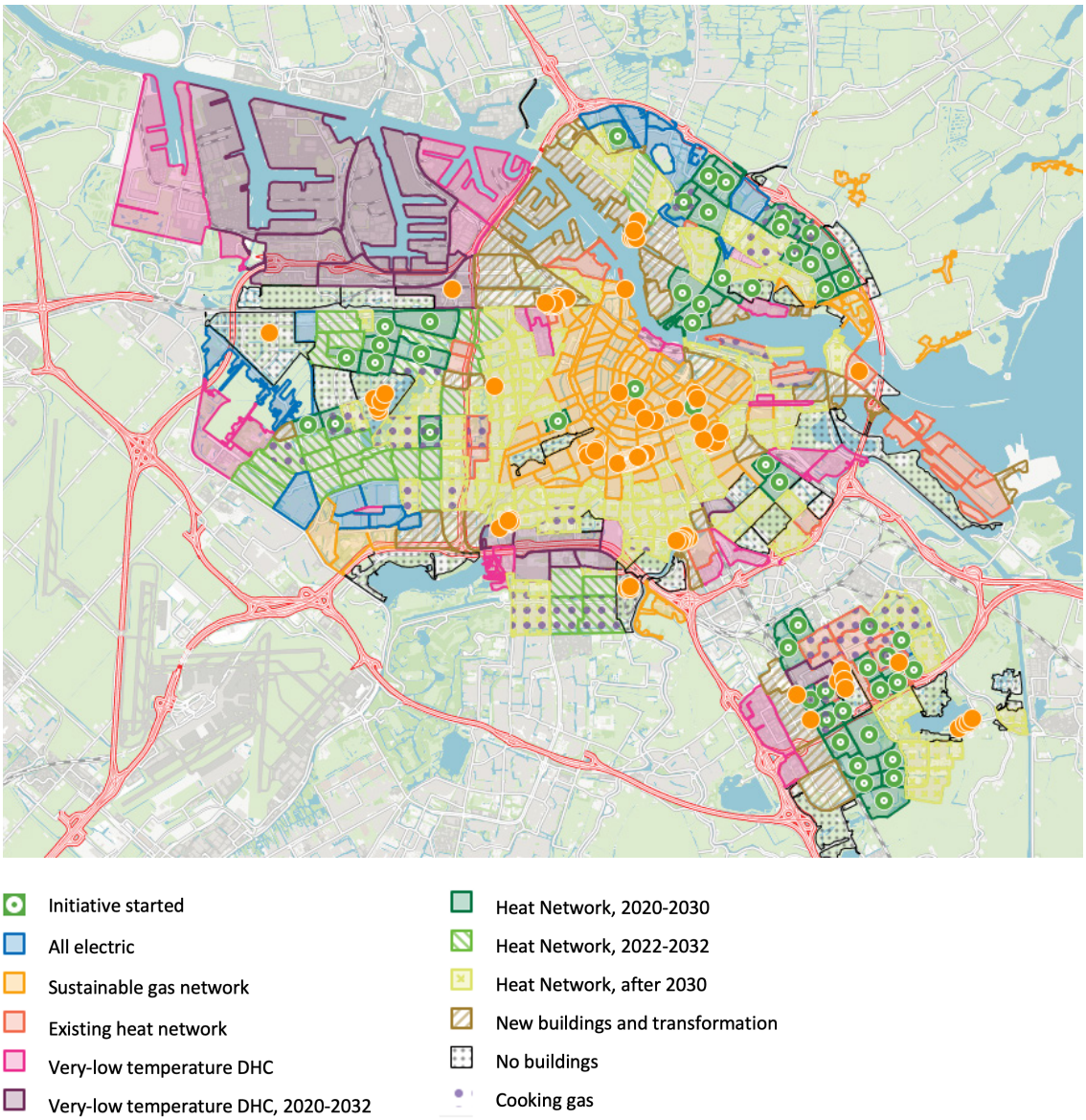
Hotmaps: an open-source mapping and planning tool for heating and cooling financed by the EU H2020 programme.

HeatNet NWE is an EU-funded project promoting knowledge and experience of the roll-out of innovative district heating in North West Europe.

The Celsius Tool Box is a source of knowledge and inspiration for cities interested in developing district energy solutions.

Keep Warm Learning Centre has developed resources to support the improvement of district heating performance in Central and Eastern Europe.

THERMOS is a software package financed by the H2020 programme for carrying out district network feasibility studies and for developing and optimising new and existing networks.



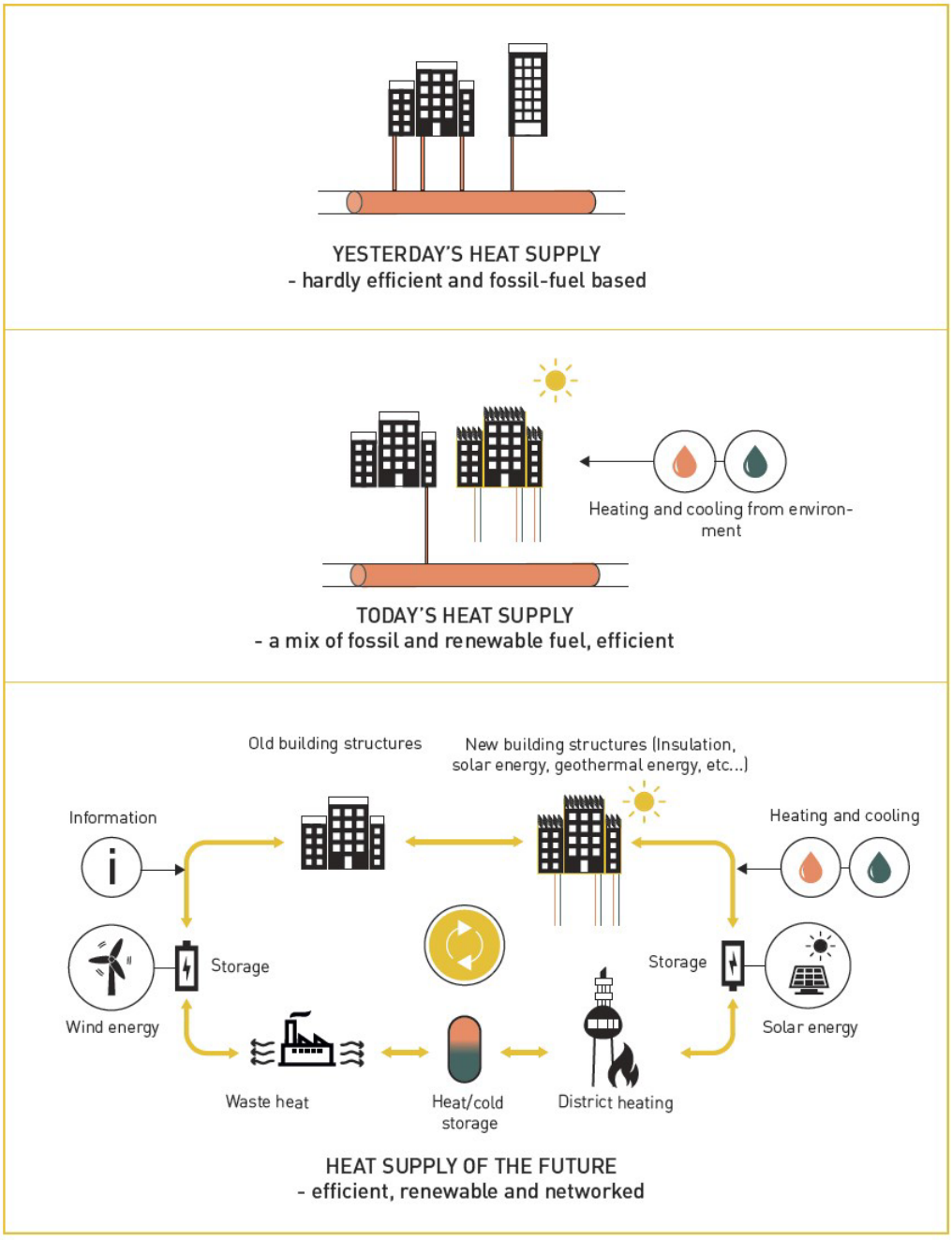
District-based mapping of the cheapest alternative to natural gas, either heat pumps or district heating, for existing buildings
Source: Rotterdam Heat Strategy

As an example, this interactive map of Amsterdam (The Netherlands) available on the ***city website***, indicates neighbourhood per neighbourhood which heat solution will be preferred to substitute fossil gas. This solution can be electrification, sustainable gas or district heating that suits better to dense areas combining high demand with a strong customer base. The preferred solution has the lowest cost for the entire neighbourhood. Also, inhabitants can search their neighbourhood and see when this sustainable solution should be ready and how they can prepare their homes" the heat sources can vary greatly. The city of Liège (Belgium), for example, wants to develop its district heating system based on waste incineration and shallow and deep geothermal energy, while the district heating system of ***Heerlen*** (the Netherlands) is based on using warm water from former coal mines and waste recovery from industries and tertiary buildings. The district heating system in ***Boulogne-Sur-Mer*** (France) uses biomass, waste heat and biogas. By contrast, a city like Munich (Germany) will instead develop the use of individual applications in some of its peripheral districts as the heating density is not high enough to expand district heating networks as such expansion would lead to high investment costs (longer pipelines) and be less efficient.

KNOW-HOW AND METHODS FOR IMPLEMENTING THE HEATING TRANSITION

The main point is that **decarbonising heating at the scale of a city does not consist of a single silver bullet but of multiple partial solutions.** Cities will in fact need to transition from a district heating system using 1 or 2 energy sources (gas + renewables for example) to a complex and comprehensive system **that includes several energy sources** (solar, wind, geothermal, waste heat, etc.) **and technologies** (renovation of buildings to improve energy efficiency, heat pumps, heat networks, seasonal heat storage, electricity storage, etc.) as shown in the figure opposite.

This new urban energy and heat system must be designed to be **flexible** in order to integrate future renewable technologies that are not yet mature.



Heat supply yesterday, today and tomorrow
source: *Energy Zoning planning*, City of Vienna

To develop such a comprehensive system, cities can use the energy zoning approach: an urban *planning method* that considers available resources and needs on a zone by zone basis to propose a suitable energy or heating solution for each area, in consultation with local stakeholders. It builds an overall vision of the city while considering the specificities of each district.

Vienna (Austria) is for instance using a zoning approach to develop a comprehensive framework called Smart City Vienna. It aims to improve the lives of its citizens, meet a net zero target and develop an action plan to decarbonise its heating system. Vienna's energy zoning process is described step by step in this *document*, mapping the potential resources (waste heat, sewage water, ambient heat, geothermal, solar energy, biomass) and needs according to the building type and infrastructure. In addition to on-going pilot projects, the city is working on a roadmap to define decarbonisation pathways until 2040.

Antwerp (Belgium) also uses a zoning approach as a tool that can be used to "zoom in microscopically on different city districts and provide tailor-made sustainable heat alternatives". This has resulted in an action plan for 9 pilot projects that will deliver their first fossil-free heat in 2021.

For local governments, the use of this zoning approach can make the following possible:

- ✓ The involvement of **citizens and consumers** in the heating plan for their area.
- ✓ **Flexibility** of the overall system by interweaving several district-based approaches, several technologies and objectives.
- ✓ Consideration of other constraints or policy objectives of the city simultaneously (urban development, lifestyles, social issues, mobility, etc.).
- ✓ The adoption of a long-term plan to **decarbonise the whole city:** those areas that can make the move early should do so, thus initiating a phased approach that will spread to other city areas.
- ✓ Choice of the **most appropriate solution** that uses the resources for each zone wisely.

Thus, there are solutions in terms of technologies but also in terms of energy planning know-how to decarbonise the heating of cities. And this applies to cities of all sizes. For instance, the finalist teams of the Helsinki Energy Challenge show concrete solutions to decarbonise the heating systems of big cities, while the smaller city of Karlovac (Croatia) is aiming to phase out fossil fuels from its district heating system by using geothermal and wood chip plants.

HELSINKI ENERGY CHALLENGE

The city of *Helsinki* organised *an international project competition* to **find future-proof solutions to heat the city and meet its goal of becoming carbon neutral by 2035.** This unique challenge received 252 proposals from 35 countries and 10 finalists were short-listed. The jury selected the 5 winning projects in March 2021. These projects aim to be adaptable to other local contexts and the details of each are available on the *Helsinki Energy Challenge website.*

III. THE KEY PATHWAYS TOWARDS FOSSIL-FREE DISTRICTS BY 2030 (AND A FULLY DECARBONISED BUILDING STOCK BY 2050)

In this paper we focus on the transition of heating systems in cities, but we encourage policy makers at all levels to adopt an **integrated approach and consider the whole energy system when planning the new heating system** as there is not one solution but a plurality of partial solutions to decarbonise a city and most of them are interlinked. When looking at the heating transition, policy makers must also look at waste management, mobility, urban development, citizen engagement and social aspects among other things.

That being said, **energy and heating plans are local in nature.** Local governments are best placed to know their needs, geographical constraints and resources. The EU and the Member States therefore need **to develop a suitable framework to empower citizens and enable cities to drive the heating transition.** For instance, ***the Dutch government*** has made it a national priority to phase out fossil gas by 2030 in 1 million households. The participative approach of this highly ambitious plan developed by the Dutch government has led to responsibility for heating planning being assigned to municipalities.

We have compiled some key drivers that are essential to further develop this framework and some others for local actors. We are aware that not all cities have the same legislative powers and some recommendations will have to be adapted to a regional or national level for certain Member States.

A NATIONAL AND EUROPEAN FRAMEWORK TO EMPOWER CITIES AND CITIZENS TO DRIVE THE HEATING TRANSITION

Key driver 1:
Create a level playing field for the development of renewable energy and heating technologies.

This comes with 3 fundamental measures:

» **End fossil-fuel subsidies: subsidies for fossil fuels should be transferred to renewable technologies and** the disparity between gas and electricity taxation should be removed. This acts as a general disincentive to electrification and in particular to investing in more efficient technologies such as individual or collective heat pumps based on renewable electricity.

» **Establish clear standards for heating appliances:** minimum energy efficiency ratings for home heating appliances, a maximum CO_2 emission threshold and a ban on fossil fuels in heating appliances by a certain date should be established. These standards and timelines will enable markets, cities and citizens to prepare for change while ensuring a fair and inclusive transition for all citizens; they will also make it possible to plan long-term investments and decisions based on clearer future supply.

» **Ensure the optimal distribution of supply sources** to enable the effective development of a low-carbon energy and heating system. This means matching low temperature supply sources (like heat pumps, waste heat, geothermal and solar) with low-temperature demand (heating in buildings), and conversely using high-level temperature solutions (biomass, green gases, green hydrogen) for high-temperature needs (e.g. industries or grid balancing). Incentives should be adjusted according to the use made of the renewable energy sources produced, and not only given to produce them.

Key driver 2:
Set clear national and European targets to support cities

To support the engagement of stakeholders by the local level, clear national and European messages should be addressed to companies and citizens. In addition to strong political messages regarding the phasing-out of natural gas in existing buildings, two measures can reinforce engagement:

» **Set targets for district energy development** in national strategies and climate plans, as well as National Recovery Plans, in line with techno-economic potentials.

» **Adopt a mandatory heat planning system** similar to what Baden-Württemberg has put in place: the ***German region*** recently required its 103 cities of more than 20,000 inhabitants to develop a vision for their CO_2-neutral heat supply by 2050, both for residential buildings and for industry.

Key driver 3: Provide technical and financial support to the local level

As we have seen, cities face barriers in terms of human skills, technical know-how and financial resources to develop and implement renewable heat plans. In order for more cities to adopt mandatory heat planning systems, the following actions will be necessary:

» **Develop state or regional aid** to directly support implementation of the local heat plan and enable local governments to have the technical and human skills needed. This can be thought of as part of the recovery plans. For example, the climate protection law that was passed in *Baden-Württemberg* entitles all cities to receive financial support from the Region to cover the costs of this compulsory municipal planning process. This is a step in the right direction to reinforce human capacities and implement the heat plans.

» **Massively extend programmes such as the** *EU City Facility* that support cities developing investment concepts and therefore access to private and public funding to implement their plans (see our *How to set up your own City Facility* guide)

» **Reinvest some EU revenue,** for example from the EU Emissions Trading System (ETS) or from unmet emission reduction targets in renewable heating or renovation projects **at the local level** (energy vouchers, renovation subsidies, investments in renewables energy or heating appliances).

Key driver 4: Facilitate access to data

Heat data is key for local authorities to map their needs and to build their heat strategies. However, cities often have no access or only partial access to this data depending on the Member States. It is therefore essential to **allow all cities to get energy-related data from utilities and heat appliance maintainers at the lowest granularity possible** (at least for a few households) **and to define EU-level confidentiality rules for these data.** Cities should be able to freely use and exchange these data within administrative departments. Recently, France and the Netherlands have established national regulations to allow access to energy-consumption data from suppliers at a good level of detail. Another example is Poland, which has introduced a new law in 2021 to ban heating systems that do not comply with certain emission standards. This involves both providing households with new heating systems and having accurate data about the currently-used system. This is why Polish households have been required to declare which heating system they use to their municipality or online as of 1st July 2021. When all the declarations are made within a year, both the state and the cities will have access to an extremely accurate inventory of emission sources for the first time.

PATHWAYS TO ACHIEVING A SUCCESSFUL HEAT TRANSITION AT THE LOCAL LEVEL

Key driver 5: Ensure a just and citizen-led transition

Local governments must ensure **that the transition is made with all citizens.** This requires informing and empowering them to become involved in the energy and heating transition through information, consultation and working with energy communities (see our ***Community Energy Practical Guide*** with various examples such as Eeklo-Ecopower). Citizens should be associated throughout the process from **the definition of the heat strategy to its implementation.** Regarding the earliest stage of the process, several successful cases can be found in the Netherlands. The region of ***Drechtsteden***, for example, aims to remove at least 12,000 households from the gas grid by 2030 and has developed a large-scale online participation process whereby residents are encouraged to share and contribute their ideas. This very bottom-up approach based on transparency, trust and a participative process, also developed in other Dutch ***cities*** and local communities can be replicated to involve citizens in the local heat transition.

The city of Niš (Serbia) is a good example of the involvement of citizens in implementing the heat strategy. Indeed, the municipal district heating company board includes some citizens who participate in the key decisions.

Cities should also prioritise **the necessity of lifting people out of energy poverty and making this transition fair and inclusive,** notably through solidarity policies, energy communities or access to renewable energy and heating, in order to end their dependence on fossil fuels.

Key driver 6: Inform and support citizens in the transition to renewable energy sources

As explained above, one of the barriers to the energy transition is the **lack of information, awareness and support for citizens.** ***One-stop shops*** for example can be powerful tools to inform citizens and put them in contact with companies carrying out renovation work or installing renewable technologies. **Dialogue and information with citizens can also help break down barriers.** For example, the city of Rotterdam (the Netherlands) supports workshops on cooking on electric hotplates because the municipality noticed that this was an important factor in citizens' reluctance to switch from gas to electricity.

In addition, certain **financial support and incentive mechanisms** can be made available to citizens and building owners. For example, the city of Winterthur (Switzerland) offers a €10,000 subsidy for the installation of a geothermal heat pump; the Metropolis of Lyon is offering ***financial support*** to companies, social housing, associations, city administrations when installing geothermal heat pumps, solar heating systems, biomass boilers or connecting to district heating and cooling systems; finally the city of ***Ghent*** (Belgium) offers a €30,000 subsidy to vulnerable people living in substandard homes and provides technical support to renovate their homes, the sole condition being that they have to reimburse these funds when there is a change of ownership, so that the city can re-invest in other houses. These are all mechanisms that can be replicated and supported by the Member States.

Key driver 7:
Consider buildings in the context of their blocks, streets, and eighbourhoods

To achieve a change of scale in building decarbonisation, it is essential to ***work at the street and neighbourhood levels***, thereby going beyond individual solutions and responsibilities. A district is a combination of spatial, economic and social relationships: it is the place where we live, play, work, shop, access education and health, move and produce our energy. Adopting a district approach is an opportunity to address socio-economic inequalities, (re)build trust and the social fabric at street-level, explore collective financing and ownership models, and perform systemic change including with regard to public spaces, mobility and amenities.

This holistic approach makes it possible, for example, to consider aligning both mobility and heat network construction to cut down on costs. The city of ***Dijon*** (France), for example, first laid the pipes of its heating network in anticipation of the construction of its tram system on the main streets. It subsequently developed a heating network of more than 120 km.

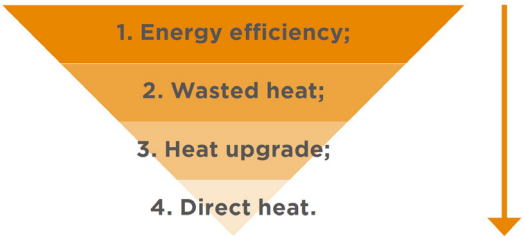
Key driver 8:
Use the zoning methodology to adapt solutions to the local context

As explained in this paper, the zoning approach is key to adapting the heating solutions to the very local context. This methodology can be used by cities to consider needs and resources by area and therefore the best renewable heating technology. For instance, areas composed only of detached houses might use different technical solutions to multi-family housing districts. The issues of ownership and decision-making will also be different, and should be taken into account in the ***strategy development***.

At the scale of the city, this zone-based approach makes it possible to build a heating system made up of multiple, interconnected solutions. Specific zoning regulations will be needed to reduce uncertainties in developing solutions chosen and agreed with citizens. For instance, as district heating and cooling systems require long-term investments, heat network zone permits (giving an exclusive right to a single organisation to operate a heat network in a specific zone) or compulsory-connection schemes to district energy networks might be introduced. These kinds of policies need to include guarantees for customers and limitations on district energy companies.

Key driver 9:
Adopt the heat hierarchy principle

The *heat hierarchy principle* ensures that **energy efficiency** is a priority in new heating planning. This will reduce final energy consumption which makes the heating decarbonisation challenge possible and will reduce the cost of the energy transition for consumers. From a circular perspective, it is also important to use on a neighbourhood scale the **residual heat** available on-site that would otherwise be wasted. The next two elements in the **heat hierarchy** are heat upgrade (lower temperature heat is upgraded or concentrated into a more useable temperature using a heat pump) and **direct heat (energy used to create heat)** that are more energy intensive but nevertheless necessary to decarbonise an entire heating system.



The Heat Hierarchy Principle
Source: *ADE*, Heat and Energy Efficiency Zoning

The Heat Hierarchy Principle is **a key tool for guiding local heat planning,** considering the needs and resources available.

Key driver 10:
Set some ambitious building rules for future-proof buildings

In order to fully decarbonise heating, cities need to adapt the existing building stock and plan for the integration of future buildings into the energy system. To facilitate this integration, there are **solutions that can be included in heating plans or building codes which depend on legislation.** For example, Vienna (Austria) has launched *"climate protection areas"* where new buildings can be built only if they have a climate-friendly energy system while Strasbourg (France) wants to introduce into *its local urban plan* a prohibition on individual heating systems in new multi-apartment buildings.

Cities can also use legislation to promote radiators with a bigger surface of exchange or floor heating, which help use renewable energy sources that supply heat at lower temperatures, or the construction of an adequate common space to host a substation to facilitate future connection to a district heating and cooling system.

Key driver 11: Develop a data policy and platform

Open data platforms gathering different information on buildings, technologies, renewable energy potentials, energy infrastructures, investment opportunities and urban plans are key tools for engaging stakeholders and ensuring informed decisions. They can be used as support to raise awareness, connect stakeholders, and catalyse projects while setting out global strategies and directions. Specific conditions in building regulations and energy plans can be introduced to require the compulsory communication of data to the city administration before specific administrative approvals (such as issuing permits), to ensure continuous updates of such platforms. For instance, in the Development Plan policies of the Greater London Authority, all combined heat and power (CHP) operators need to provide specific data on their installations before operating them, so all information is uploaded to the London Heat Map.

ENERGYCITIES

www.energy-cities.eu

@energycities

@energycities.eu

BESANÇON
2 chemin de Palente
25000 Besançon, France

BRUSSELS
Mundo Madou
Avenue des Arts 7-8
1210 Brussels, Belgium

Energy Cities' mission is to empower cities and citizens to shape and transition to future-proof cities. We showcase concrete alternatives deployed by cities, we advocate changing policy and economic governance at all levels and we foster wide cultural change leading to a future-proof society. Energy Cities community is composed by local leaders of thousands of cities in 30 European countries.