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15-Minute City: Utopia or reality?

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Abstract

The city model of the 21st century is in a moment of transformation and reflexion, especially after the impact of the 2020 pandemic and the serious energy crisis that is emerging. In the *Green Deal* and the scope of the *EU Mission: Climate-neutral and Smart Cities By 2030*, European policies have placed mobility at the focal point of the environmental and social challenges of cities, with the aim of making Europe the first climate-neutral zone of the world in 2050. At COP21 in Paris in 2015, the concept of the *15-Minute City* was coined for the first time. An integrated and sustainable urban development model that can help cities achieve climate neutrality focussing on the human being that is having a strong national and international impact. To achieve these objectives, a mobility transformation is necessary. This article analyses the city of Madrid based on the holistic approach proposed by *C40 Cities*. Specifically, it is applied to three neighbourhoods with different sociodemographic, physical, and urban variables of the city. From the results obtained, it can be concluded that these neighbourhoods are aligned with the key points of the decahedron and with the main variables for the implementation of the *15-Minute City* strategy; however, it is observed that the model faces the great challenge of answering displacements for work purposes.

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1. Introduction

Carlos Moreno spreads the concept of the *15-Minute City* (C15'), and the *30-Minute Territory*, linked to the 'city of proximity', which took off strongly in the campaign to Anne Hidalgo's mayor's office in Paris in 2019 and, above all, a year later with the outbreak of the pandemic. An idea that goes beyond being a slogan for the city, since it proposes a change in the way of living in cities, so that they are no longer a hostile space and become places to live and enjoy public space. In essence, it is not a new concept, but it has arrived at the right time. According to a 2020 survey by the World Economic Forum, 9 out of 10 people around the world want a more sustainable and equitable world after the pandemic (World Economic Forum, 2021).

Currently, there are already many cities that are adhering to this new approach and its contribution to improving the quality of life of their citizens. In these cities, they try to reinvent themselves by focussing the urban model on

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'proximity', understood not only as the metric distance that separates two points, but also including other forms of proximity, such as affective, cultural, etc. —, in synergy with active mobility. This model contributes to building more liveable cities on a human scale, giving preference to the most vulnerable neighbourhoods and groups, while helping cities in the transition to zero carbon. "*It is about moving from urban planning to urban life planning where access to six basic needs is provided: living, working, provisioning, caring, learning and resting*" (NESI,2022). To achieve this, it is necessary to rethink the existing model based on the use of private vehicles, avoiding unwanted or unnecessary trips by promoting proximity through coherent urban planning that favours sustainable mobility. All of this to achieve cities that are pedestrian-friendly and integrate nature.

1.1. Transforming mobility

Mobility is changing and transforming cities. The future of cities must be based on sustainable mobility. It is a question of promoting the binomial between sustainable mobility — moving around using the most appropriate mode of transport depending on where we need to go — and smart mobility — considering the needs of each user in each circumstance and at each moment of their lives.

We are living in a time of climate, health, and energy crisis. European cities have an appointment with carbon neutrality by 2050, because the EU, from 2021, has made the commitment to achieve climate neutrality a legal obligation. The use of public transport is one of the most powerful levers to reduce greenhouse gas emissions in cities. Improving public transport and designing cities to reduce car dependency could therefore contribute between 20% and 45% of the total global emissions reductions needed to limit global warming to 1.5°C (C40 Cities, 2021).

There is still a long way to go to reach the proposed objectives, and the starting situation is not favourable. In the EU, the car is the main polluter, with 60.6% of total road transport emissions and an average occupancy of 1.6 people per car (European Parliament, 2019). In Spain, in the last 30 years, there has been a 124% increase in the total vehicle fleet and in each category. Not only is the total number of vehicles is increasing, but so is the average age, which stands at 13.49 years in 2021, and, in addition, 63.7% of vehicles are older than 10 years (ANFAC, 2022).

There are two ways to contribute to reducing CO2 emissions: making vehicles more efficient or improving the fuel they use. In 2021, in Spain the most abundant category was Euro 6, with 26% of the total. Euro 3 and 4 passenger cars are still abundant, 21.3% and 21.9%, respectively, and the Euro 5 category is scarce, with 12.6%. However, the variation with respect to 2020 is positive, with Euro 6 cars increasing by 13.6%, Euro 5 cars by just 0.1%, and the rest decreasing (DGT, 2022).

On the other hand, modal split is the main parameter for understanding the general state of mobility. It varies according to the purpose of the trips (all purposes, or distinguishing work and studies, and other purposes, leisure, shopping, etc.), the geographical area where the trips take place (capital city, metropolitan area) and the size of the area. For all purposes, in the larger metropolitan areas, car trips are lower, with an average of 45%, and public transport is used the most, with an average of 11%. However, in smaller areas, active mobility is visible with an average of 43%. In the capital cities, active modes are the most used (53%) and the car is used less (31%) than in other areas; 52% in the metropolitan area; and 77% for trips between the capital city and the metropolitan area. It is also observed that active mobility is higher when the reason for the trip is 'non-compulsory', i.e. mainly for personal activities, leisure or shopping. However, high car use remains one of the most important challenges to improve mobility to work (61%) (MMO, 2022).

In 2008, the EU set a target to reduce greenhouse gas emissions by 20% compared to 1990 levels. The results achieved in 2019 were a reduction of 24% and 31% in 2020, the latter being more favourable due to non-mobility during the pandemic. In 2021, this target will be more demanding, and GHG emissions are expected to be reduced by at least 55% in 2030 and to reach climate neutrality in 2050. However, current projections estimate a 41% growth in 2030 (EU Parliament, 2018).

Good urban planning, with the integration of land use and public transport, could favour these figures, as it will avoid trips, positively influence mobility and accessibility to the different places in the area in question, in terms of removing barriers, reducing distances, and optimising travel time.

1.2. Factors involved in the transformation of mobility.

In order to reduce the emissions of pollutants that directly affect human health and the environment, it is urgent and necessary to implement, among other measures, a change in the mobility model. This model change can be approached in two main ways: through technological advances and changes in mobility habits.

Technological advances make transport more efficient and have a lower impact on the environment and human health, reducing total emissions of polluting gases. For this reason, one of the main objectives of the EU and Spain is the complete decarbonisation of the mobile fleet: a renewal and electrification of the fleet is necessary. Another of the great technological advances related to the reduction of pollutants has been the worldwide elimination of lead as a petrol additive, together with the improvement and optimisation of electric vehicles, and the use of green hydrogen as fuel (although it is still an incipient technique), among others.

In 2016, the DGT introduced the environmental label for vehicles based on their energy efficiency and the environmental impact they generate. This classification positively discriminates the most environmentally friendly vehicles. Despite this, the percentage of non-polluting vehicles with respect to the total is still very low. In 2021, 0.55% of the total was labelled 'zero emissions' and 3.07% 'eco' (DGT, 2022). Therefore, Spain must accelerate the renewal of its vehicle fleet to meet air quality standards.

To achieve these objectives, the improvement of technologies must be accompanied by a significant change in the mobility habits of users. It is a matter of inverting the urban mobility pyramid, with a new order of priorities and ensuring that the most sustainable modes, such as pedestrians and cyclists, together with public transport, are the main means of transport for citizens, and the preference when designing and prioritising public space.

1.3. Climate Neutral and Smart Cities Model

The EU, through the *Horizon Europe: Research and Innovation funding programme* (2021-2027) launched the *EU Missions* as a strategy to address the challenges facing the continent in terms of environment, health, and sustainable development. The main objective is to support cities to accelerate their green and digital transformation and achieve the goal of reducing their emissions by 55% by 2030. At the same time, it seeks to improve the conditions for citizens through cleaner air, safer transportation, reduced congestion and noise levels.

In the Mission *100 Smart and Climate Neutral Cities by 2030*, 7 Spanish cities have been selected to serve as inspiration and leverage so that other cities can also become climate neutral by 2050.

The main challenges of a smart city in terms of urban mobility are related to environmental pollution and commuting time. Especially in large cities, where citizens have to travel long distances by private or public transport from their homes to their workplaces.

The implementation of the 'C15 model' implies a change in city lifestyles, which requires structural changes in the way cities are managed, designed, and inhabited (NESI, 2022).

In order to achieve climate-neutral cities, the EU limits the maximum annual pollution levels and has recently presented a new proposal with stricter but more lax values compared to those set by the WHO, as shown in Table 1.

Table 1. Maximum annual pollution levels according to EU and WHO.

Particles $[\mu g/m^3]$	New proposal [EU]	Current levels [EU]	Levels [WHO]
NO_2	20	40	10
$PM_{2,5}$	10	25	5
PM_{10}	20	40	15

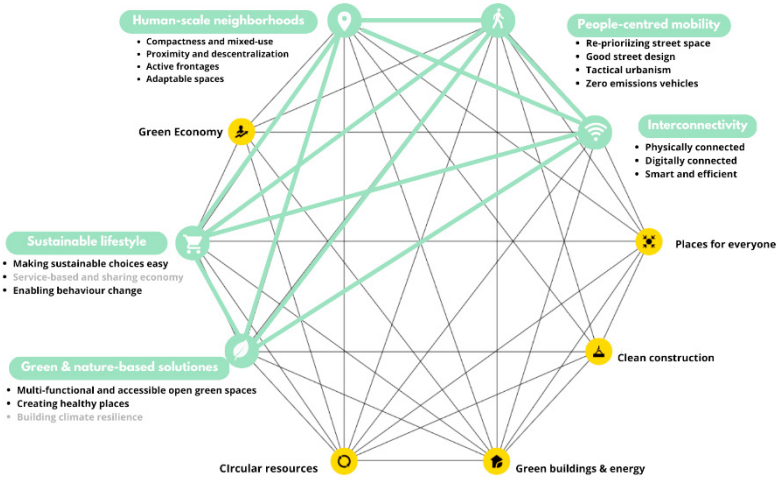
Reducing emissions to zero is a goal that requires acting now, making technological investments, and changing habits, and it takes time. Technology alone cannot solve a city's problems; it is a means, but not an end. It is necessary to have tools to push cities and to be able to envision the zero city and, at the same time, digital city. Will 7 years be enough?

2. Methodology

The C15' strategy was first applied in Paris and has already been extended to other cities such as Ottawa, Melbourne, Portland, Milan, and Nantes. Each city has unique characteristics that need to be taken into account when planning 15-minute cities (Chaire-ETI, 2020).

It is a holistic vision for the whole city, although it focuses on action by neighbourhood. It is the convergence point of three concepts: chrono-urbanism —using places intensively (polymorphism) and changing the relationship of time to places (polyvalence)—, chronotropy —a place with multiple uses, places change over time — and topophilia —meaning pride of place—.

The methodology to be applied to this study is that proposed by *C40 Cities* (2021), which is based on an integrated approach to achieving net zero at the neighbourhood scale, which can be applied to the new as well as the old. It sets out ten key points: human-scale neighbourhood, people-centred mobility, interconnectivity, places for all, clean construction, green energy and buildings, green solutions, sustainable lifestyle, and green economy. In this article, only those focusing on mobility and affecting air quality have been selected and are highlighted in the interconnected decahedron diagram in Fig. 1., representing that the action at each power point synergises and



influences the others.

Fig. 1. *C40 Cities* approach.

In order to implement the *C40 Cities* approach, as we will call from now on the methodology applied at neighbourhood level, the city of Madrid (one of the cities selected for the *EU Mission: Smart and Climate-Neutral Cities by 2030*) has been chosen as a case study.

The following phases are identified:

1. Analysis and assessment: an analysis of the current city context to identify areas that need improvement and establish clear points for the implementation of the C15 objectives. Factors such as: population density, distribution of services and places of interest, air quality, and existing transportation by neighbourhoods can be taken into account and key points will be identified.

2. Urban design: the city should be planned and designed so that services and places of interest are within walking and cycling distance, and neighbourhoods are mixed-use. Cycling and pedestrian routes and public transport improvement options will be reviewed. And catchment areas within a 15-minute walking radius can be established to consider whether all daily needs can be met within an accessible radius.

3. Citizen participation: surveys and consultations can be carried out to find out the needs and opinions of residents.

4. Implementation of supporting policies and regulations: e.g., the implementation of *Low Emission Zones (LEZs)* to set clear GHG emission reduction targets.

5. Monitoring and evaluation: Continuous monitoring can be carried out to adjust and improve policies and actions as necessary.

For the case study, analysis variables are selected at the city scale, and others that will be applied to three neighbourhoods of the municipality, which guide the creation and implementation of the C15'.

The selected neighbourhoods are Gaztambide — belonging to the district of Chamberí, in Almendra Central —, Puerta Bonita— belonging to the district of Carabanchel, on the edge of M-30 in the southwest — and Valdebernardo — belonging to the district of Vicálvaro, on the edge of M-40 in the southeast—. In making the choice, the aim was to compare the different neighbourhoods in terms of location, socio-demographic, physical and urban characteristics.

The *15-Minute City* white paper focuses on 4 variables: density, proximity, functional diversity, and digital ubiquity (which will not be taken into account in the analysis).

Gaztambide is the densest neighbourhood in Madrid with 447 inhabitants/ha and the oldest population. Puerta Bonita has an intermediate density and Valdebernardo has the lowest density and the youngest population. In terms of average net income per household, Gaztambide (49,435€) is above the Madrid average (43,003€), and the other two neighbourhoods are below (28,320€ and 42,891€). The neighbourhood with the most cars is Puerta Bonita, followed by Gaztambide and Valdebernardo, the latter being the furthest from the centre and the largest. Table 2 summarises this general data.

Table 2. General data on the three selected neighbourhoods.

	Gaztambide	Puerta Bonita	Valdebernardo
Surface	50,65	160,86	255,51
Density [hab./Ha] (2022)	447	220	68
Population	22659	35395	17431
% Male	44,4	47	47,7
% Female	55,6	53	52,3
% Population years	9,5	14	11,2
% Population years	64,8	68,5	75,7
% Population years	25,6	17,6	13,1
Average income per household [€]	49435	28320	42891
Number of passenger cars (2021)	8643	10905	5803
Premises by type of access (2022)	1824	1386	312
Grouped	27	37	60
Street door	1399	1352	242
Indoor	398	30	10

The predominant building typology in Gaztambide is from the late 19th and early 20th centuries, with multi-family dwellings of between five and six storeys. Many buildings have commercial premises on the ground floor, which gives the neighbourhood a particularly dynamic character. The predominant building typology in Puerta Bonita is a mixture of buildings from different periods, some dating from the mid-20th century and others of more recent construction, and tends to be of the flat block type of different heights, built in the 1950s and 1960s. It is worth noting the existence of some industrial buildings converted into cultural centres and spaces for public use. And finally, Valdebernardo has a predominantly residential building typology of recent construction, in the 80s and 90s of the 20th century, in a closed multi-storey block surrounded by large garden areas and communal spaces.

3. Results

The city of Madrid has set ambitious GHG emission reduction targets and has implemented several measures to achieve them. All measures in line with the implementation of the C15' model, as in recent years it has carried out actions under the *C40 Cities* approach. Some of these actions are described below and presented in Figures 3 and 4.

- **Promote active mobility,** by improving the network of cycle lanes and increasing pedestrian zones. Madrid has 355 km of cycle lanes (an increase of 11.2% compared to 2019), 301 km of cycle lanes segregated from traffic (23.8% more than in 2019), and 47 km not segregated. Although the share of cycling in the city's mobility remains low, according to EDM'18 data, walking is the most common means of transport in the centre and interior of Madrid with 40% and 32%, a percentage that decreases by 29.2% in the peripheral cities.
- **Improve public transport**, Madrid has increased the length of bus lines by 6.5% and the length of the rail network by 5.3% between 2015 and 2021. It is only surpassed by Barcelona in km of bus lanes in Spain, with 190 km (2020), with integrated public transport cards to facilitate their use.
- **Development of mixed-use neighbourhoods,** by promoting offer a variety of service uses and locations within walking distance of the place of residence.

First of all, for these three actions, the analysis is carried out at the neighbourhood level, but also at the district level. Then, the main transport, health, educational, cultural and commercial infrastructures have been quantified. A spatial analysis has also been carried out using mapping with a radius of 750 m from the centre of the neighbourhoods, estimating a pedestrian speed of 5 km/h and 15 minutes on foot, and it has been identified that the three neighbourhoods are accessible at this scale. In some cases it has been indicated as "nearby", when the service or infrastructure is not located in the neighbourhood itself, but in an adjacent area.

		Gaztambide	Puerta Bonita	Valdebernardo
TRANSPORT	Subway station	3	3	1
	Subway Lines	4	3	1
	EMT Stops	23	50	35
	Interurban bus stops	Moncloa	10	2
	Suburban train station			
	SUburban train lines			
	Intercambiador	Moncloa		
	Highways	1		
	Gas stations	4 nearby		2
	Post offices	3 nearby	3 + 2 nearby	3 + 2 nearby
	Parking	1 nearby	1	1 + 1 nearby
	Bicycle lanes [m]	2307		
	Bicycle rings		1	1 nearby

		Gaztambide	Puerta Bonita	Valdebernardo
HEALTH	Hospitals	3 nearby	1 nearby	
	Health centers	2	2	1
	Pharmacies	20	19	5
	Social centers	3	14	17
EDUCATION	Public centers	6 nearby	11	6
	Private centers	12	6	4
	Universities	1 y 7 nearby	1 nearby	
	Senior high schools	3		6 nearby
	Campus	2	1 nearby	3 nearby
ENVIRONMENT	Park	1	2 + 1 nearby	6
	Theme parks			1
	Air stations	1	1	1

		Gaztambide	Puerta Bonita	Valdebernardo
CULTURE	Libraries	1 nearby	2	1
	Bookstores	16	1 + 2 nearby	
	Cinemmas	1		
	Museums	1		1 nearby
	Theaters	3 nearby	1 + 3 nearby	1 nearby
	Sports institutions	1 nearby	5	2
COMMERCE	Markets	1	2 + 2 nearby	1 nearby
	Shopping malls	3 nearby	1 nearby	1
	Bank offices	15	7	3
	Accommodations	74	9	
	Premises	1.824	1.416	312
	Grouped access	27	37	60
	Street door access	1.399	1.343	242
	Indoor access	398	30	10

Fig. 3. Transportation services and general infrastructure by category and neighbourhood.

The great challenge for large cities such as Madrid is to effectively manage forced mobility, which is mainly conditioned by the location of workplaces. As can be seen in Fig. 4, the distribution of the population in the Community of Madrid (CAM) is not balanced with the location of workplaces. Only 55.7% of the population residing in the CAM carries out its professional activity in the same municipality of residence (CRTM, 2020). Fig. 4. shows the labour flows in the city (in green with the destination Madrid and in brown, from Madrid outwards) and Table 3 shows the distribution by population and workplaces in each area of the city (CAM, 2017).

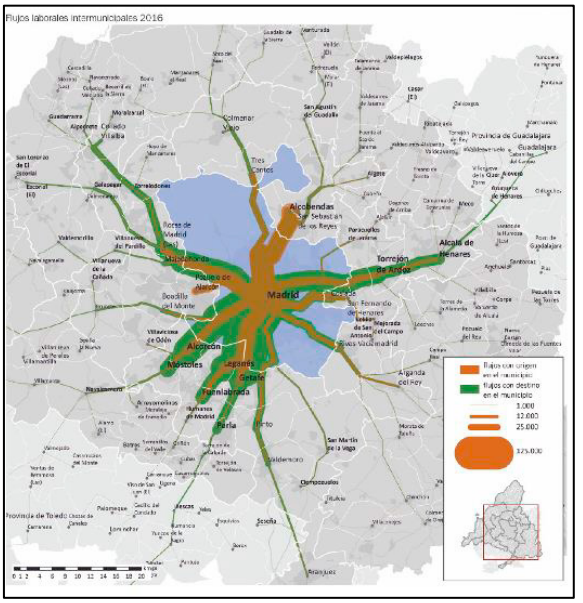


Table 3. General data on the three selected neighbourhoods.

Zones	Population [%]	Work location [%]
Central Almond	15	29
Madrid Periphery	34	30
Metropolitan area	44	35
Regional crown	7	4
Outside the CAM		2

Fig. 4. Population and workplaces in CAM and main flows.

- **Traffic reduction**, from January 2022 Madrid implemented a LEZ inside the M-30 and two other zones known as: Special Low Emission Protection Zones (ZBEDEP), these are Plaza Elíptica and Distrito Centro (formerly known as "Madrid Central" and with greater access restrictions than in the other zones). The first is outside the LEZ area and the other included. These limitations influence in the air quality of the three neighbourhoods selected for the analysis. These meet the air quality limits currently in force in the EU. Based on data from the three stations measuring the level of emissions: Cuatro Caminos (urban background type, measuring NO_2, $PM_{2.5}$ and PM_{10}), Plaza Elíptica (traffic type, measuring NO_2, $PM_{2.5}$ and PM_{10}), and Puente de Vallecas (urban background type, measuring NO_2 and PM_{10}).

Finally, Fig. 5 summarises Madrid's situation in terms of key points for the *C40 Cities* approach.

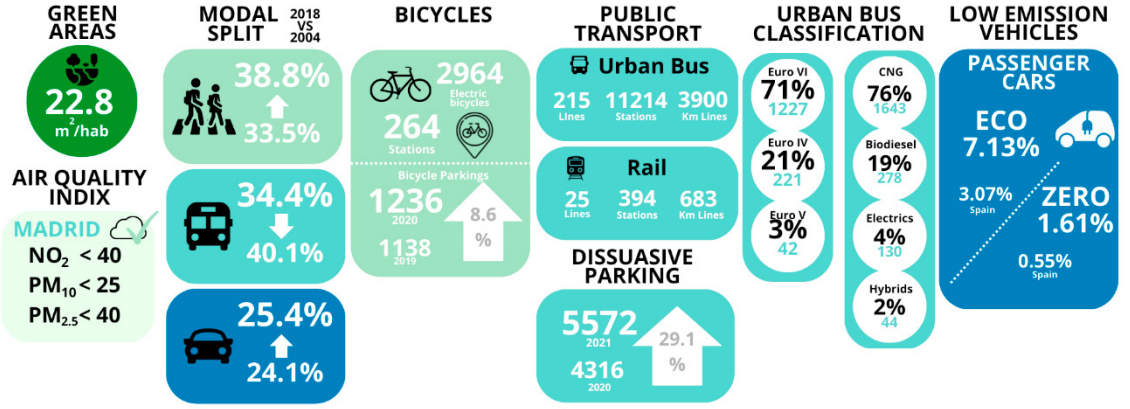


Fig. 5. Summary of the status of the key points for the *C40 Cities* approach in Madrid.

In summary, possible proposals for improvement in these neighbourhoods to achieve the C15' model are indicated:

- **Gaztambide:** The neighbourhood already has a good offer of services, but it has aspects in which improvements could be made, such as pedestrian accessibility —widening of pavements and creation of pedestrian priority areas— and cycling, reducing of noise and air pollution due to the area in which it is located, and increasing the offer of public services.
- **Puerta Bonita:** It would be necessary to improve public transport connections —for example, with other neighbourhoods in Carabanchel—, reduce waiting times and improve accessibility to public transport stations and stops, promote sustainable mobility —with the creation of cycle lanes, improvement of pavements—, improve public spaces, promote local commerce and the creation of coworking spaces, reduce traffic, and therefore, positively affect air quality.
- **Valdebernardo:** Connections with other neighbourhoods in Vicálvaro district could be improved. Although it already has public spaces, they could be improved to make them more attractive and accessible to residents, with better squares and meeting places. Promote local commerce, supporting small businesses in the neighbourhood through local commerce networks or associations, or the organisation of small events. Indoor connections could be improved to reduce the time residents need to travel within the neighbourhood itself.

Workshops, meetings, or surveys could be organised in the three neighbourhoods to gather the opinions and suggestions of residents and neighbourhood associations.

4. Conclusions

The city of Madrid has 21 districts and 131 neighbourhoods, so 131 different C15' cases could be found. Considering the key points of the decahedron, many of them would already fulfil the C15' approach: some in better conditions than others. The challenge is how to deal with commuting to work or study (mandatory mobility) despite the growth of teleworking.

Answering the question that heads this article: The 15-Minute City, utopia, or reality? we conclude that it has part of both. Utopia means “the best place that does not exist” and "is the imaginative representation of a future society with characteristics favourable to human well-being". It is therefore the dream of a better world, which starts from a critique of the current reality but indicates where to go. It is not only necessary to plan, to define clear objectives that direct actions, but also to constantly evaluate the progress made. Any change towards an “ideal” model has a part of utopia, a desire to achieve.

The concept of the “city of proximity” implies a humanisation of the city, where the model is implemented, so that actions aimed at this implementation can be driving force behind others that radically influence the improvement of the quality of life. It is worth continuing to promote it. So the second part of the question is how to put it into practice, bearing in mind that any action in favour of these changes, however small, contributes to the climate fight.

As Jan Gehl says, "a living city is always under construction. When something does not change, it dies".

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