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CIVITAS ECCENTRIC foster active mobility in Madrid through improvements in the public space

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CIVITAS ECCENTRIC FOSTER ACTIVE MOBILITY IN MADRID THROUGH IMPROVEMENTS IN THE PUBLIC SPACE

ABSTRACT

CIVITAS ECCENTRIC is a European project focused on sustainable mobility in peri-central areas and innovative urban freight logistics. It comprises more than 50 measures related to active mobility, the use of public transport, electric mobility and urban freight logistics. These measures have been evaluated in 5 laboratory areas, located in the cities of Stockholm (Sweden), Madrid (Spain), Munich (Germany), Ruse (Bulgaria) and Turku (Finland).

11 measurements were carried out in Madrid, many of them in the laboratory area: the districts of *Puente* and *Villa de Vallecas*. With the outbreak of the health crisis, measures related to the promotion of active mobility (MAD 2.8, MAD 4.6 and MAD 4.7) have gained importance.

The project obtained significant results through specific improvements in public space, such as the implementation of pedestrian and bicycle routes, improvements in accessibility at pedestrian crossings, tactical urbanism actions, a smart signage system addressed to pedestrians and cyclists, etc.

13% of the affected population that live within a 400m band along the streets included in the measure MAD 4.6 declared to have changed to walking, resulting in 273,150 additional trips per month (or 9,105 additional trips per day). 30% of them were influenced by the street improvements on their choice for walking.

The lack of a connected and safe cycling infrastructure acted as a barrier to the choice of the bicycle as a transport option. Despite this, the measure MAD 4.7 achieved 849 new cycling trips per day coming from other modes of transport (almost 2% of modal share). 16% of these residents were influenced by the street improvements on their choice for cycling.

The results showed that pedestrian-friendly interventions are likely to increase the walking and cycling modal share, improving citizens' perception of road safety and achieving a significant reduction of CO2 and other pollutant emissions.

However, the results also showed that only a small fraction of the modal shift towards sustainable modes is likely to come from former car users. To curb car use, providing significant emission savings, cities should combine actions oriented to promote sustainable modes with car restrictions.

1. THE CIVITAS ECCENTRIC PROJECT

CIVITAS ECCENTRIC is a European project focused on demonstrate and test innovative sustainable mobility measures in peri-central areas and innovative urban freight logistics, two important areas that have previously received less attention in urban mobility policies.

It comprises more than 50 measures related to active mobility, the use of public transport, electric mobility and urban freight logistics. These measures have been evaluated in 5 laboratory areas, located in the cities of Stockholm (Sweden), Madrid (Spain), Munich (Germany), Ruse (Bulgaria) and Turku (Finland).

Some of these laboratory areas are densely populated neighbourhoods with few job opportunities, which concentrate social and urban problems such as unemployment and the deterioration of public space.

With regard to urban mobility, although communication with the city centre is generally efficient, it is not easy to move within the neighbourhood or to other nearby peripheral neighbourhoods. In the first case, pedestrians and cyclists are faced with a public space excessively occupied by cars. In the second case, public transport offers few direct services. The negative consequences for the city are multiple, including accidents, time wasted in transport, deterioration in physical and mental health, increased dependence of vulnerable groups, etc.

11 measurements were carried out in Madrid (Table 1), many of them in the laboratory area: the districts of *Puente* and *Villa de Vallecas*.

Table 1. ECCENTRIC Madrid measures and Work Packages

Work Packages		Measures	
WP. 2	INCLUSIVE URBAN PLANNING	MAD 2.3	Adaptive parking management based on energy efficiency and occupancy
		MAD 2.8	Mobility management strategies for vulnerable groups
WP. 3	MOBILITY AS A SERVICE	MAD 3.3	Open platform for multimodal mobility information and services
WP. 4	SAFE WALKING AND CYCLING	MAD 4.1	Innovative and participative approach to traffic safety
		MAD 4.6	Pedestrian-friendly public space outside the city centre
		MAD 4.7	Enabling cycling outside the city centre
WP. 5	CLEAN PUBLIC TRANSPORT	MAD 5.1	High-level public transport service corridors in peripheral districts
		MAD 5.8	Electric and hybrid electric buses for public transport
WP. 6	ADOPTION OF CLEAN VEHICLES	MAD 6.2	Test fleets, policy incentives and campaigns for the uptake of electric vehicles
WP. 7	CLEAN FREIGHT LOGISTICS	MAD 7.1	Consolidation centre with electric vehicles and local regulations for clean urban freight logistics

		MAD 7.6	Prototype for an ultra-low-emission cargo vehicle

Source: CIVITAS ECCENTRIC Project

With the outbreak of the health crisis, the measures related to the promotion of active mobility through improvements in the public space (MAD 4.6 and MAD 4.7) have gained importance. This communication presents their main outputs, results and lessons learned.

After this introductory part, section 2 presents the main urban and socio-economic characteristics of the laboratory area that affect urban mobility. Section 3 describes the main achievements of the ECCENTRIC measures. The fourth section presents the procedures of the evaluation framework. The fifth section, the results obtained in relation to modal shift, emission savings and road safety. Finally, the last section reflects on the lessons learned during the process.

2. VALLECAS: THE LIVING LAB IN MADRID

The Living Lab area includes the districts of the *Puente de Vallecas* and *Villa de Vallecas*, with 345,206 inhabitants. Both districts are part of the urban periphery area, and are included in the inner zone (zone A) of the public transport fare system (figure 1).

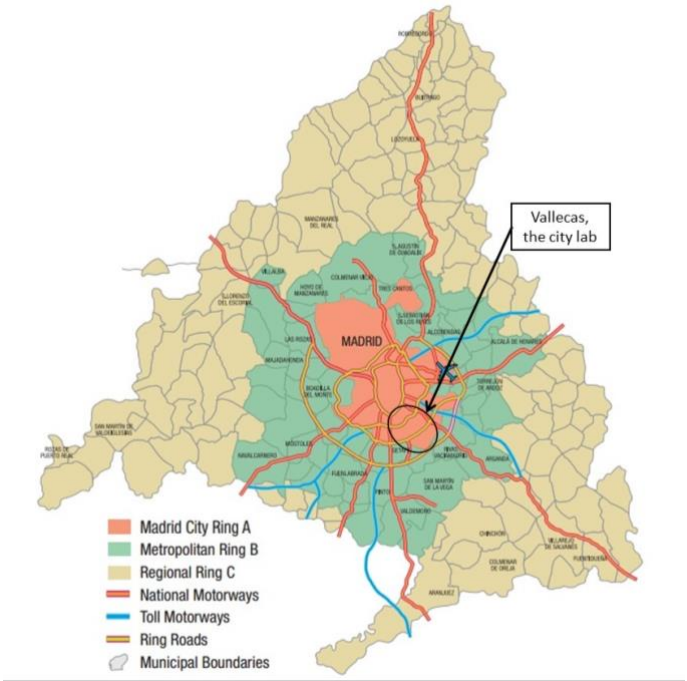

Figure 1. *Vallecas*: The laboratory area. (CIVITAS ECCENTRIC Project)

These two districts are divided into nine neighbourhoods. Most of them lost population in the last decade, as can be observed in table 2. The only exception is the neighbourhood *Casco Histórico de Vallecas*, which has significantly increased its population (+60,1%), due to a huge new development known as *Ensanche de Vallecas*, one of the main new residential areas planned by the 1997 Land Use Plan, and progressively built up since the mid-2000s, based on medium-to-low densities and a car-oriented urban design.

Table 2. Population in the demonstration area

Districts and neighbourhoods	Population 1/1/2019	2019-2009 Growth	% of City Lab Population.
Total PUENTE DE VALLECAS (PV)	234.770	-4,2%	68,0%
Entrevías	34.698	-6,4%	10,1%
San Diego	41.664	-3,4%	12,1%
Palomeras Bajas	40.166	-4,5%	11,6%
Palomeras Sureste	42.594	-3,0%	12,3%
Portazgo	28.350	-4,1%	8,2%
Numancia	47.298	-4,2%	13,7%
Total VILLA DE VALLECAS (VV)	110.436	36,8%	32,0%
Casco Histórico de Vallecas + Ensache de Vallecas	86.108	60,1%	24,9%
Santa Eugenia	24.328	-9,6%	7,0%
TOTAL PV+VV	345.206	5,9%	100,0%

Source: Subdirección General de Estadística. Ayuntamiento de Madrid (2019).

Compared to the central districts of Madrid, the Living Lab population is younger, and shows lower income and employment rates. The percentage of elderly (more than 65 years old) is 17,9% in *Puente de Vallecas* and only 12,5% in *Villa de Vallecas*, lower than the city 20,3% average. 19.3% of the population in *Villa de Vallecas* is under 16 years old, higher than the value in *Puente de Vallecas* (13,9%) and the city average (14.2%).

Due to the loss of traditional industrial activity in *Puente de Vallecas*, and the significant population increase in *Ensanche*, there is a significant imbalance between jobs and residents. The ratio of jobs to employed population is just 37% in *Puente de Vallecas* and 67% in *Villa de Vallecas*. The average income is also lower than the city average: 25% lower in *Puente de Vallecas* and 9% in *Villa de Vallecas* [1].

The urban structure is characterized by dense and consolidated neighbourhoods, particularly in *Puente de Vallecas*, which includes the densest neighbourhoods: *San Diego* (410 inhab/ha), *Numancia* (262 inhab/ha), *Palomeras Bajas* (237 inhab/ha) and *Portazgo* (233 inhab/ha), with more than 220 inhab/ha. The neighbourhoods built after 1970 have still high, but much lower densities, such as *Palomeras Sureste* (139 inh/ha), *Santa Eugenia* (119 inh/ha) and *Ensanche de Vallecas* (77 inhab/ha). The neighbourhood of *Centro histórico de Vallecas* has an unusual low density (just 10 inh/ha) due to the extensive undeveloped areas it includes.

There is a sharp contrast among the street pattern of the older neighbourhoods (narrow streets following the old trails and roads), the neat patterns of the planned neighbourhoods of *Santa Eugenia* and *Palomeras* and the over-dimensioned, wide and straight avenues in *Ensanche de Vallecas*.

This mainly affects non-motorized mobility. The sensorial experience of walking through the traditional neighbourhoods is totally different from the pedestrian experience in *Ensanche*, characterized by the excess of road space dedicated to car, lack of social interaction and urban vitality.

Figure 2. Historical centre of *Villa de Vallecas*. Author: unknow.

Figure 3. *Ensanche de Vallecas*. Author: Alvaro García.

Regarding the urban context, the Living Lab is separated from the city centre by the *M-30* ring road, and is surrounded and intersected by large road and rail metropolitan infrastructures, providing high metropolitan accessibility but, at the same time, creating major barriers for local mobility and blighting in the vicinity. The two districts in the Living Lab, *Puente de Vallecas* and *Villa de Vallecas* are separated by the *M - 40* ring road; the other two ring roads, *M-45* and M-50, go through the Eastern part of *Villa de Vallecas*.

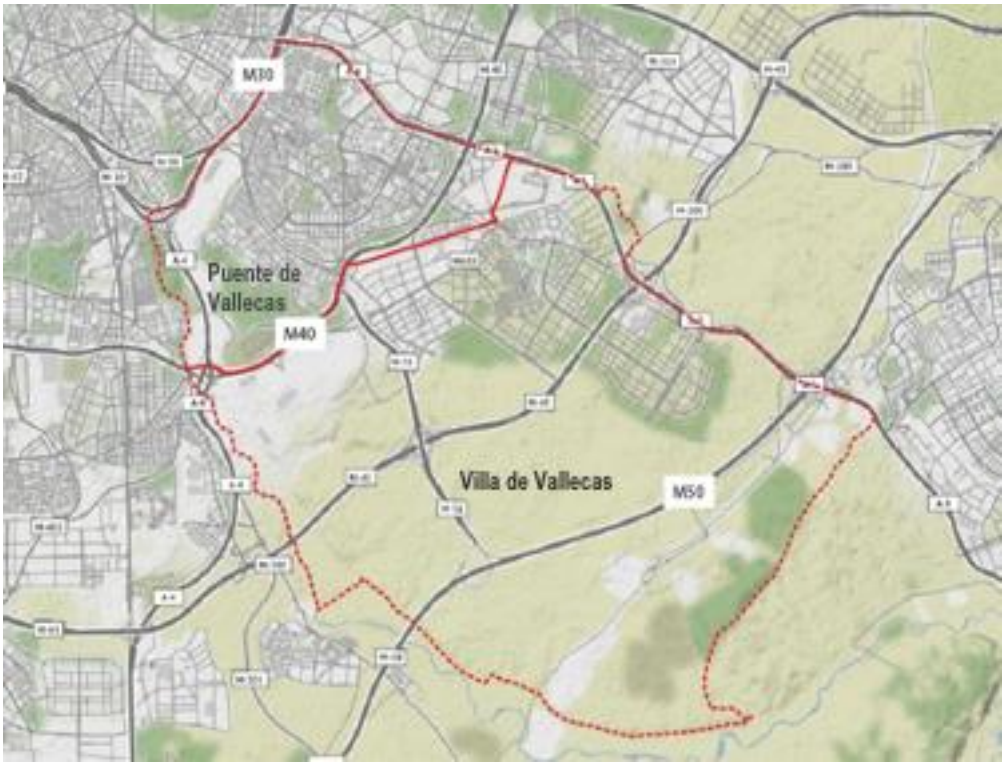

Figure 4. The urban structure (CIVITAS ECCENTRIC Project)

Based on the last household mobility survey (EDM 2018), some mobility traits can be highlighted about the mobility patterns in the demonstration area:

Table 3. Key mobility indicators in Madrid and in the demonstration area

	TOTAL	Rest of Region	Metropol. Ring	Madrid Municipality	Puente de Vallecas	Villa de Vallecas
Population 14-80	5,375,334	337,878	2,396,227	2,370,261	186,845	84,122
Cars/household	1.08	1.44	1.28	0.88	0.73	1.06
% pop. travelling	89%	87%	90%	89%	84%	89%
Trips/person	2.59	2.49	2.58	2.64	2.27	2.52
% NMM	34.4%	29.7%	34.5%	35.3%	35.2%	25.8%
% PT	24.3%	10.3%	16.0%	33.5%	36.0%	30.9%
% Car	39.0%	56.7%	48.0%	28.4%	26.9%	41.3%

Source: CRTM (2019).

The share of private car use is significantly lower in the capital (28.4%) than the region average (39.0%). There is a sharp contrast between the lower car use in *Puente de Vallecas* (26.9%, below the regional and capital average) and *Villa de Vallecas* (41.3%, well above the regional average). This can be explained by the influence of the residents in the car-oriented new neighbourhood of *Ensanche*.

As mentioned before, in general terms, the neighbourhoods in *Puente de Vallecas* district have high population densities, employment opportunities and a greater presence of proximity services. With the exception of the *Casco Histórico de Vallecas*, *Villa de Vallecas* has lower urban densities, a strong residential character, and a car-dominated street design, discouraging

walking and cycling trips. This explains the low percentage of non-motorized trips in *Villa de Vallecas* (25.8%), compared to *Puente de Vallecas* (35.2%), close to the capital average (35.3%).

The picture is similar in what refers to the use of public transport, with *Puente de Vallecas* showing a higher modal share than the capital's average (36.0% versus 33.5%) while public transport use in *Villa de Vallecas* is lower (30.9%).

The number of cars per household is also lower in *Puente de Vallecas* (0.73) than the capital's average (0.88), whereas in *Villa de Vallecas* (1.06) is higher and close to the regional average (1.08) [4].

3. ACTIONS CARRIED OUT TO PROMOTE ACTIVE MOBILITY

Considering the challenges related to sustainable mobility in the laboratory area, the ECCENTRIC project dedicated two measures to increase the modal share of active modes through improvements in the public space: the MAD 4.6 (Pedestrian-friendly public space outside the city centre) [2] and the MAD 4.7 (Enabling cycling outside the city centre) [3].

The two measures started from a wide objective of establishing a high-quality and combined pedestrian and cycling network linking several disconnected areas of the Living Lab, considering the main public facilities and urban activities. However, they had to adjust themselves to the budgetary constraints and bureaucratic difficulties of the municipal programmes; and also to the priorities identified by local stakeholders in the living lab.

Challenging the lack of time and resources, many actions were implemented between 2018 and 2020. Other actions, like the future e-mobility station in *Sierra Guadalupe*, were not discarded by the municipality, and could be implemented after the project life span.

The following paragraphs summarizes the actions carried out by the project until 2020:

- Implementation of some sections of the high-quality pedestrian and cyclist corridor *Itinerario Miradores* in *Puente de Vallecas* (figure 5), connecting the major green areas in this district, while improving north-south connectivity for pedestrians and cyclists in the area. Several sections of this corridor were completed in 2019 and others are being completed in 2020.
- Tactical urbanism in *Calle Arboleda*, that links the Southern Campus of the Technical University of Madrid with the rail and metro station *Sierra de Guadalupe*. This action, carried out in cooperation with UPM south campus, was focused on pedestrians and cyclists and included a cycle lane and the widening of sidewalks.
- Implementation of the first pilot smart signage system, specifically addressed to pedestrians and cyclists, in the surroundings of the future e-mobility station in *Sierra de Guadalupe* (figures 6 and 7).
- Punctual works in the surroundings of the future e-mobility station and in the *Peña Gorbea* Boulevard, *Constitución* Square and *La Cañada* Park, including accessibility improvements, pedestrian crossings, etc.

- Organisation of the communication campaign *Camina Madrid*, focused on pedestrian priority in the use of sidewalks, in accordance with the new municipal Ordinance approved in October 2018. The campaign made use of a variety of advertising supports such as lampposts, underground and commercial centres, bus stops, etc. (figure 8).
- Design and implementation of some key elements of the cycling network in *Vallecas*. This includes several shared lanes for bikes and general traffic, along key north-south and east-west sections within the living lab. The shared lanes were implemented along 2018 and in the first months of 2019 in the main corridor of *avenida de la Albufera* (figure 9) and in the following streets: *Martínez De La Riva; Sierra Toledana; Rafael Alberti; Puerto de Canfranc; Monte Igueldo; Convenio; El Bosco; and Camino del Pozo del Tío Raimundo*.

The network of shared lanes was adapted to the spatial distribution of urban activities and the location of facilities, with particular emphasis on public transport, educational and sports centres; as well as to topography (slopes) and the general traffic volumes on the roads. The prioritisation of these streets was also based on the level of support received by citizens in the Participative Budgets Process established by the municipality.

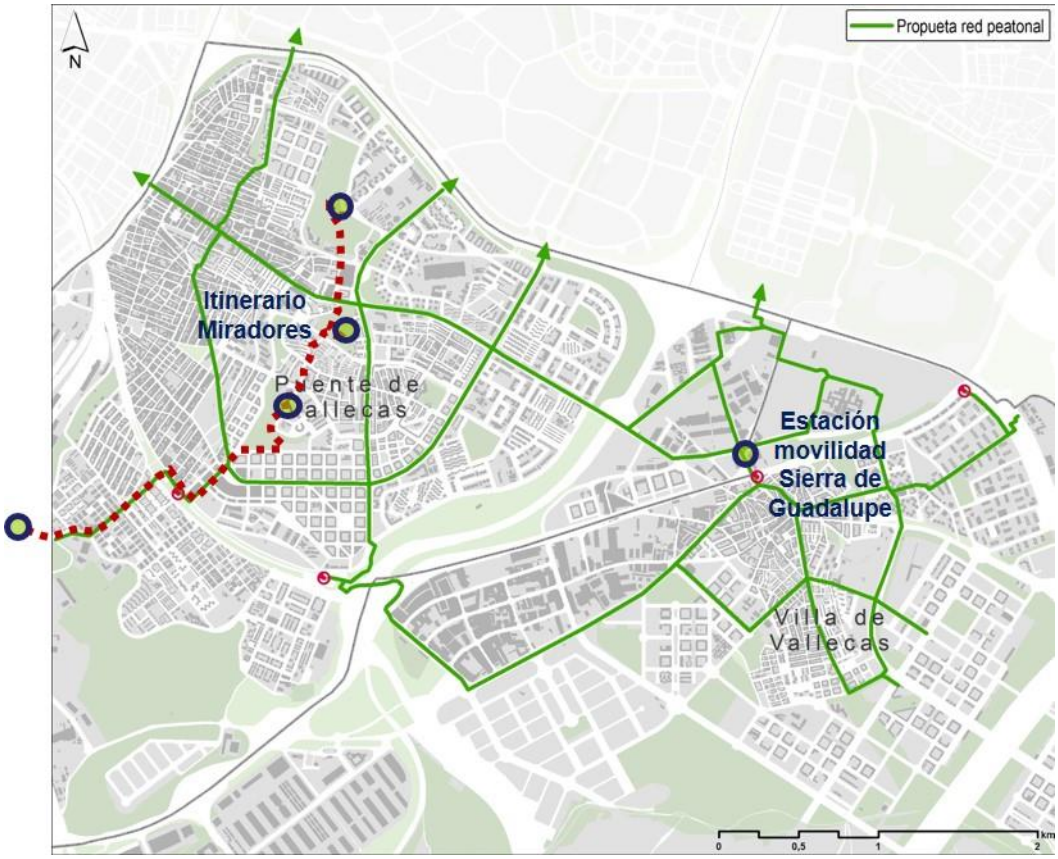

Figura 5. Pedestrian network (green) and high-quality pedestrian corridor *Itinerario Miradores*. (CIVITAS ECCENTRIC Project)

Figura 6. First pilot smart signage system, addressed to pedestrians and cyclists. (CIVITAS ECCENTRIC Project)

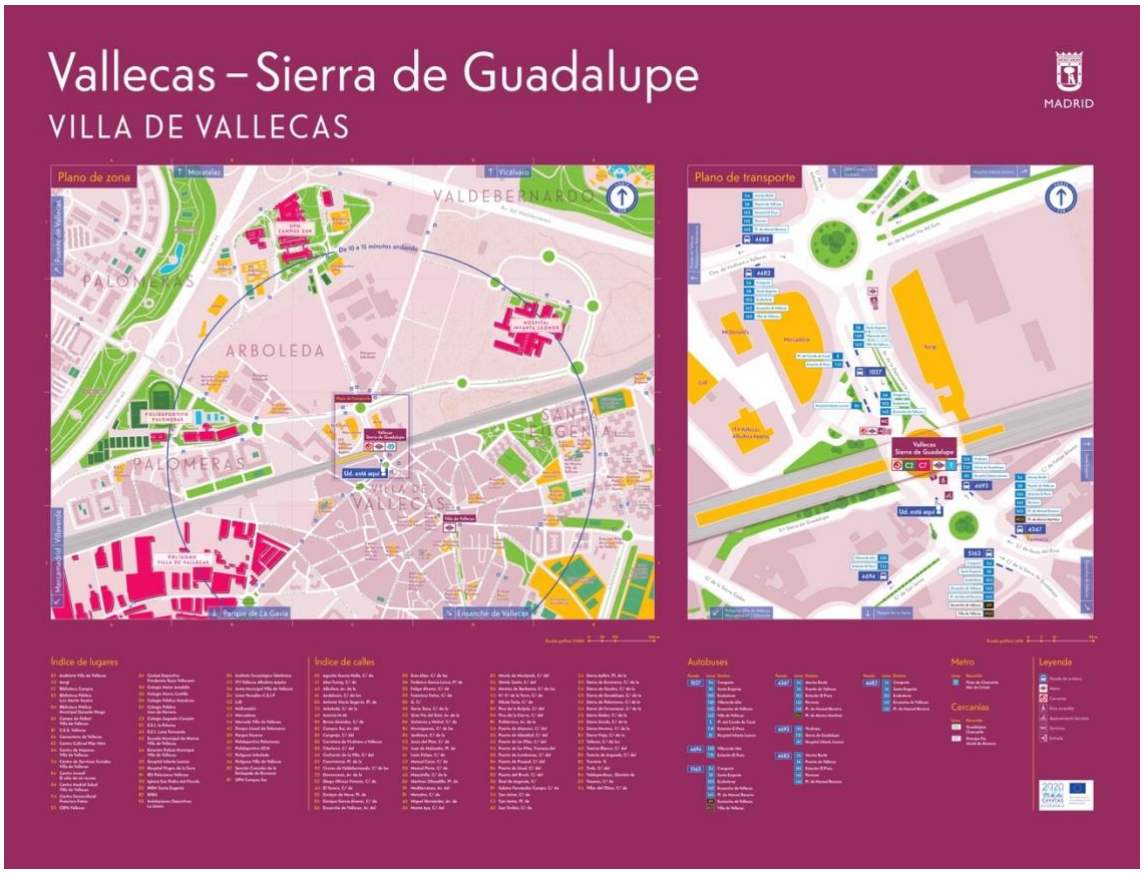

Figure 7. First pilot smart signage system, addressed to pedestrians and cyclists. (CIVITAS ECCENTRIC Project)

Figure 8. Campaign *Camina Madrid* (CIVITAS ECCENTRIC Project)

Figure 9. Shared lane on *avenida de la Albufera*. (CIVITAS ECCENTRIC Project)

4. THE EVALUATION FRAMEWORK

The following table summarizes the selected main indicators and the method to evaluate the performance of each measure [2] [3]:

Table 4: Key Performance Indicators for the measures.

Indicator	Data units	Method	MAD 4.6	MAD 4.7
Modal shift	Trips	Survey	x	x
Systems usage: pedestrians and cyclists flow (daily average)	Users	Survey	x	x
Satisfaction	Score (1-5)	Survey	x	x
CO2 emissions avoided due to modal change	Tons/year	Estimation	x	x
NOx emissions avoided due to modal change	Tons/year	Estimation	x	x
PM emissions avoided due to modal change	Tons/year	Estimation	x	x
Number of casualties (including fatalities) involving pedestrians and cyclists in the area	Quantity/ month	Data collection	x	x

Source: CIVITAS ECCENTRIC Project

The references for modal shift were the 2004 household survey (EDM 2004) and the 2014 survey (taken cautiously, due to the smaller sample). Another useful reference was the traffic counting database of the municipality, that includes the number of bikes and pedestrians on certain streets in the area (counting of bicycle and pedestrian flows were made in May 2018).

To assess the impact of the measures in terms of modal change and emission savings, an on-street survey was applied to a sample of pedestrians and cyclists in the streets were the municipality had implemented actions to improve walking and cycling conditions. The survey provided the percentage of pedestrians and cyclists that have changed from other modes, and the characteristics (previous mode, distance and frequency) of their trips before the new infrastructure was implemented.

The emissions saved in each replaced trip were estimated making use of the coefficients provided by COPERT 5.1[1] (Calculation of Emissions from Road Transport), a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories[2].

The coefficients in the table below were multiplied by trip distance and frequency (number of trips per year), and divided by occupancy for every respondent in the survey, and expanded to the whole number of pedestrians and cyclists counted in the surveyed streets in order to obtain the annual emissions of the pollutants in tons.

[1] Considering an average speed of 20 km/h for cars and an average speed of 15 km/h for buses; average car type 50% diesel and 50% petrol medium-size car; average bus occupancy, 40 persons; Euro V bus, average car occupancy, 2 persons; Euro VI, up to 2016 technology.
[2] https://www.emisia.com/utilities/copert/

Table 5. Average emission factors per trip (g/km and passenger), for car and bus

	CO2	NOx	NO2	PM10	PM2.5
Car trip, gasoline	296.3583	0.069	0.0014	0.0231	0.013
Car trip, diesel	222.5852	0.6827	0.2048	0.0246	0.0145
Bus trip, Euro 5	1280,3214	10,14	1,014	0,1743	0,1254

Source: COPERT

5. RESULTS

The results can be discussed from the perspective of the main KPIs.

5.1. Modal shift

The number of walking trips in the vicinity of the streets included in the measure MAD 4.6 has increased substantially (more than 9,000), far beyond the 1,000 initially target. 13% of the affected population that live within a 400m band along the streets included in the measure declared to have changed to walking; and 30% of the people who answered the survey were influenced by the street improvements on their choice for walking. However, 83% of the new walking trips were formerly travelled by public transport.

The lack of a connected cycling infrastructure acted as a barrier to the choice of the bicycle as a transport option. Despite this, the measure MAD 4.7 achieved 849 new cycling trips per day coming from other modes of transport (almost 2% of modal share). 16% of the residents who answered the survey were influenced by the street improvements on their choice for cycling.

However, modal change to cycling was mainly due to trips formerly done by pedestrians (54.8% of trips changing mode) and public transport users (36.6% of trips changing mode). Only 8.5% of the cycling trips changing mode correspond to former car users.

5.2. CO2, NOX, PM emissions

The measure MAD 4.6 have achieved around 40% reduction of CO2 and other emissions thanks to the modal shift. This result can be considered as substantial, as it is equivalent to removing 100 cars from traffic in the area. However, it is important to highlight that almost 8 of every 10 trips gained by walking are coming from public transport and only 2 from private cars.

Regarding the MAD 4.7, the reduction of CO2 (and other) emissions has been 35.2 tons/year instead of target of 50 tons/year. The modest attainment in terms of emission is consistent with the fact that only 8.5% of the trips changing mode to cycling are coming from private cars, and 47.1% from public transport.

5.3. Road Safety

The perception of the street conditions (which include safety as a key trait) has notably increased: 30% of the people who answered the MAD 4.6 survey were influenced by the street improvements on their choice for walking; and 16% of the respondents to the MAD 4.7 survey were influenced by the street improvements on their choice for cycling.

The number of traffic accidents involving cyclists has slightly decrease in the Living Lab (by 3.5%), although this figure has to be taken cautiously due to the changes made in the accident data collection procedures in 2018.

6. LESSONS LEARNED

The main lessons learned are related to the participatory process with different stakeholders and the results in terms of modal shift.

It is difficult to introduce participatory approaches into research and demonstration projects with tight deadlines. It is important to identify the main stakeholders and participatory channels still in the design process, and from the consolidation of a dialogue channel, co-design the decision-making procedures.

Local bureaucracies can put demonstration projects at risk. Would be interesting to establish special approval and budgeting procedures for these actions.

The evaluation results showed that pedestrian-friendly interventions are likely to significantly increase the number of walking and cycling trips, improving the road safety perception by the citizens and achieving a significant reduction of CO2 and other pollutant emissions.

However, the results also showed that only a small fraction of the modal shift towards sustainable modes is likely to come from former car users. To curb car use, providing significant emission savings, cities should combine actions oriented to promote sustainable modes with car restrictions.

7. REFERENCES

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