

XXV International Conference Living and Walking in Cities - New scenarios for safe mobility in urban areas (LWC 2021), 9-10 September 2021, Brescia, Italy

Micro-mobility in the “Virucity”: The Effectiveness of E-scooter Sharing.

Romano Fistola^{a*}, Mariano Gallo^a, Rosa Anna La Rocca^b

^aDING, University of Sannio of Benevento, Benevento, Italy

^bDICEA, University of Naples Federico II, Italy

Abstract

The Covid-19 pandemic event has produced an acceleration in the use of technological innovation which, in some cases, has substituted some urban activities usually carried out through direct interaction between people. The restrictions on mobility, the collapse of tourism and the spread of teleworking have produced important effects on the demand for mobility at urban, extra-urban and international level. Collective transport was penalized, as considered unsafe for contagion. Policies were mainly oriented at reducing the service capacity to mitigate the theoretical crowding on board rather than increasing the number of vehicles. So, the transport services just worked because the demand for the LPT naturally decreased out of fear of contagion. Alternatively, for short distance in urban areas "non-conventional" modes of travel have been spreading, also encouraged by some governmental measures. The spread of “urban micro-mobility” systems including the supply of e-scooters has had an immediate impact. Beginning with these considerations, this study proposes an analysis of the spread of e-scooters in Italian cities starting from the pandemic event, with the aim of verifying their effectiveness even in the post-emergency phase. With this aim, the study is divided into three parts. The first part offers an overview on the theme of urban micro-mobility particularly referring to the use of e-scooters in Italian cities. The second part illustrates the results of direct surveys carried out through questionnaires addressed to a specific range of users, the undergraduate students, considered as a highly significant age range. In the conclusions, some initial considerations are proposed to define the contribution of these "new modes of travelling" in the city to the whole urban sustainability. The final objective of the study is the foreshadowing of possible recommendations to improve the integration between mobility planning and governance of urban transformations.

© 2022 The Authors. Published by ELSEVIER B.V.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0>)

Peer-review under responsibility of the scientific committee of the Living and Walking in Cities

Keywords: Micromobility; e-scooters sharing; Sustainability

* Corresponding author. Tel.: +39 0824 305537.

E-mail address: rfistola@unisannio.it

1. Covid and urban mobility: the impact of the pandemic on transportation modes

Recently, there has been an increasing number of studies investigating the impact of the pandemic on the anthropic concentrations of the planet where the contagion has spread by totally changing the functional system, the social presence, and the spatial perception (Fistola & Borri, 2020) and particularly affecting one of the vital functions of urban systems: the mobility. Mobility represents the only urban function not permanently located in anthropic space but developed through it. Mobility can be interpreted as the activity that enables much of urban survival through the physical movement of individuals and goods in the city. There is no doubt that the segment most affected by the pandemic phenomenon has been the Local Public Transport (LPT), which ensures movement, with reference to the homework or home-place of study typology. The first solution to this impasse has been, on the one hand, to replace physical flows with telematic flows, cutting down on physical movement and, on the other, a dramatic reduction in the capacity of LPT carriers, which has almost never corresponded to an increase in the number of the vehicles themselves. However, it should be noted that both the push towards telematic virtualization of activities (Fistola & La Rocca, 2001) and the adoption of smart mobility can be listed, along with others, among the factors on the "positive side" of the pandemic (Mastrodonato, 2021). The general response to the dangers of the spread of the virus and the potential of contagion has consisted of, especially for the urban travel needs of citizens, using primarily the private car and then other means of transportation. According to the results of a recent survey conducted by the company Aretè (2021), it should be noted that, especially for young Italians, the car remains the preferred means of transport for travel (75% of the sample considered, it was 72% in April 2020), followed by bicycles (8%), motorcycles and scooters (4%) and shared vehicles (3%). It also seems relevant to note that a substantial push towards urban micro-mobility has been produced by government policies through support for the buying and use of electric vehicles. In particular, the Italian Government has provided, through article 229 of the Relaunch Decree, an incentive of up to 500 euros for those who intend to purchase a means of "sustainable mobility", including muscle bikes, e-bikes, and electric scooters. The Government's initiative, although strongly criticized by the opposition, has resulted in the sale of 350,000 vehicles, with funds of 120 million euros planned. However, it should be noted that the diffusion of electric scooters in many cities of metropolitan dimensions represented a first response to traffic congestion problems that could be "easily" implemented as an aid to these issues. This new type of micro-mobility has also stimulated many interesting studies suggesting applications of complex statistical methods, such as the Characteristics Object METHod (COMET), in order to determine the best model to choose by considering such factors as price, top speed, weight, autonomy (battery life) and motor power expressed in watts (Kizielewicz B. & Dobryakova, 2020). However, the real breakthrough of electric scooters in urban areas has occurred thanks to the massive diffusion, also on the Italian territory, of e-scooter sharing (in conjunction with e-bikes) that has affirmed this new urban micro-mobility.

2. Micro-mobility in sharing in Italian cities

2.1. *The characteristics of sharing mobility systems: the supply side*

Shared mobility is becoming increasingly popular in Italy, Europe and around the world. Shared mobility systems, even when changing the type of vehicle, have the following main elements in common:

- you only pay for the use of the vehicle and for the time needed to move;
- the traditional concept of "possession" of the vehicle, with all its economic consequences, is abandoned and the vehicle is replaced by a concept of "use";
- for cars, the use of the sharing vehicle is usually occasional and can replace the possession of a second or third vehicle in the family, in cities where the collective transport system is not widespread and efficient, while it can also replace the possession of the first vehicle in cities where collective transport services are widespread and efficient;
- it is a very convenient service, as a supplement or substitute for the collective transport system, for tourists or other temporary visitors to a city.

Shared mobility can be based, mainly, on three types of vehicles: cars (car-sharing); bicycles, normal or pedal-assisted, (bike-sharing); scooters, usually electric, scooter-sharing or micro-mobility. The cars are usually electric, hybrid or, in any case, not using conventional fuels (e.g., LPG or methane). There are 4 main modalities of service provision:

- Bidirectional, with fixed pick-up and drop-off points (station-based); this type of service is usually provided only for car-sharing. Customers book their vehicle at a specific pick-up/drop-off point (parking point) with an app or through a dedicated website, specifying the time of pick-up and the expected duration of use. The user must return the vehicle to the same location where it was picked up (with a few exceptions) and pay for the entire time between the start and end of their reservation. Clearly, this system is the most restrictive for the user, but also the easiest to manage.
- One-way, with fixed pick-up and drop-off points (station-based). This mode is also called point-to-point. The user picks up the vehicle (in some cases even without a reservation), at a pick-up/drop-off point (parking) with an app or via a dedicated website. The user can return the vehicle at any pick-up/drop-off point. The user pays for the distance travelled and/or the time for the journey made and is not bound to using the same service for the return journey. The management of vehicle relocation by the operator is fundamental, given the directionality that demand may have.
- Free-floating, without pre-established pick-up and delivery points. This mode is usually used for micro-mobility, sometimes for bicycles, but can also be used for cars. The user picks up the vehicle at any point inside the city (there are no fixed pick-up/drop-off points). The app provides the user with information about the nearest vehicle location. The vehicle can also be booked (so it is taken out of the availability for others). The user can return the vehicle at any point in the city. The user pays for the distance travelled and/or the time for the move. Fundamental to this is the management of vehicle relocation.
- Peer-to-peer, with the sharing of one's own vehicle. In this case, private individuals make their vehicle available to share with others and receive compensation when it is rented. Shared vehicles are equipped with technological devices so that they can be booked and used via apps and/or smartcards. If the vehicle is not equipped, the owner also shares the keys to the renters to use the vehicle. The role of the service operator is to manage the online marketplace to connect vehicle owners with users, but not the fleet. In addition, the operator provides vehicle owners with insurance products and keeps a percentage from each rental transaction. Typically, this system, for obvious reasons, is operated as a two-way service: the vehicle must be returned to where it was picked up.

Shared e-scooters usually use the free-floating system. Regarding the spread of these services in Italy, it is necessary to discern between car-sharing, bike-sharing and scooter-sharing. For car-sharing, the most recent data available refers to 2019 then, pre-pandemic (Aniasa, 2020). This data shows an increase, compared to the previous year, in the number of members of car-sharing management companies (+21%) reaching about 2.2 million. The fleet of cars is about 6,300 vehicles, with a total number of rentals of about 11.7 million (+26% compared to 2015). The average rental duration is 32 minutes and the average distance per rental is 7.4 km. The main cities where these services are widespread are Milan and Rome, with a total of about 9.38 million rentals (over 80% of the total) and about 5,000 vehicles (about 80% of the total), followed at a distance by Turin and Florence. Car-sharing is also present in the following other Italian cities: Naples, Bologna, Parma, Brescia, Savona, Venice, Padua and Palermo. A complete map of the cities where the service is available can be found at the online link published by Iniziativa Car Sharing. Bike-sharing services are, obviously, more widespread throughout the territory. The National Observatory on Sharing Mobility has surveyed 31 provincial capitals in which there is a service with at least 80 bikes available. In these 31 cities, the total fleet of bikes has more than tripled from 2015 to 2019, reaching over 5,400 bikes overall. The services offered in these cities are predominantly station-based (19/31); 4 cities offer only a free-floating service, while 7 others offer both types of service. Rentals totaled more than 12.5 million in 2019, up sharply from 5.6 million in 2015.

2.2. The characteristics of micro-mobility: the demand side

Micro-mobility sharing has recently been emerging as one of the most promising solutions for the spread of sustainable modes of travel in urban areas. Also, in the scientific literature with specific reference to the use of electric powered Personal Mobility Vehicles (e-PMVs) and their impact on urban mobility and city planning, there is now a

substantial number of contributions that has allowed interesting insights that can be considered at the base of this study (Boglietti et al., 2021). The micro-mobility sharing segment includes three main categories of vehicles: a) scooter sharing; b) bike sharing; c) electric scooters. These vehicles, in addition to having the characteristic of being available in sharing mode, must meet requirements that help to understand what is meant by micro-mobility. First, the relationship with urban space. To be effective, sharing services must meet the criteria of distribution, accessibility, and reachability. Distribution concerns the widespread location of points of service over the territory. Accessibility refers to how the service can be effectively used, both in terms of ease of use and in terms of functionality, safety, and comfort of the fleet. Reachability is related to the ease of finding the location of the vehicles in the area and is complementary to the previous concepts. Secondly, the characteristics of the vehicles must meet the criteria of lightness (low weight) and, at the same time, reliability, and safety. Finally, the practicability of the route. This last point highlights a fundamental aspect of the definition of micro-mobility as a mode of transport and not exclusively referred to the carrier. Micro-mobility, with reference to this characteristic, must be understood in terms of the length of the route and its conditions of practicability in safe conditions (Fistola et al., 2020).

In this study, reference has been made to micro-mobility in the terms mentioned in the three previous points, to propose an interpretation of the phenomenon of diffusion both in relation to the supply component and above all, in relation to the definition of possible demand profiles, with reference to the use of electric scooters in sharing. In Italy, the spread of micro-mobility can be compared to other European countries, in particular France, which has perfected the offer of alternative modes to the use of the private car, especially for short-distance urban travel, for several years now. Italian success has been strongly linked to the distribution of economic incentives, demonstrating that the promotion of sustainability is still very much linked to principles of economic development. The Italian National Observatory for Sharing Mobility, in its recent 4th report of 2020, highlights the exponential and rapid growth of the supply of e-scooters sharing in Italian cities (Table 1) focused on the lockdown period.

Table 1. E-scooter services activated in Italian cities.

	December 2019	September 2020
Bari	-	1,000
Bergamo	-	300
Cesena	-	200
La Spezia	-	300
Lecce	-	250
Milan	-	6,000
Modena	-	200
Monza	-	400
Naples	-	900
Parma	-	900
Pesaro	-	250
Pescara	-	500
Ravenna	-	350
Rimini	1,000	1,000
Rome	-	11,000
Turin	2,650	3,000
Venice	-	300
Verona	1,000	1,000
Total	4,900	27,850

The provincial capitals in which the e-scooter sharing services were activated went from 3 to 18 in a very short period, with a territorial distribution highly concentrated in the cities of Milan, Rimini, and Rome. It is significant to note how the supply component, in a period of less than twelve months, assumes not only a significant consistency but also a significant difference between operators (Table 2) especially in the cities of Milan, Turin and Rome. Naples, until 2020, was the only large city with a single operator (Helbiz) that managed the supply of electric scooters amounting to 900 units, currently present in the central parts of the city. From November 2020, the service was intensified with a new operator that increased the supply of e-scooters with 250 vehicles.

Table 2. Private Operators of e-scooters in Italy

	Helbiz	Bit	Bird	Circ	Dott	Wind	Voi	Lime
Bari	500	500						
Bergamo		300						
Cesena	200							
La Spezia		300						
Lecce		250						
Milan	750	750	750	750	750	750	750	750
Modena	200							
Monza					200	200		
Naples	900							
Parma	300	300				300		
Pesaro			250					
Pescara	500							
Ravenna	350							
Rimini			500					500
Rome	2,500		2,500		2,500	1,000		2,500
Turin	500	500	500	500	500			500
Venice		300						
Verona	200		500					300
Total	6,900	3,200	5,000	1,250	3,950	1,250	750	4,550

Most significant, for the purposes of this study, is the demand data, collected in the 17th Report on the Mobility of Italians. Between management of the present and strategies for the future", published by ISFORT in 2020, allows some useful comments to be made. In addition to the growth, the data shows some characteristics of the demand especially in reference to the duration of the trip that confirms a use of short-average duration (about 10 minutes on average) for a maximum distance of about 1.5 km and a growing propensity for the use of the electric scooter by the mid-young population (up to 40 years).

It seems to be significant to observe that the segment of the population that is "sensitive" to the spread of the electric scooter is essentially made up of a specific age group that, as a matter of fact, represents for now the only user, among other things, very favorable to the spread of this means, both in large cities and in small towns (Audimob observatory, 2020). This is in line with the values of other European countries such as France, which has a much more consolidated tradition than Italy in the use of sustainable mobility sharing and particularly of e-scooters (Fig. 1).

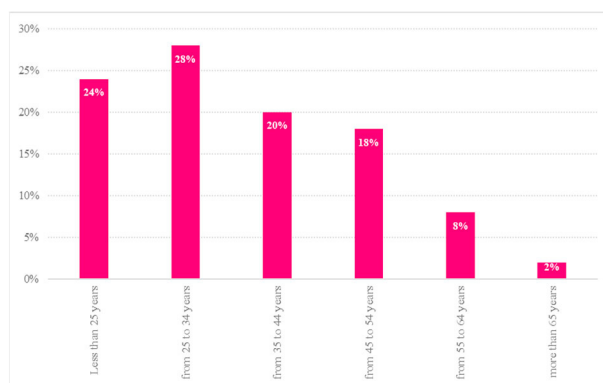


Fig. 1. Users of e-scooters per ages in France

The growth of interest in the use of e-scooters is, in part, influencing the need for greater safety. Firstly, the need to provide travel on mixed routes (pedestrian and cycle paths) and protected lanes, adequately designed to guarantee the same safety conditions as bicycles and pedestrians. Secondly, the need to regulate the use of this means of transport on the road, and by implementing rules that can encourage their use, precisely because of their reduced impact in terms of polluting emissions. After defining a group of users most interested in the use of e-scooters in the urban environment, also on the basis of surveys developed by observatories dedicated to the phenomenon, the study focused on the population of university students in order to monitor the phenomenon and verify the actual effects in terms of reducing traffic congestion, but above all to identify a possible effective alternative able to reduce the contagion from covid 19. The student population, in fact, represents the largest share, after commuters who travel for work, of the population that uses local public transport to reach the place of study.

3. Micro-mobility and university students: comparing large and small universities in Campania

As has already been pointed out, among the elective users of shared micro-mobility on electric scooters it seems possible to identify university students. These "urban actors" are the ideal users because they are better able than other age groups to appreciate the ease of use, the widespread availability of the vehicle, the use of apps on smartphones and all the other elements that make these "new" modes of transport accessible.

The study examined a particular mode of home-study travel composed of the population of university students, also because of the limitations in the use of LPT due to the Covid-19 pandemic. It was considered useful to directly interview a sample of university students enrolled in two different universities in Campania. The sample of about 200 interviewees is represented by students enrolled at the University of Naples "Federico II" and the University of Sannio of Benevento (Unisannio); the questionnaire was distributed during the period March 4 through April 18, 2021.

The "Federico II" is one of the oldest public universities in the world and is in the region's capital, while the "Unisannio" is a small university, founded twenty years ago, located in an internal area of Campania on a hilly urban territory (like that of Naples). It should be noted, as mentioned before, that in Naples there is currently an active mobility service on e-scooter sharing, provided by more than one company, while in Benevento there is still no such service. The answers to the questionnaire can be considered for an evaluation of potential demand. The two universities see significantly dissimilar student populations: Federico II has a total of about 80,000 individuals, while Unisannio has a total of about 5,500 students. The questionnaire was constructed and made available online via Google Forms and was structured in three parts. The first part contains the personal data of the participant. The second part is aimed at obtaining information on the availability of private transport for home-study trips. The third part is oriented towards acquiring information about the users' travel habits, also to understand the propensity to use alternative modes of travel and the users' knowledge of these modes. Particular attention has been dedicated to understanding if and how the pandemic phenomenon has impacted the modes of travel of the student, with the intention of accompanying the interviewee to the subsequent questions focused on the specific means of transport in question. The segment on the mode of transport is preceded by the verification of the propensity to use it, particularly in relation to the distance to

be covered and the time to be spent moving. Further questions investigate the frequency of use, the propensity to drive the vehicle and particularly the so-called advantageous conditions offered by the availability to find the vehicle, generally supported by special applications on smartphones, and the possibility to leave the vehicle near the destination without having to find specific parking areas. The last part of the questionnaire is oriented towards making the respondents participants in a possible project for improving the sharing mobility system and leading them towards the definition of possible proposals. Infrastructures and actions to support use (dedicated routes, rewards, and incentives) constitute the final questions, whose answers can be particularly indicative for the development of policies by the municipal administration. In conclusion, the participants are asked to express a general opinion on urban micro-mobility sharing, both in relation to the possibility of representing a possible response to the pandemic emergency and in relation to the perception that electric scooter sharing can be a concrete and effective alternative solution for the reduction of urban traffic congestion, even for other types of movement besides home-study.

4. The results of the survey: evaluations and considerations

An early review of the results of the survey shows that the composition of the sample is characterized by an almost equal distribution between males and females, with a majority (72.1%) of respondents in the 19-23 age range, belonging to households of 3 or more members (over 96% of respondents). Most of the students responding belong to the University of Naples and around 13% to Unisannio. In most cases, students reside in municipalities other than the one where the university is located and are concentrated in outlying municipalities or the province.

This condition could configure the need for an interchange in the mode of travel, with a first segment of reaching the university campus and a subsequent move to the university for which the electric scooter may represent the elective means. The results of the survey showed that most respondents (74.6%) have the possibility of using a car for their urban travel, 21.4% a motorcycle, 21.4% a muscle pedal bike and 4.5% a pedal-assisted bike. Only 4 respondents (2%) have electric micro-mobility vehicles available to them. 16.9% stated that they do not have the availability of any private vehicle for their urban travel. Electric scooters have been declared useful by the majority of those interviewed: 40.8% consider them useful for any type of urban travel, 24.9% consider them useful for occasional travel, 11.4% only as a means of travel supplementary to public transport (to go to stations). Only 2% considered them of little use in any case, while 20.9% said they were unable to evaluate. The impact of the pandemic on travel habits was significant: only 21.4% of respondents said they had not changed their travel habits, while the remaining 78.6% had (36.3%, only partially). The greatest impact was on the collective transport system, considered the most dangerous for contagion. In fact, taking out the interviews of those who did not even use public transportation before, 25.6% of respondents said they no longer used public transportation and 53.9% said they had greatly reduced their use, while only 20.5% said they used it as much as before. On the usage side, 20.4% of respondents used micro-mobility vehicles, 31.8% never used them even though the service was available in their city, and 45.8% did not use them because they were not available in their city. The propensity to use micro-mobility services shows positive values divided between those most willing to use scooters occasionally (42.3%) and habitually (39.3%); 18.4% of those interviewed would not use them at all, showing a certain reluctance to use the means because they are considered unsafe. The correlation between the propensity to virtualize urban functions and the propensity to use scooters offers some important food for thought.

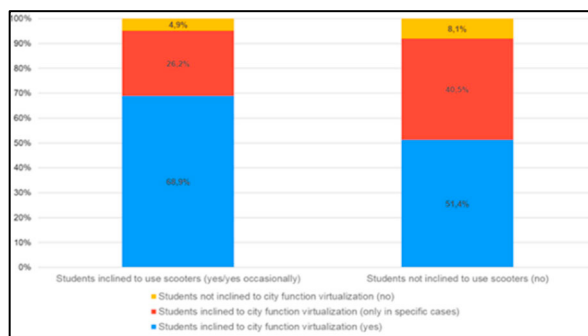


Fig. 2. Correlation between the propensity to use scooters and propensity to virtualize city functions.

As shown in Figure 2, the percentages of propensity to virtualize city functions is higher for students inclined to use scooters; this result may indicate how the urban scooter is perceived as one of the "smart" innovations introduced to respond to the pandemic emergency. Finally, it should be emphasized that these are only initial evaluations of a study currently in progress whose results require more extensive and detailed considerations that cannot be produced here.

5. Micro-mobility and the city: possible integrative scenarios for urban sustainability

In a first general evaluation of the results, it seems possible to conclude that e-scooter sharing can represent a particularly effective mode of "smart" urban travel for university students to reach study centers quickly, avoiding or integrating the use of LPT. It should also be emphasized that the service could significantly expand its user base among students through a general reduction in tariffs (for unblocking and use) or through bonuses for use profited on the student population. It is also evident the contribution to the levels of urban livability and sustainability in the move related to the reduction of emission of exhaust gases in the urban environment, even if, as is known for all vehicles that use electricity, it is a "shift pollution". Another element that should be strongly pointed out is the consistent demand for dedicated lanes for urban micro-mobility, which would allow a considerable increase in safety during displacement and help to avoid improper behavior related to speed, the use of sidewalks both for walking and for "wild abandonment" of the vehicle, which seems to have become a widespread practice but very irritating for citizens. As noted in the first lines of the study, by proposing the questionnaire in various Italian cities, considering the physical-functional specificities also in intermediate cities where there is currently no e-scooter sharing, it will be possible to arrive at a classification of the effectiveness" of shared micro-mobility, prefiguring possible recommendations for mobility-territory integration. One of the future developments of the study could be the development of a GIS that, considering the origins and destinations of the most frequent trips, the urban areas where the greatest presence of potential users are found, the areas of location of the functions with the highest polarization of flows, etc., could represent an effective tool of government for this form of urban micro-mobility and a useful support for the choices of local decision-makers.

References

- Aniasa, 2020. 19° rapporto Aniasa sul noleggio dei veicoli 2019. Giugno, 2020.
- Aretè, 2021. Instant survey "Millennials e Zoomer qual è il loro rapporto con l'auto e la mobilità", www.aretè-methodos.com/
- Boglietti, S.; Barabino, B.; Maternini, G., 2021. Survey on e-Powered Micro Personal Mobility Vehicles: Exploring Current Issues towards Future Developments. In "Sustainability" 2021, 13, 3692. <https://doi.org/10.3390/su13073692>.
- Fistola, R., 1999. Virtualizzazione funzionale e pianificazione interagente nella città digitale, in "Atti della XX Conferenza Italiana di Scienze Regionali. AISRE, Piacenza 1999, ISBN 88-87788-00-6.
- Fistola, R., & La Rocca, R. A., 2001. The virtualization of urban functions, in "NETCOM" Réseaux, communication et territoires/Networks and communication studies, 15(1), 39-48.
- Fistola, R., & Borri, D., 2020. Virucity. Rethinking the urban system. In "TeMA - Journal of Land Use, Mobility and Environment", 179-187. <http://www.tema.unina.it/index.php/tema/article/view/6971>, <https://doi.org/10.6092/1970-9870/6971>
- Fistola, R., Gallo, M., La Rocca, R.A., & Russo, F., 2020. The Effectiveness of Urban Cycle Lanes: From Dyscrasias to Potential Solutions. In "Sustainability" 2020, 12, 2321. <https://doi.org/10.3390/su12062321>.
- ISFORT, 2020. 17° Rapporto sulla mobilità degli italiani. Tra gestione del presente e strategie per il futuro, <https://www.isfort.it/wp-content/uploads/2020/12/RapportoMobilita2020.pdf>
- Kizielewicz, B. & Dobryakova, L., 2020, How to choose the optimal single-track vehicle to move in the city? Electric scooters study case, in "Procedia Computer Science" 176 (2020) 2243–2253 1877-0509, 24th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems.
- Mastrodonato, L., 2020. Il lato positivo della pandemia? Ora sappiamo quali sono le vere priorità. In "WIRED" <https://www.wired.it/attualita/politica/2020/11/11/pandemia-lato-positivo-cose-importanti/>
- Osservatorio Nazionale Sharing Mobility, 2020. 4° rapporto nazionale sulla sharing mobility, <http://osservatoriosharingmobility.it/wp-content/uploads/2020/12/IV-RAPPORTO-SHARING-MOBILITY.pdf>
- Repower, 2021. La mobilità sostenibile e i veicoli elettrici. White paper sulla mobilità sostenibile. V rapporto, <https://mobilitasostenibile.repower.com/>