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Sustainable mobility scenarios in southern Switzerland: insights from early adopters of electric vehicles and mainstream consumers

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Abstract

The transition towards electric mobility is increasingly acknowledged as one of the most beneficial strategies for the reduction of air pollution and noise in urban areas, for climate protection at the worldwide level and for direct integration with smart electric grids. Moreover, it may act as a leverage to promote a wider transition towards more sustainable mobility patterns.
We investigated this phenomenon in the e-mobiliTI living lab, a socio-technical learning process held in Southern Switzerland between 2012 and 2015. We involved eleven early adopters of electric vehicles and sixteen mainstream consumers, all living in the Lugano area, which is the main urban conurbation of the Italian-speaking part of Switzerland. In Spring 2013 a first three-months smartphone-based monitoring phase allowed us to identify their reference mobility patterns. In Spring 2014, during a second three-months monitoring phase, they experienced new mobility options (electric cars and bicycles, public transport season tickets and car and bike-sharing subscriptions) in their complex, real-world settings. Results gathered show high potential for substitution between conventional and electric cars, even if range autonomy and investment costs are still significant barriers. Nevertheless, the supposed wider transformation of mobility patterns did not occur and the car maintained its dominance.
The e-mobiliTI living lab experiment allowed the collection of bottom-up, user-centered perceptions on the strengths and weaknesses of the mobility options being tested. This process allowed us to highlight the reasons for the lack of attractiveness of

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the means of transport other than the (private) car and to outline scenarios and policy recommendations for local and regional authorities.

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Keywords: Electric vehicles; opportunities and barriers; living lab; socio-technical process; transition

1. Introduction

The diffusion of electric vehicles (EVs) is one of the most promising opportunities to reduce dependency on fossil fuels, in Switzerland and worldwide (De Haan and Zah (2012)). The cost of electric vehicles has sensibly decreased everywhere, up to the point that in a few years it is expected to become equivalent to the cost of conventional internal combustion engine vehicles (ICEVs) (see for example World Bank (2011)). Therefore, it is essential to investigate whether other barriers might preclude their future wide diffusion.

Further, electric mobility might act as a leverage to foster the transition towards more sustainable mobility means of transport, such as slow mobility, public transport and transport sharing services. It is therefore useful to investigate this phenomenon and to take awareness of possible barriers precluding such a transition.

Among the methodologies to study these aspects (see Graham-Rowe et al. (2011) for an extensive review), we opted for the living lab approach, which is increasingly acknowledged as very powerful (Higgins and Klein (2011), Almirall et al. (2012), Dell'Era and Landoni (2014)), since it gives the possibility of testing, validating and refining innovation by monitoring real-life users in their real-life context. In this framework, in 2012 we launched in Southern Switzerland the e-mobiliTI living lab: a socio-technical field experiment (Schot (2001), Geels and Schot (2007)) explicitly addressing consumer perceptions and behaviour (Geels et al. (2011)).

In this paper we first introduce the research questions, design and methodologies adopted in the e-mobiliTI living lab (Section 2), then we describe the outcomes of our experiment: the potential for diffusion of EVs (Section 3) and other means of transport, alternative to the private car (Section 4). Finally, we present user-centred bottom-up mobility scenarios for Southern Switzerland (Section 5) and conclude with a general assessment on the representativeness and possibilities of generalization of our results.

2. The e-mobiliTI living lab

Our e-mobiliTI living lab experiment was designed to answer the following specific research questions: (1) can EVs effectively replace ICEVs, without imposing limitations on their users or causing regrets in the overall satisfaction of their mobility needs? And, if this is true, (2) does the availability of EVs uniquely result in the replacement of ICEVs (”substitution effect”)? Or does it foster a wider change in mobility patterns, favouring slow mobility, public transport and shared mobility services (”transformation effect”)?

To answer these questions, we recruited a panel (sample) of families living in the City of Lugano in Southern Switzerland and involved them in the living lab experiment. The panel was identified by means of a public open call held in December 2012, looking for two categories of users:

- ”early adopters” (EAs): families who already used EVs, having made a choice in favour of electric mobility before the launch of the project. They are classified as “early adopters” according to Rogers' categories for the diffusion of innovation (Rogers (2010)): they are "experts" and can provide hints and suggestions directly taken from their previous personal experience;
- ”mainstream consumers” (MCs): families interested in testing new mobility options, in particular EVs and electric bicycles. According to Rogers' categories, they are the ”early majority” consumers. That is, they are intrigued by EVs but, for a number of reasons, they have not adopted this mobility option yet.

Our panel was composed of singles, couples with and couples without children. Overall, sixteen families, for a total of twenty-seven users, took part in the living lab; seven of these families were EAs, while nine of them were

MCs. Details regarding their socio-economic conditions were provided in Cellina et al. (2015). They all lived in the Lugano area: a conurbation of around 135'000 inhabitants characterized by heavy urban sprawl, where people has a strong tendency to use the private car for the majority of their trips (OFS-ARE (2012)).

An important consideration regarding the panel: due to self-nomination of the candidates and limited size, it could not be regarded as representative of the whole Lugano population. However, it was quite interesting for us, since it included pro-environment individuals, used to a sustainable lifestyle, side by side with lovers of driving, speed and sports cars. Therefore, though not meeting representativeness requirements, thanks to the variability in attitudes and beliefs of its members, the panel provided us with a wide spectrum of insights on the opportunities and barriers for the adoption of sustainable mobility patterns.

2.1. Design of the field experiment

The e-mobiliTI field experiment was divided in two Phases. In Phase 1, held in Spring 2013, we performed a three-months monitoring period aimed at identifying the users' current mobility patterns. That is: we followed them in order to understand how much they travelled and which means of transport they used.

During Phase 2, held in Spring 2014, we performed a further three-months monitoring period, aimed at identifying the users' mobility patterns while they were experiencing new mobility options in their complex, real-world settings. The new mobility options tested in Phase 2 are listed in Table 1. They were fully available to the users for the three months tracking period and were the same for all participants, with the exception of electric bicycles that were available only to MCs because of budget limitations.

Providing the participants with the new mobility options, we removed a key barrier to EVs diffusion, that is their cost, and created a niche to analyse their behaviour with respect to other barriers. Therefore, comparing the mobility patterns observed during the two monitoring phases allowed us to answer our research questions.

Table 1. The mobility options available to the participants to the e-mobiliTI living lab.

Mobility options available	Phase 1: current mobility patterns	Phase 2: mobility patterns while testing new options

Early adopters (EAs)	Their own means of transport, including their own EV	- Their own means of transport, including their own EV;
		- and, for every member of the family:
		  - a regional public transport three-months pass (trains and buses: Arcobaleno ticket);
		  - a car-sharing season ticket (Mobility);
		  - a bike-sharing season ticket (Publibike Lugano).

Mainstream consumers (MCs)	Their own means of transport	- Their own means of transport;
		- an EV (Nissan Leaf);
		- an electric bicycle (Flyer T Series);
		- and, for every member of the family:
		  - a regional public transport three-months pass (trains and buses: Arcobaleno ticket);
		  - a car-sharing season ticket (Mobility);
		  - a bike-sharing season ticket (Publibike Lugano).

2.2. Quantitative and qualitative monitoring activities

In order to monitor travel behaviour and to identify mobility patterns, we relied on both quantitative automatic data, gathered by means of a smartphone application (app), and on qualitative insights on perceptions of the strengths and weaknesses of the mobility options being tested, gathered by focus groups and individual interviews. In our approach, therefore, qualitative data integrate quantitative, automatic data and help to interpret them.

The e-mobiliTI app exploits smartphone built-in GPS devices. Descriptions of this app and of the main challenges related to automatic data gathering are presented in Cellina et al. (2013) and Rizzoli et al. (2014). The app was used during Phase 1 and Phase 2; to support participants in the use of the app and keep their interest high, a group meeting was hosted every month. Such meetings were mainly occasions to let the participants know each other, to share problems (and solutions) regarding the use of the app and to provide them with information on the progress of project activities. No discussions on their mobility patterns were performed during those meetings, even though at the end of each tracking phase we performed statistical and spatial analyses of their mobility patterns, both at the individual and at the group level (see Cellina et al. (2015)).

Specific discussions on mobility patterns, opportunities and barriers to change were instead performed during focus groups and interviews. We held two focus group sessions, following guidelines by Krueger and Casey (2009): the first one took place towards the end of Phase 2 (May 2014), while the second one took place eight months after the end of Phase 2 (February 2015), when all the analyses on the data gathered had been performed. In both cases, two focus group meetings were held, in order to limit the number of participants at eight/ten persons per group. Participants were split among the two groups with the aim of creating an adequate mix in terms of shyness/talkativeness, number of EAs/MCs and level of use of private motorized means of transport (PMT)), that is cars or motorcycles. To this purpose, we exploited the knowledge of the participants gained during the group meetings mentioned above and the statistical analyses performed at the end of Phase 1 and Phase 2. Participants to both groups were stimulated with the same questioning route and results of the two discussions were integrated and summarized into a single report. Conversations during the meetings were audio-registered, transcribed and then summarized in a final report adopting a narrative approach.

The first focus group session aimed at identifying the specific opportunities and difficulties they met in Phase 2 while testing the new mobility options - that is: not prior perceptions or stated preferences but the direct outcome of their real-life experience. The second session instead aimed at testing and validating the hypotheses of future mobility scenarios and policy recommendations we had developed taking into account both the quantitative and qualitative elements gathered through previous activities.

Between the two focus groups, and once the individual analyses on the data tracked by the app had been performed, we also carried out semi-structured interviews with every family. In most cases, all the members of the family involved in monitoring activities also took part in the interviews; in some cases however only one representative per family attended. Interviews lasted about one hour each; they were audio-registered and reported in a detailed way. The report of each interview was sent to every participant in order to verify we had correctly interpreted their declarations and opinions.

Interviews began asking them to indicate how they would have described their mobility patterns before, during and after the e-mobiliTI experience (with specific reference to Phase 2), with the aim of creating awareness on possible behavioral changes. Then, the discussion moved to the specific means of transport: they were asked to indicate opportunities and constraints and, if any, to highlight differences in their perceptions over time once they got used to the new means of transport. Finally, they were asked whether they intended to keep using the means of transport they were given, by buying an electric car, bicycle or the season tickets.

2.3. Insights on strengths and weaknesses of the means of transport tested

Reports of the first focus group and individual interviews were coded in order to identify strengths and weaknesses of the means of transport tested, with specific reference for the Lugano region. We opted for a “grounded theory inspired approach”, as suggested by Strauss and Corbin (1998) and Willig (2001): we did not start by considering a pre-defined list of possible topics, checking whether the participants had indicated them or not; instead, we identified the categories from a bottom-up perspective, letting them arise from the reports themselves.

To avoid biases in results, two researchers independently analyzed the reports and coded the categories, adopting the constant comparative method suggested by Glaser and Strauss (1967): every time semantically similar category labels were identified, they were compared and the most appropriate one was selected. This gradual refinement process was further supported by frequent discussions between the two researchers, aimed at getting a common understanding of the categories. Finally, once the categories had been definitively established, the reports were read again and every occurrence of a category was registered in a matrix, together with a quotation of the direct words of the participants, if they were especially clarifying.

3. Does the substitution between conventional (ICEVs) and electric (EVs) vehicles take place?

Of the twenty-seven participants to the living lab, we could only consider quantitative data regarding twenty of them: four of them in fact changed home or workplace, preventing a comparison between Phase 1 and Phase 2, and three of them were not constant enough in the use of the e-mobiliTI app in Phase 2. The analyses we performed on the quantitative data of the remaining users (methodologies, assumptions and filters) are described in detail in Cellina et al. (2015).

In general, the elements we gathered show that MCs' potential for substitution between ICEVs and EVs is high. Key quantitative elements are summarized in Table 2. Substitution between ICEVs and EVs in fact took place both in terms of kilometers driven and in terms of number of trips: on average, EVs replaced ICEVs for 63% of the daily kilometers travelled and were used for a number of trips double than ICEVs. Interestingly, these parameters are aligned between MCs and EAs: this confirms that using an electric vehicle is quite easy and no long onboarding phase is requested.

Table 2. A selection of quantitative indicators describing the use of electric (EVs) and conventional (ICEVs) vehicles.

	Number of trips [num]		Average length of trips [km]		Percentage of the average daily kilometers driven by car [%]	
	EVs	ICEVs	EVs	ICEVs	EVs	ICEVs
Mainstream consumers MCs (Phase 2)	441	224	19.5	23	63	37
Early adopters EAs (Phase 1)	245	112	26	34	67	33

Quantitative data tracked also show that a "rebound effect" may occur: an increase in the daily kilometers and in the number of trips driven by car, either EV or ICEV, is in fact registered for some e-mobiliTI MCs between Phase 1 and Phase 2. Insights gained during individual interviews show that this is mainly due to a "novelty effect", combined with the awareness that the EV would remain available for a limited period of time. During that period the users were led to use it as much as possible, in order to get acquainted with all its functionalities. We believe therefore that a longer period of testing would have definitely reduced such a rebound effect.

Observing Phase 1 EAs' mobility patterns, however, one can suppose that in EV drivers such a rebound actually takes place, even though in smaller percentages. In fact, the average percentage of the daily kilometers that in Phase 1 the EAs drive by car (both EV and ICEV) reaches 95%, a much higher value than the average one provided by the Swiss Census of mobility and transport for the Lugano area, equal to 75% (OFS-ARE (2012)). This might be explained considering that EVs' purchase cost is definitely higher than ICEVs': who buys an EV is therefore led to use it as much as possible, in order to amortise the investment made. If so, this would go exactly in the opposite direction of our initial hypotheses regarding EVs as a leverage towards transition.

3.1. Barriers to the diffusion of the electric car

Notwithstanding those very promising results for the potential EVs diffusion, the large MCs majority declared that, should they replace their ICEV today, they would not buy an EV as one and only family car:

- six families out of nine would buy an EV as second (or third!) family car;
- five families out of nine would not buy an EV, preferring instead a fuel-electricity hybrid vehicle (HEV);
- one family out of nine would instead buy an EV.

Reasons for this choice were investigated during focus groups and individual interviews and, using the methodology presented in Section 2.3, were classified in categories as shown in Figure 1. The really critical limitation perceived by e-mobiliTI MCs lies in the autonomy range: participants dislike the idea that for some occasional trips they will not be able to use their own car: "*Since one needs to pay a lot of money for an EV, one expects to use it in any occasion, also to go on holiday once a year*".

Further critical elements refer to battery recharging activities. Weaknesses are registered for both recharging at the domestic level, for those living in flats without a direct connection to their own electricity counter ("*Recharging at home is impossible, since there's only one plug, shared with the other tenants, which is even far from our parking*"), and when travelling. For the latter activity, weaknesses are indicated both regarding travels abroad ("*why* *not allowing to recharge via credit* card, *instead of limiting access to subscribers of regional recharging systems?*") and regarding local travels ("*recharging stations are often busy in the central areas of Lugano, street indications to find them are lacking and occasionally there are maintenance problems and they are out of order*").

Finally, the investment cost for electric vehicles is still considered too high for many e-mobiliTI MCs, if compared to conventional vehicles of the similar classes. Some of them would therefore be interested in buying second-hand cars, however so far there is hardly no market for second-hand electric cars.

Instead, the need to plan one's own trips in advance and the corresponding lack of flexibility is not seen as a really critical limitation, though being acknowledged as a factor one needs to take into account when organizing one's daily activities ("*It's true: one needs to plan the trips for the following days. But all in all it is easier than planning trips by public transport*"; "*In a few weeks you learn how to organize yourself: now I'm used to asking myself every night: where should I go tomorrow?*"). Rather than being perceived as a real barrier for change, this is presented as a matter of fact, without negative implications.

Remarkably, a few MCs identified among the key barriers for change also technology elements which are not specific for EVs, being instead usually available also for conventional ICEVs. Three of them in fact lamented "*I do not like the automatic gear, which decreases my pleasure of driving*". This is quite interesting, considering that driverless cars are among the most promising transport option for the future.

From a totally different point of view, other MCs highlighted that EVs and conventional ICEVs share critical impacts from the environmental and traffic point of view: "*An electric car is always a car, therefore it produces traffic congestion and soil sealing for roads and car parks*". Further, depending on how electricity is produced, electric cars might be responsible for air pollution and CO_2 emissions: "*I did not pollute at home, but somewhere else the electricity power station polluted. From a global energy perspective, I don't see EVs as something really convenient*". Finally, some MCs expressed concerns for the whole production and disposal process of the electric car, especially regarding consumption of rare raw materials for battery production.

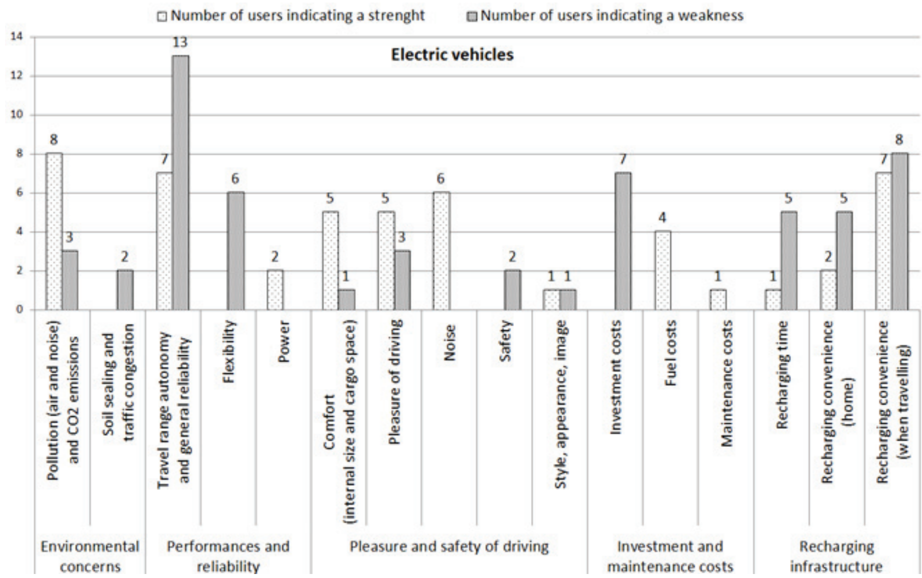

Fig. 1. Strengths and weaknesses of electric vehicles, according to e-mobiliTI focus groups and interviews.

4. Does electric mobility act as a leverage to favour a wider transformation in mobility patterns?

The last considerations, expression of environmental awareness, seem to reflect an increase in environmental and energy awareness of the e-mobiliTI participants, which could pave the way for a wider transformation in mobility choices towards a decrease in the use of the (individual) car. Besides, the transformation towards more sustainable mobility patterns could even be a direct consequence of EVs' limitations in the range of autonomy. Turning into a positive factor, they might in fact act as a trigger, pushing drivers (1) to take awareness of the daily kilometers travelled and to plan their trips in advance, (2) to drive only the really necessary kilometers and (3) to use other alternative, energy-efficient means of transport, if the range of autonomy is not wide enough to satisfy their needs.

Among these elements, the e-mobiliTI living lab only focused on modal transformation, since transformations in the amount of kilometers travelled are too strongly dependent on exogenous factors, such as the place of living and working, the activities performed during leisure time, the family needs and so on - all aspects which were not directly influenced by the e-mobiliTI field test.

Quantitative data gathered during the experiment show that the hypothesized transformation towards other than the car modes of transport did not occur. In particular, neither slow mobility nor public transport, either alone or in combination with electric bicycles, car and bike-sharing, could compete with individual cars (either EV or ICEV). When the use of the EVs was precluded due to autonomy reasons, in fact, e-mobiliTI participants opted for using their own ICEV instead of the electric bicycles or free public transport passes. In other words: whenever a private motorized means of transport (PMT) was available, it markedly prevailed over the other mobility options.

From this perspective, no differences were noticed between MCs and EAs. Table 3 shows that, between Phase 1 and Phase 2, the overall PMT percentage of kilometers travelled tended either to remain constant or to increase, both in MCs and EAs: only two participants out of twenty show a decrease in such a percentage.

The automatic mobility tracking data suggest therefore that a transformation of the dominant car-based mobility patterns still needs to overcome sturdy and consolidated barriers. Qualitative insights from interviews and focus groups show that the users ask for a significant increase in the attractiveness of the means of transport other than the car, especially in terms of flexibility, capillarity, comfort and safety (see Figure 2 and Figure 3).

Table 3. Modal transformation between Phase 1 and Phase 2, based on percentage of PMT kilometers (private motorized means of transport).

Variation in the average daily percentage of PMT kilometers between Phase 2 and Phase 1	Number of users [num]		
	Mainstream consumers (MCs)	Early adopters (EAs)	All e-mobiliTI participants
Increase	6	1	7
Constant (differences <= 5%)	6	5	11
Decrease	2	0	2

4.1. Barriers to a wider use of public transport

Main weaknesses for public transport are related to the increase in travelling time, together with the decrease in flexibility and comfort, if compared to private motorized means of transport (cars and motorcycles).

In particular, participants highlighted the complexity of performing trips across suburban areas and especially from one suburban neighborhood to another: waiting times at junctions are judged too long, making the public transport far less attractive than the car ("*In general public transport connections are not optimized and transfers expand travel time: you know when you leave but not when you'll arriv*e"; "*I use public transport when I have no time constraints*"; "*When I work I cannot use public transport, since I need flexibility and promptness in case of emergencies*"). The problem of travel time reflects in the request for an increase in the frequency of the journeys.

Comfort is also very important: "*I often move with my three kids: public transport is uncomfortable when I travel with them*"; "*When going to work, I need to carry with me bulky material: PC, electric cables and other equipment*".

Finally, some of the participants lamented fares are too expensive: "*I don't like to pay 2.30 francs every time I use the bus; however I do not buy a public transport season ticket because I do not use it enough* ".

4.2. Barriers to the diffusion of electric bicycles

Electric bicycles were used very seldom within the e-mobiliTI living lab, though they were given to every MC family. The reasons are essentially two. First, there is a comfort problem: using a bicycle, even if electric, implies a certain level of physical effort – especially in Lugano, which is characterized by frequent climbs up and down: "*Even though it is electric, you sweat a lot when going back home for lunch, especially if you are wearing a tie*". Also the weather conditions are considered critical from the comfort point of view: in Winter it is cold, in Summer it is hot – and, no matter about the season, when it rains using a bicycle is not attractive. Finally, using a bicycle mainly imposes to adopt a casual way of dressing, which is not always allowed, especially when travelling for job purposes: "*You cannot use it if you are supposed to wear an office outfit*".

Second, there is a safety problem: people do not like using the bicycle because there are not cycling lanes and bicycles are compelled to move along the roads together with cars, trucks, motorbikes and buses: "*I fear going by bike along congested roads: I would really prefer biking lanes*". A MC also indicated she does not like cycling in the traffic because "*It is very dangerous breathing cars' and trucks' exhaust gases*".

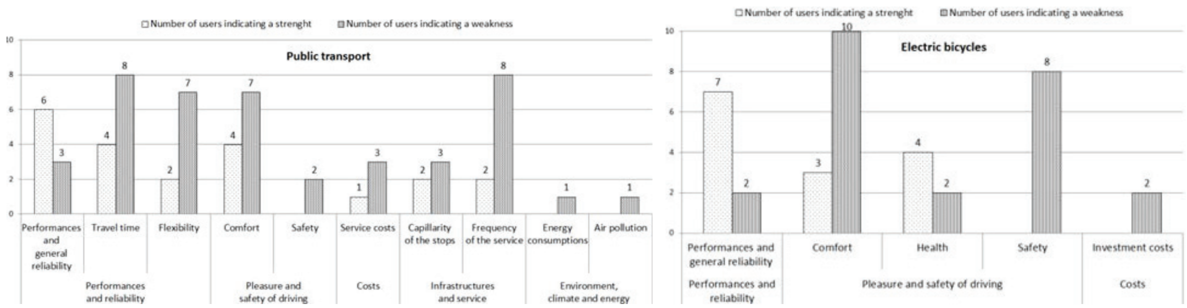

Fig. 2. Strengths and weaknesses of public transport and electric bicycles, according to e-mobiliTI focus groups and interviews.

4.3. Barriers to the diffusion of car-sharing

In Phase 2 all the e-mobiliTI participants were offered the possibility to test the car-sharing service provided by the Mobility company. Actually, only one of them (an EA) used it once, while two of them (an EA and a MC) declared they had tried it at least once in the past, before the e-mobiliTI experiment. All the other participants simply did not use it because "*There were no occasions I needed it*". Their perceptions regarding strengths and weakness of car-sharing therefore mainly reflect preconceived judgements and assessments, based on the information they received on car sharing working principles.

According to their indications, the main factors precluding the diffusion of car-sharing refer to both a general rigidity in the system and in the level of the rates, considered too expensive. Car-sharing is rigid because "*It compels you to return the car in the same place you picked it up*" and "*You need to indicate, at the moment of the reservation, how long you will use it. And what happens if you are late? You are fined!*". Moreover, some of the users "*live far away from the Lugano pick-up point: it is not easily accessible to us*".

Regarding the second barrier – tariffs are too expensive – one has to consider that all the e-mobiliTI users were already endowed with their own ICEV(s): using a car-sharing vehicle would therefore imply for them to afford both the indirect cost of their own vehicle(s) and the costs of renting the car-sharing vehicle.

4.4. Barriers to the diffusion of bike-sharing

In Phase 2 all the participants were endowed with a personal, free season ticket for the Publibike service in Lugano. Also in this case, however, the number of those who actually used the service is very limited, equal to three MCs. Besides them, a fourth participant was already experienced with the bike-sharing service, having used it quite frequently in the past before a change in the public transport lines at the urban level made public transport much more effective for her needs. Therefore, also in this case comments and perceptions on strengths and weakness should be mainly considered as prior perceptions.

According to the e-mobiliTI panel, the main barrier to the diffusion of bike-sharing is related to the limited number of stations all over the city: it is rare to find a bike-sharing station exactly where it is needed, both to take and to return the bike ("*The closest station was usually farther from home than the place I was heading to*"). They also see a problem in the capacity of the stations, especially regarding the possibility to return the bicycle: what happens if all the places are already occupied by other bicycles? There is no possibility to leave it in other stations, since they are quite far away the one from the other: "*Sometimes I was in trouble in finding a free space to return the bike, especially in the city centre*"; "*I did not try this service because I feared I could not find the place to return the bike, once finished to use it*". Finally, bike-sharing suffers from the problems already mentioned for electric bicycles: lack of comfort, safety and negative impacts on health.

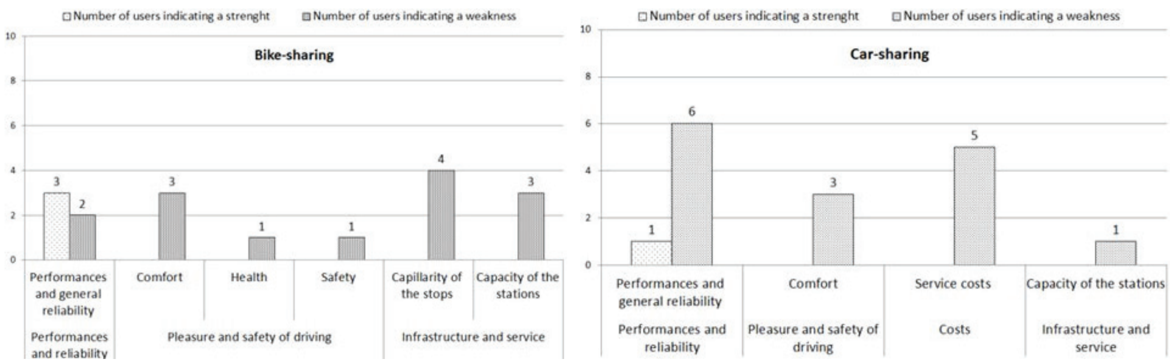

Fig. 3. Strengths and weaknesses of bike-sharing and car-sharing, according to e-mobiliTI focus groups and interviews.

5. Discussion and future scenarios for Southern Switzerland

The results of our living lab experiment are influenced by three main critical factors. First, our results have limited representativeness, since the sample is very small. Specific mobility needs of the e-mobiliTI participants might in fact have tangibly influenced the global results. Second, the results we gathered are also influenced by the duration of the testing period. A three months testing period might not have been long enough to overcome the initial ”novelty effect” associated to the electric car. Our experience therefore suggests that a testing period of at least one year would have been preferable. Third, we gave an electric car to every MC family, as an addition to their own means of transport. In families owning only one private car, with two persons owning a driving licence, this increased possibilities to use a car, either EV or ICEV. That is, we artificially created a bias towards car use.

In spite of these limitations, we believe that the information collected from real-life users is rich enough to sketch feasible and realistic short to medium term scenarios for mobility transition in Southern Switzerland. Indeed, such transition process would initially involve families interested in new mobility options, well represented in our panel but not representative of Southern Switzerland.

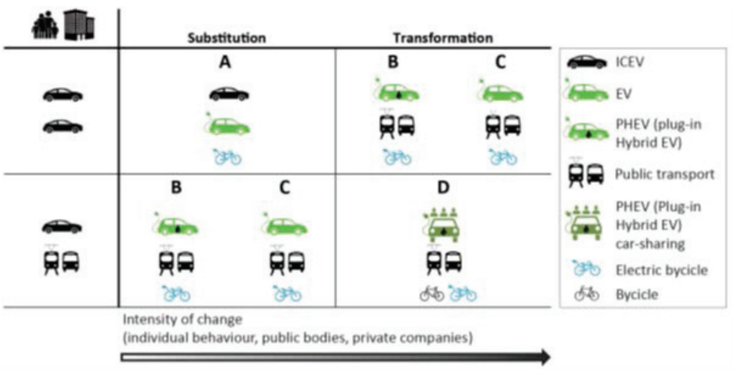

Fig. 4. Realistic future scenarios regarding the means of transport used by an average four-persons family in the Lugano area.

We built those scenarios according to a bottom-up perspective, referring to an average Lugano family: two parents and two children, owning either two ICEVs or an ICEV and a season ticket to public transport. The scenarios show possible evolutions in the dotation of means of transport of the family and are accompanied by policy recommendations suggesting the measures that public authorities, private companies and single citizens can actuate in order make the transition happen.

The realistic transitions we identified are summarized in Figure 4. According to the level of change with respect to the mobility options initially available to the family, we call them either ‘’substitution’’ or ‘’transformation’’ scenarios: in the first case, depending on the initial conditions, at least one of their ICEVs is substituted by an EV or a PHEV; in the second case, they sell one of their ICEVs and move either to an EV/PHEV in combination with public transport or to car-sharing (better if PHEV operated), in combination with public transport and slow mobility.

Moving from left to right in Figure 4, difficulty of actuation of the scenario increases. According to the e-mobiliTI experience, a family can easily substitute an ICEV with an EV, provided that another ICEV is still available (scenario A). If not, substitution can be better achieved opting for a PHEV in combination with public transport (scenario B).

Scenarios A and B are the conditions that, during the focus groups in which the scenarios were presented, e-mobiliTI participants (both EAs and MCs) indicated as more suitable to their mobility needs. In fact, they mainly require intervention by public authorities or private companies (such as monetary incentives for electric vehicles, regulations to favour charging in apartment blocks, increase in the fast-charge public charging points or increase in the frequency, capacity and capillarity of public transport) and require very low effort in terms of individual behavior change. However, only scenario D, based on public transport in combination with slow mobility and car-sharing (if possible, PHEV operated) would produce the paradigm shift we are now in need of - and that's what forward thinking political choices should promote.

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