M06.05 – Executive summary

Car Sharing service introduced a new mean of transport in Brescia, integrated with other ones, that represents an intelligent way of driving everywhere without financial disadvantages. The car sharing service represented an important innovation as regards the modal split in Brescia, also towards an integrated view of transport systems of the city, linked with both the new metro line realization and the "smart city" image of Brescia. The Brescia Car Sharing service has been also integrated with the existing Italian network of car sharing (namely ICS, “Initiative Car Sharing”).

Considering the medium size of the city and the geographic distribution of its citizens, a study of the needs to be met by car sharing was carried out, as well as a benchmarking to evaluate other car sharing experiences in Italy, to find out the best way to manage the new service. A scheme suitable for Brescia was defined and the tender documents for the award of service was prepared.

The main problem to be solved was related to Car Sharing fleet dimension in relation to size of the city.

Muovosviluppo (i.e. the company who won the tender) decided to focus its offer more on the variety of deals (for e.g. hotel – car sharing) and agreements (for e.g. with the University of Brescia, with IKEA, etc.) instead of on the fleet size. It was agreed to increase the latter by steps, according to the success of the service. Therefore the potential users targeting was fundamental to the success of the service.

As regard the actual functioning of the car sharing, an ICS system was implemented: the users are then able to book the car sharing vehicle by using internet (for example, the website) and, at the same time, the service administration system organizes reservations, considering the time and place chosen by users. The users pick up the car after 24 hours, using their contactless cards. The cars have to be brought back again to the same parking place, once used.

The car sharing service started in March 2010 and its fleet was composed by 6 cars, half powered by natural gas, and 7 reserved parking places located around the city. Before the end of Civitas project, the car sharing counted more than 290 subscribers.

From an impact evaluation view point, due to the small fleet, environmental indicators were not considered significant in relation to emissions reduction in the city. They have been monitored as complementary indicators in order to verify how choices on vehicles typology, potentially influenced by different factors – such as special offers on cars, customer needs, etc., could have an impact on the environment.

The quality of the service and the vehicle occupancy have been assessed through a survey addressed to the Car Sharing subscribers. A very good judgement were made about the service with an awareness level of 29% and an acceptance level of 16% while a mean value of vehicle occupancy equal to 1.7 made evidence of the use of car sharing mostly for individual trips.

It has been also monitored the average modal split, but the small fleet of the car-sharing service resulted to be non-influential towards the modal split of the city, even if this complementary indicator can be useful to monitor citizens less dependency of private car.

Finally, a Cost-Benefit Analysis has been performed to assess from an economic view point the measure. As a result the investment cost by Brescia Municipality (194,000 €) to support the car sharing Civitas measure will be re-paid in 15 years, thanks emission and fuel saving, only if the total kilometres running by car sharing service will be 1,526,420 km. This means that, the car sharing

service, with its low starting (i.e. 16,022 km made in 2010 and 44,142 km in 2011), should have a yearly increase of 28.8% during the next 15 years.

A. Introduction

A1 Objectives

The measure objectives are:

(HH) High level / longer term:

- To introduce innovative mobility services alternative to private mobility

(II) Strategic level:

(1) To introduce innovative mobility service integrated with private mobility and PT service,

(2) To start up the car sharing service in Brescia, to be integrated in the mobility connected to the new metro line.

(JJ) Measure level:

(1) To start up the car sharing service in Brescia;

(2) To reach maximum 10 cars;

(3) To reach maximum 7 reserved parking places;

(4) To reach about 220 service subscribers;

(5) A car sharing service for the citizens fully integrated within the Italian network ICS.

A2 Description

Car Sharing service introduces a new mean of transport in Brescia, integrated with other ones, that represents an intelligent way of driving everywhere without financial disadvantages. The car sharing service represented an important innovation as regards the modal split in Brescia, also towards an integrated view of transport systems of the city, linked with both the new metro line realization and the "smart city" image of Brescia.

Considering the medium size of the city and the geographic distribution of its citizens, a study of the needs to be met by car sharing was carried out, as well as a benchmarking to evaluate other car sharing experiences in Italy, to find out the best way to manage the new service. A scheme suitable for Brescia was defined and the tender documents for the award of service was prepared. The company who won the tender (Muovosviluppo s.r.l.) set up a service characterized by the following features:

- hybrid methane/gasoline and gasoline cars;

- ICS tools for the service management;

- accurate localization of the car sharing stations for an optimal intermodality;

- agreements with companies and public bodies for dedicated fares;

- promotional activities (leaflets distribution, web site, etc…).

The booking of the service is made through ICS, call centre or via Internet (see fig.1), 24 hours on 24. The service launched in Brescia foresees a subscription by signing a contract.

Fig.1: Home page of the web site www.carsharingbrescia.it

The subscriber is entitled to book the vehicle at any time and pick it up within 24 hours (the service was organized as shown in fig.2).

Fig.2: Organization of the service: 1) Subscription; 2) Booking; 3) Go to the parking; 4) Take the car; 5)Leave the car

The fleet available consists of 6 vehicles, half of which powered by natural gas (5 more vehicles are to be bought in the near future). The service cars are distributed in central urban areas and neighbourhoods immediately next to the historic centre.
The car sharing service started in Brescia in march 2010 it has 7 reserved parking places located in the city, the service exceeded 250 subscribers.

B. Measure implementation

B1 Innovative aspects

- New conceptual approach
- Use of new technology/ITS
- New mode of transport exploited
- Targeting specific user groups.

The innovative aspects of the measure are:

- **Innovative aspect 1 (New conceptual approach)** – From a cultural point of view, car sharing is an innovative mobility service for Brescia and for most Italian realities.
- **Innovative aspect 2 (Use of new technology/ICS)** – For the management of the service (board computer, call centre, card, etc.) the following ICS system (represented by figures 3 and 4), has been used: the users are able to book the car sharing vehicle using internet (for example, the website) and, at the same time, the service administration system organizes reservations, considering the time and place chosen by users. The users can pick up the car after 24 hours, using their contactless cards. The cars will have to be brought back again to the same park place, once used.,.

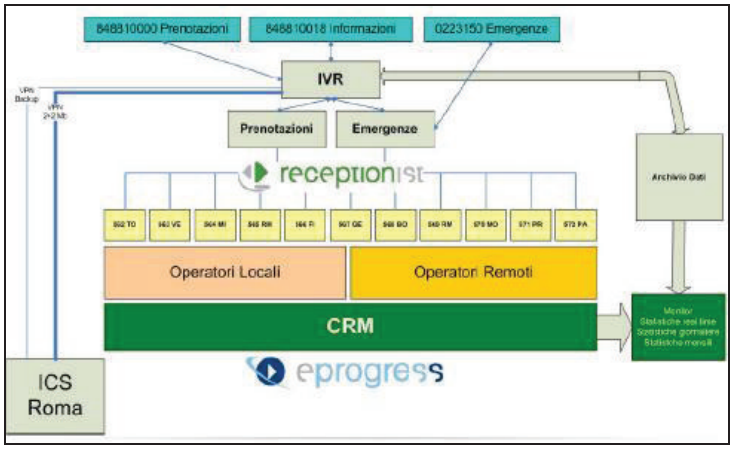

Fig3-4: ICS system: technological infrastructure and information management

- **Innovative aspect 3 (New mode of transport exploited)** – The idea is to try to reduce dependency from the use of private cars and enhance the use of the innovative transport solutions. Indeed, Car Sharing in Brescia can be considered an innovative mode of transport if integrated with other modes of Public Transport such as, bike sharing, TPL and the future Metro line..
- **Innovative aspect 4 (Targeting specific user groups)** – Usually the target users (private customers) are composed by 35-40 aged people. The innovative aspect of the service set up in Brescia is the extension of the target age to 20-50 aged people, in order to reach a total target population of about 2000 users. Car sharing in Brescia tries to involve also other target groups composed by public bodies/companies employees, city users, students, young people, tourists, etc...

B2 Research and Technology Development

A study of the needs to be met with car sharing has been carried out, as well as a benchmarking to evaluate other car sharing experiences in Italy. The technical project, made by the service manager (Muovosviluppo S.r.l.) took into consideration the ICS system requirements already experimented in other city services and tried to apply the most suitable features for Brescia.
In particular the value of the study is related to the analysis of good practices already implemented in Italy. Also bad practices have been taken in consideration by Muovosviluppo S.r.l. in order to better understand the drivers and barriers encountered during the service management.
In Italy car sharing service (active in Biella, Bologna, Brescia, Firenze, Fossano, Genova, Milano, Padova, Palermo, Parma, Roma, Savona, Scandicci, Sesto Fiorentino, Torino and Venezia) is quite differentiate according to different territorial realities (sometimes was stopped, because in a short time it was proved inefficient (for example, Rimini - experimental site - see figure 5). The main problems are related to the fleet dimensioning in relation to the size of the city. As a consequence, in the case of Brescia, it was decided to focus more on the variety of offers (for eg. hotel – car sharing) and agreements (for eg. with the University of Brescia, IKEA, etc.) instead of on the fleet number. It was agreed to increase the latter by steps according to the success of the service.

City	Start - Stop	n. Cars	n. of subscribers	Parking
Bologna	Ago. 2002	44	1.166	31
Brescia	Feb. 2010	6	187	3
Firenze	Apr. 2005	23	842	28
Genova and Savona	Lug. 2004 - Giu. 2009	78	2.347	55
Milano	Sett. 2001	134	4.882	77
Padova	Sett. 2011	10	40	10
Palermo	Mar. 2009	36	663	44
Parma	Feb. 2007	18	368	12
Rimini (*experimental site)	Summer 2002 (*) Mar.2003	-	-	-
Roma	Mar. 2005	104	2.232	686
Torino	Nov. 2002	121	2.600	82
Venezia	Ago. 2002	44	3.594	12
Tot.		**618**	**18.911**	**422**

Fig.5 Car sharing managed trough ICS in Italy - Data updated al Feb. 2012 Source: http://www.icscarsharing.it

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The optimal localization of the car sharing stations have been carried out following specific guide lines including target groups, GIS studies (influence areas), Local Public Transport and the main urban/suburban "attraction poles".

B3 Situation before CIVITAS

The setting up of a car sharing service in Brescia was already approached before CIVITAS with no practical results, mainly due to a lack of precise commitment and of a clear framework. Therefore Brescia Municipality decided to implement the measure to try to start up this service together with other sustainable mobility moods such as Metrobus and car pooling. Another driver was the necessity to implement a new smart image of the city as a whole connected to the start up of the Metrobus

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Analysis, definition of the user need and design of the car sharing scheme for Brescia and its approval *(15 October 2008 – 15 January 2009) – The first step to develop car sharing service in the city consisted in the definition of users needs. This step was considered particularly important to the success of the measure because the city had already invest in car sharing projects without implementing them. The potential users and their geographical distribution, the city characteristics and its mobility, the socio economic distribution of population and business, etc. were analysed to define at best the potential car sharing users and the development plan. A benchmarking – comparison with other Italian car sharing services was made in order to get the final design of the car sharing scheme (procedures, parking spaces locations, tariffs, etc.) including the management scheme.*

Stage 2: Tender for the selection of the operator and contract service with the operator for the car sharing service development *(15 January 2009 – 15 January 2010) – The tender was published at the end of December 2008. As no offer arrived from the potential operators a modified version of the tender document was been published in order to increase their interest. To better understand the reason of the failure of the tender, suggestions (through customer methods) were collected and promotional activities also at national level were undertaken. In November 2009 the approval of the offer was signed.*

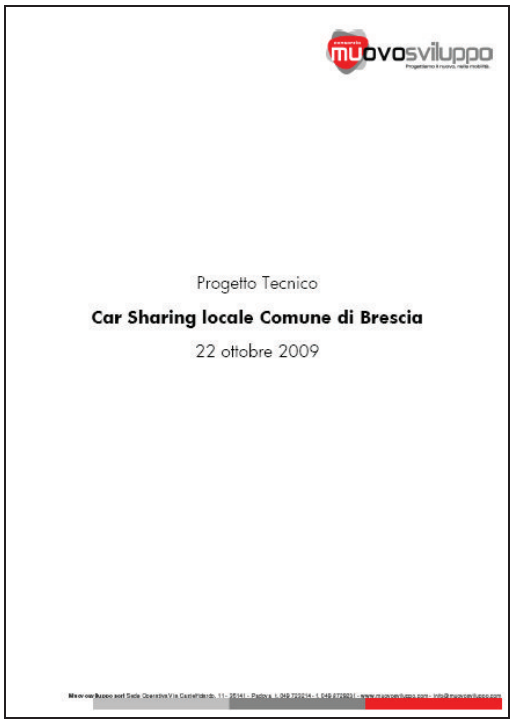


Fig.6: First page of the Brescia Car Sharing service technical project

Stage 3: Operational launch and expansion of the service *(15 January 2010 – 15 October 2012) – The service has been operational since February 2010 and has 292 members (data updated to May 2012). The operator's work in this start up period consisted mainly in the development of communication campaigns and signing of agreements and arrangements with organizations and companies in the territory, to promote and increase the number of subscribers to the service by offering them affordable fares.*

During this stage the number of stations and cars increased, in order to extend the service to a wider number of users and city area (see the figures 7-8). The upgrade of the service followed the financial timetable signed by CBS and the service operator.

City Area	***N. of parking lots***	***Intermodality***
City centre – Vittoria Square	*2*	*bus and bike sharing*
City centre – Arnaldo Square	*1*	*bus and bike sharing*
Business Area – Brescia 2	*1*	*bus*
North district – Padre Pio Square[*]	*1*	*bus and bike sharing*
West extra urban – IKEA	*1*	*bus*

[*]*Place added in 2011*

Fig.7: The stations of the Car Sharing service

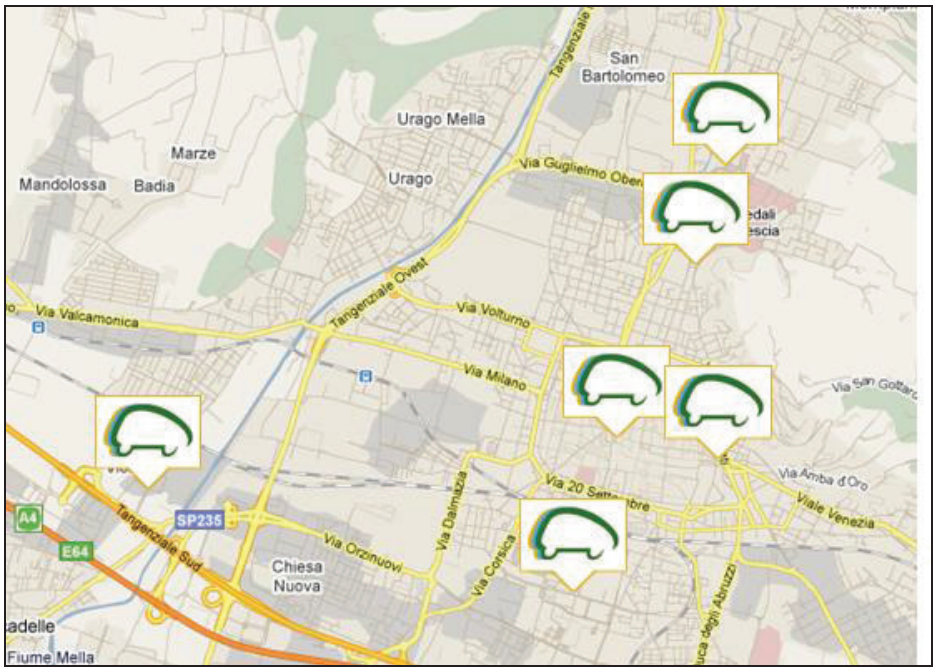


Fig.8: Map showing the current CS station in Brescia

As already mentioned since its beginning the service manager Muovosviluppo srl has signed agreements with IKEA, Brescia University, Catholic University of the Sacred Heart, Banca Etica, Legambiente, Acli, Arci, Coop, Legacoop Italia, Public bodies, etc. for the reduction of prices.

Even more attention was given to the following targeted cathegories:

- *citizens (families, students, elderly peolple);*
- *free lance consultants;*
- *firms (with 0 a 3 employees,, from 3 to 6 employees, more than 7 employees);*
- *hotels (city package tours, outskirts package tours and business package tours).*

Some discounts gave been reported in the figure below, as examples:

	entrance fee discount	year's subscription discount	hourly rate	kilometres rate
Public bodies employees	- 50%	- 30%	-	-
University of Brescia and Catholic University students	- 100%	- 70%	-40%	- 40%
University of Brescia and Catholic University employees	- 50%	-10%	- 30%	- 30%
IKEA	- 50%	- 40%	-	-

Fig.9: Example of some discounts for the car sharing service in Brescia

B5 Inter-relationships with other measures

The measure is not related to other Civitas measures. From a strategic point of view it must be underlined that Car Sharing implementation is one of the most important figure for the development of Smart Cities.

C. Evaluation – methodology and results

From the measure evaluation point of view indicators have been chosen in relation to the expected results at local level, in the view of the Car Sharing realization in Brescia.

C1 Measurement methodology

Indicators have been divided into two macrocategories: main indicators and complementary indicators (for more information see section C.1.1.).

Main indicators are able to evaluate the measure efficiency in terms of objectives achievement. In addition complementary indicators are introduced in order to assess specific issues. These indicators are relevant only at local level and are used to give additional information in order to better understand the measure performance.

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
1.	Economy	Capital Costs	Data provided by "Muovosviluppo srl"	Main Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
2.	Operating Revenues	Average Operating Revenues	Data provided by "Muovosviluppo srl"	Main Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
3.	Operating Costs	Average Operating Costs	Data provided by "Muovosviluppo srl"	Main Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
4.	Fuel Consumption	Vehicles fuel efficiency/km per type of trip	Data of km per type of trip are provided by "Muovosviluppo srl"	Main Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011

5.	Fuel Consumption	Fuel mix / km per type of trip	Data of km per type of trip are provided by "Muovosviluppo srl"	Complementary Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.:April 2011
6.	Emissions	CO_2 emissions/ per type of trip	The value is related to the to the average emissions produced by private car passengers in Italy. The theoretical value is given by the hypothetical fleet proposed by the Muovosviluppo plan	Complementary Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.:April 2011
7.	Emissions	CO emissions/ per type of trip	The value is related to the average emissions produced by private car passengers in Italy. The theoretical value is given by the hypothetical fleet proposed by the Muovosviluppo plan	Complementary Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
8.	Emissions	NOx emissions/ per type of trip	The value is related to the average emissions produced by private car passengers in Italy. The theoretical value is given by the hypothetical fleet proposed by the Muovosviluppo plan	Complementary Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
9.	Emissions	Small particulate emissions/ per type of trip	The value is related to the average emissions produced by private car passengers in Italy. The theoretical value is given by the hypothetical fleet proposed by the Muovosviluppo plan	Complementary Indicator Theoretical ex ante is related to the business plan produced by "Muovosviluppo srl" First data collection after the o.p.: April 2011
10.	Transport	Quality of the service	Survey among CS users	Main Indicator No ex ante foreseen First data collection after the o.p.: June 2011
11.	Transport	Average Modal Split - trips	data coming from ISTAT/SISTAN census referred to 1991-2001	Complementary Indicator The after data collection wasn't carried out because the data coming from

				ISTAT/SISTAN weren't available
12.	Transport	Vehicle Occupancy	Survey among CS users	Main Indicator No ex ante foreseen First data collection after the o.p.: June 2011
13.	Awareness	Awareness Level	CBS questionnaire	Main Indicator First data collection after the o.p.: June 2011
14.	Acceptance	Acceptance Level	CBS questionnaire	Main Indicator First data collection after the o.p.: June 2011

Detailed description of the indicator methodologies:

- **Indicator 1** (CAPITAL COSTS) – Capital costs include all the initial investments and the eventual next purchase of equipments useful for the beginning/upgrading of the service. In particular, as regards the car sharing service, initial costs consist in fleet rent, software/hardware purchase and smart cards acquisition. In this case, theoretical value of the ex ante data collection is related to the business plan produced by "Muovosviluppo srl"; the actual value of ex ante is 0, because the service wasn't implemented before Civitas.
- **Indicator 2** (AVERAGE OPERATING REVENUES) – The indicator "average operating revenues" is defined as the ratio of total incomes generated from fares/tickets divided by the total vehicles/km completed by the service in a given time period (one year). In this case, theoretical value of the ex ante data collection is related to the business plan produced by "Muovosviluppo srl"; the actual value of ex ante is 0, because the service wasn't implemented before Civitas.
- **Indicator 3** (AVERAGE OPERATING COSTS) - The indicator "average operating costs" is defined as the ratio of total operating costs incurred by the service divided by the total vehicles/km completed by the service in a given time period (one year). In this case, theoretical value of the ex ante data collection is related to the business plan produced by "Muovosviluppo srl"; the actual value of ex ante is 0, because the service wasn't implemented before Civitas.
- **Indicator 4** (VEHICLES FUEL EFFICIENCY/KM PER TYPE OF TRIP) - This indicator is defined as the energy consumption per unit of transport activity. This derives from the vehicle type and the fuel type. In this case, theoretical value of the ex ante data collection was related to the business plan produced by "Muovosviluppo srl"; the actual value of ex ante was 0, because the service wasn't implemented before Civitas.
- **Indicator 5** (FUEL MIX / KM PER TYPE OF TRIP) – This indicator is defined as the percentage of the market share of transport fuel for each type of fuel used in a given period (one year). In this case, theoretical value of the ex ante data collection was related to the business plan produced by "Muovosviluppo srl"; the actual value of ex ante was 0, because the service wasn't implemented before Civitas.
- **Indicator 6** (CO2 EMISSIONS/ PER TYPE OF TRIP) – This indicator is defined as the average CO2 emissions per vehicles/km according to vehicle and fuel types. As regard the emissions estimation, theoretical value of the ex ante data collection is related to the average emissions produced by private car passengers in Italy. Therefore the theoretical value was given by the hypothetical fleet proposed by the Muovosviluppo plan. The actual value of ex ante was 0, because the service wasn't implemented before Civitas.

- **Indicator 7** (CO EMISSIONS/ PER TYPE OF TRIP) – This indicator is defined as the annual average CO emission per vehicles/km according to vehicle and fuel types. As regard the emissions estimation, theoretical value of the ex ante data collection is related to the average emissions produced by private car passengers in Italy. Therefore the theoretical value was given by the hypothetical fleet proposed by the Muovosviluppo plan. The actual value of ex ante was 0, because the service wasn't implemented before Civitas.

- **Indicator 8** (NOX EMISSIONS/ PER TYPE OF TRIP) – This indicator is defined as the annual average NOx emission per vehicles/km according to vehicle and fuel types. As regard the emissions estimation, theoretical value of the ex ante data collection is related to the average emissions produced by private car passengers in Italy. Therefore the theoretical value was given by the hypothetical fleet proposed by the Muovosviluppo plan. The actual value of ex ante was 0, because the service wasn't implemented before Civitas.

- **Indicator 9** (SMALL PARTICULATE EMISSIONS/ PER TYPE OF TRIP) – This indicator is defined as the annual average particulate matter (PM10 and PM2.5) emission. Where possible both Italian laws and COPERT methodology were considered. As regard the emissions estimation, theoretical value of the ex ante data collection is related to the average emissions produced by private car passengers in Italy. Therefore the theoretical value was given by the hypothetical fleet proposed by the Muovosviluppo plan. The actual value of ex ante was 0, because the service wasn't implemented before Civitas.

- **Indicator 10** (QUALITY OF THE SERVICE) – This indicator is defined as the user's perception of the overall quality of the service provided through a specific survey among the CS users.

- **Indicator 11** (AVERAGE MODAL SPLIT-TRIPS) – Using data coming from ISTAT/SISTAN census referred to 1991-2001, the modal split for the city of Brescia has been identified. The "modal split" has to be intended as the percentage of how systematic movements (Home-work and home-school) take place inside and outside Brescia.

- **Indicator 12** (VEHICLE OCCUPANCY) – This indicator considers the average people on board during Car sharing trips.

- **Indicator 13** (AWARENESS LEVEL) – The calculated indicator is made up of 2 results: the awareness level of the population in relation to the CIVITAS project in general and in relation to Car Sharing. These 2 results are expressed by the percentage of people who has knowledge of a specific aspect respect to the total number of people who answered the questionnaire. The starting question was:

  "*Do you know that in Brescia a Car Sharing service will be implemented?"*

- **Indicator 14** (ACCEPTANCE LEVEL) – As described for indicator 13, the following question was:

  "*According to your mobility needs, would you be interested in this service?*"

C1.2 Establishing a Baseline

To understand the impact of the measure, a theoretical baseline was established starting from the scenario illustrated in the call for bids won by Muovosviluppo in 2009. As a matter of fact, Muovosviluppo won the call for bids proposed by the Municipality of Brescia, thanks to a five-years plan which aimed to the promotion of the Car Sharing service in Brescia. For this purpose, the company made a comparative analysis among different Car Sharing experiences in Italy, which

became the theoretical baseline for the evaluation of Car sharing.

The theoretical indicators reported in the following table have been calculated starting from the data which can be found in the Muovosviluppo plan.

Indicators related to tender	**Theoretical baseline (2009)**	**Real baseline**
1.Capital Costs (for the car sharing service)	32.328 €	0€ (no service)
2.Average Operating Revenues (for the car sharing service)	0,71 €/vkm	0€ (no service)
3.Average Operating Costs (for the car sharing service)	2,16 €/vkm	0€ (no service)

Tab.1: indicator 1, 2 and 3 baseline

Indicators related to the plan fleet structure	**Theoretical baseline (2009)**	**Real baseline**
4. Vehicles fuel efficiency/km per type of trip	2,74 MJ/vKm	0 (no service)
5. Fuel mix / km per type of trip	Average energy consumption for the vehicles using Methan gas/Gasoline 2,72875 MJ/Km; Average energy consumption by the vehicles using Gasoline 2,747 MJ/Km	0 (no service)

Tab.2: indicator 4 and 5 baseline

As regards the emissions estimation, the baseline was referred to the average emissions produced by private car passengers in Italy; the theoretical baseline was given by the hypothetical fleet proposed by the Muovosviluppo plan.

Indicators	**Theoretical Baseline (business plan)**	**Baseline 2008 (National data)**
6.CO2 emissions/ per type of trip	Ministry methodology: 133,88 g/vkm TREMOVE: 170,22 g/vkm	164,1 gCO2/vkm (*)
7.CO emissions/ per type of trip	7,2 g/vkm	2,272 gCO/vkm (**)
8.NOx emissions/ per type of trip	1,2 g/vkm	0,638 gNOx/vkm (***)
9.Small particulate emissions/ per type of trip	(PM 2,5) = 0,0018 g/vkm	0,054 gPM2,5/vkm (****)
Notes: The theoretical baseline refers to the Muovosviluppo business Plan fleet; The Baseline is referred to average national data taken from the following sources: ISPRA environmental yearbook edition 2009 and National Transport and infrastructure count - edition 2008/2009. Data referred to year 2008 ISPRA, "Annuario dati ambientali edizione 2009"; Ministero delle Infrastrutture e dei Trasporti, "Conto Nazionale delle Infrastrutture e dei Trasporti - Anni 2008-2009. (*) ISPRA yearbook table 3.42; (**) Estimation of the CO using data coming from the ISPRA yearbook (tables 6.15, 3.3, 3.28 – year 2007) (***) Estimation of the NOx using data coming from the national count (table VIII.5.2.2) and from the ISPRA yearbook		

(table 3.28)
(****) Estimation of the PM2,5 using data coming from the ISPRA yearbook (tables 3.9 and 3.28 – year 2007)

Tab.3: indicator 6,7,8,and 9 baseline

As regard indicator 11 Average Modal Split – trips, data proposed by the new Brescia Master Plan (PGT) were used; indicator 12 represented the average vehicle occupancy in Italy (source: Ministero infrastrutture e dei trasporti, "Conto Nazionale delle infrastrutture e dei trasporti - Anni 2008-2009").

Indicators	**Baseline (2008)**
11. Average Modal Split – trips (PGT)	On foot 9,9 % Bicycle 2,4 % PTW 3,0 % Car 58,3 % Bus 23,8 % Train 2,6 %
12.Vehicle Occupancy	1,7 passengers/vehicle (National data)

Tab.4: indicator 11 and 12 baseline

Indicator 10 had no baseline; indicators 13 and 14 represented the interest shown by citizens for Car Sharing in Brescia.

Indicators	**Baseline**
10.Quality of the service	none
13.Awareness Level *Do you know that in Brescia a Car Sharing service will be implemented?*	No 619 (89%) Yes 74 (11%)
14.Acceptance Level *According to your mobility needs, would you be interested into this service?*	No 631 (91%) Yes 62 (9%)

Tab.5: indicator 10, 13 and 14 baseline

C1.3 Building the Business-as-Usual scenario

As everybody know, the Car Sharing service didn't exist in Brescia before CIVITAS. Since the beginning of the 90s, besides some researches deepening the issue of the metro transport system, several proposals for the reduction of the private passenger cars use in the city were evaluated. Some solutions, such as for example the introduction of the LAM for busses ("high mobility lanes", i.e. dedicated bus lanes) and the realization of bicycle lanes/itineraries were put into operation during the previous administration. Other solutions, such as Car Sharing and Car Pooling were recently considered priority projects for the city, also in view of the considerable financial investments made for the new metrobus construction. Bike Sharing service in Brescia was activated in 2008 under the new administration.

Bike Sharing service has been particularly effective because Brescia can be crossed by bike in a short time in competition also with the bus,. It is favoured also by the difficulties in finding free parking especially in the areas near the railway station.

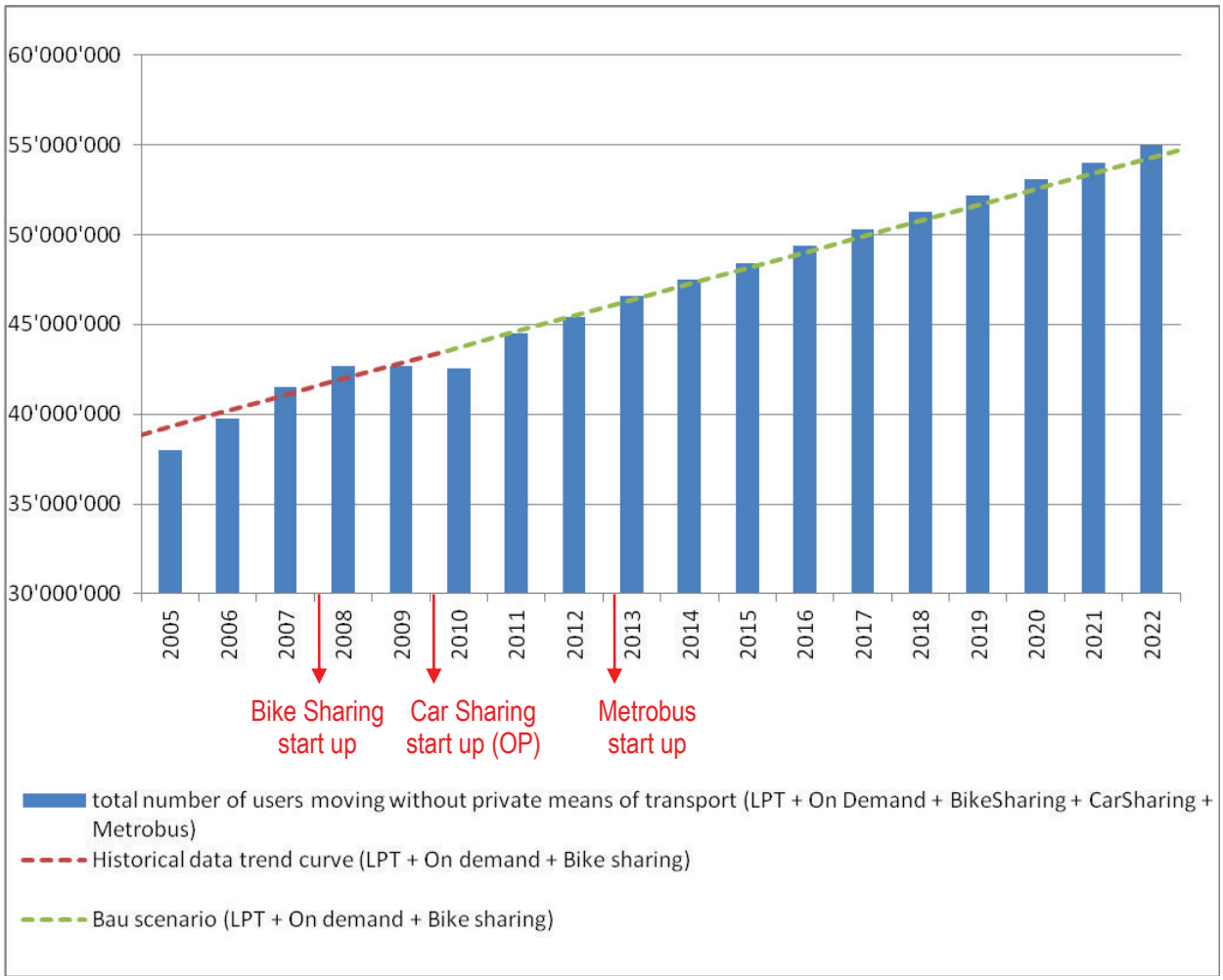
Bike sharing has been considered an alternative solution to private car use, the service can also be addressed to those citizens who need to move in the city or to reach particular services.. Also intermodal split areas can be properly provided with bike sharing stations. For example in the

historical centre there are 15 bike sharing stations - excluding those set along the ring road, with a total number of 149 bikes; at the railway station there is 1 bike sharing station offering 30 bikes and at the general hospital there are 2 stations with a total number of 19 bikes.

Deepening the different sustainable mobility solutions offered and promoted by the city of Brescia in order to empower the public transport service, the following policies emerge:

1) to improve the local public transport mobility realizing dedicated bus lanes along the most important bus creating which cross the city from North to South (LAM);
2) to promote public transport services toward specific kinds of users (like for example H-bus for disabled people or School busses for students);
3) to favour the use of bicycles creating cycle lanes and providing Bike Sharing.

The BaU scenario construction is based on the assumptions mentioned above, namely the maintenance and the strengthening of the mobility policies of the city. It's important to stress the fact that such actions are addressed predominantly to improve the overall mobility conditions for the citizens moving in the urban centre and for the city users along the main traffic directions approaching the city (see point 1,2,3 mentioned above).



Note: The total number of LPT users takes in account also the number of the foreseen metrobus passengers (the data are based on the documentation used for metrobus tender). Instead the passenger contribution of the bus, Bike Sharing, Car Sharing and On demand services has been estimated singularly, projecting the respective historical data series. The baseline trend curve has been

calculated considering data up to February 2010 (start up Car Sharing service). The baseline situation considers the total number of bus, on demand and bike sharing services users.

Fig.10: LPT, Bike Sharing, Car Sharing and On demand services BaU scenario

It should be assumed that without Civitas the car sharing service would never have started, therefore the main indicators related to the service will be "0" both the ones related to the tender and the ones related to the plan fleet structure.

Indicators related to tender	**BaU 2012**
1.Capital Costs (for the car sharing service)	0 € (no service)
2.Average Operating Revenues (for the car sharing service)	0 € (no service)
3.Average Operating Costs (for the car sharing service)	0 € (no service)

Tab.6: indicator 1, 2 and 3 BaU

Indicators related to the plan fleet structure (car sharing)	**BaU 2012**
4. Vehicles fuel efficiency/km per type of trip	0 (no service)
5. Fuel mix / km per type of trip	0 (no service)

Tab.7: indicator 4 and 5 BaU

For the same reason also main indicators measuring the impact on society will be "0" because the service won't be implemented without Civitas and no questionnaire would have been administered.

Indicators	**BaU**
10. Quality of the service	0 (no service)
13. Awareness Level ***Do you know that in Brescia a Car Sharing service will be implemented?***	0 (no service)
14. Acceptance Level ***According to your mobility needs, would you be interested into this service?***	0 (no service)

Tab.8: indicator 10, 13 and 14 BaU

For complementary indicators the BAU was calculated starting from the fleet proposed by Muovosviluppo using the emission data foreseen in ISPRA environmental data yearbook and in the "national transport and infrastructure count" (year 2009).

In this case the BAU is useful to compare the fleet proposed for Brescia with the Italian "passenger car fleet".

Indicators	**BaU 2012 (National data 2009)**
6. CO2 emissions/ per type of trip	161,8 gCO_2/vkm (*)
7.CO emissions/ per type of trip	1,95 gCO/vkm (**)
8.NOx emissions/ per type of trip	0,57 g/vkm (***)
9.Small particulate emissions/ per type of trip	0,0397 g/vkm (****)
Notes: Data sources for the BaU scenario is the ISPRA environmental data yearbook and the "national transport and infrastructure count", referred to year 2009 ISPRA, "Annuario dati ambientali edizione 2010"; Ministero delle Infrastrutture e dei Trasporti, "Conto Nazionale delle Infrastrutture e dei Trasporti - Anni 2009-2010". (*) ISPRA yearbook table 3.39; (**) Estimation of the CO using data coming from the ISPRA yearbook (tables 6.25, 3.3, 3.27 – year 2008) (***) Estimation of the NOx using data coming from the national count (table VIII.5.2.2) and from the ISPRA yearbook (table 3.27) (****) Estimation of the PM2,5 using data coming from the ISPRA yearbook (tables 3.9 and 3.27 – year 2008) Complementary indicators	

Tab.9: indicator 6, 7, 8 and 9 BaU

As regard complementary indicator 11 Average Modal Split – trips, data proposed by the new Brescia Master Plan (PGT) are used; while indicator 12 represents the average vehicle occupancy in Italy (source: Ministero infrastrutture e dei trasporti, "Conto Nazionale delle infrastrutture e dei trasporti - Anni 2009-2010").

Indicators	Bau 2012
11. Average Modal Split – trips (PGT)	On foot 9,9 % Bicycle 3,4 % PTW 3,0 % Car 58 % Bus 23,1% Train 2,6 %
12.Vehicle Occupancy	1,7 passengers/vehicle (National data)

Tab.10: indicator 11 and 12 BaU

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – economy, energy, environment, society and transport.

C2.1 Economy

Table C2.1.1: **Results obtained for the Indicators corresponding to area "economy"**

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
1. Capital Costs	No Ex Ante foreseen (From the Business Plan – theoretical value; October 2009: 32.328 €)	March 2010/March 2011: 89.668 €	March 2010/March 2011: 0 € (no service)	Not Assessable	Not Assessable
		March 2011/March 2012: 49.839 €	March 2011/March 2012: 0 € (no service)	Not Assessable	Not Assessable
2. Average Operating Revenues	No Ex Ante foreseen (From the Business Plan – theoretical value; October 2009: 0,71 €/vkm)	March 2010/March 2011: 1,49€/vkm	March 2010/March 2011: 0 €/vkm (no service)	Not Assessable	Not Assessable
		March 2011/March 2012: 1,24 €/vkm	March 2011/March 2012: 0 €/vkm (no service)	Not Assessable	Not Assessable
3. Average Operating Costs	No Ex Ante foreseen (From the Business Plan – theoretical value; October 2009: 2,16 €/vkm)	March 2010/March 2011: 6,57 €/vkm	March 2010/March 2011: 0/vkm € (no service)	Not Assessable	Not Assessable
		March 2011/March 2012: 12,60 €/vkm	March 2011/March 2012: 0/vkm € (no service)	Not Assessable	Not Assessable

- As regards the economic indicators 1 "Capital Costs" and 2 "Average Operating Revenues" and 3 "Average Operating Costs", by the comparison between the theoretical value reported in the Business Plan *(Muovosviluppo Business Plan, 2009)* and the actual values, some observations were listed:
- - there was a general underestimation of the "Capital Costs", in particular in the costs of the SW service (estimated about 5.000€/year instead of about 65.000€ in the first year and about 32.000€ in the second year) .
- - there was a general overestimation of the "Average Operating Revenues", in particular due to an overestimation of the kilometres yearly made by the fleet.
- - regarding the Operating Costs it should be underlined that there were less operating costs due to the real kilometres yearly made by the fleet. The service therefore was pricey than expected.

C2.2 Energy

Table C2.2.1: **Results obtained for the Indicators corresponding to area "energy"**

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
4. Vehicles fuel efficiency/km per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; 2,74 MJ/vKm)	March 2010/March 2011: 2,51 MJ/vKm	March 2010/March 2011: 0 MJ/vKm	Not Assessable	Not Assessable
		March 2011/March 2012: 2,53 MJ/vKm	March 2011/March 2012: 0 MJ/vKm	Not Assessable	Not Assessable
5. Fuel mix / km per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; Average energy consumption for the vehicles using Methan gas/Gasoline 2,72875 MJ/Km Average energy consumption by the vehicles using Gasoline 2,747 MJ/Km)	March 2010/March 2011: Average energy consumption for the vehicles using Methan gas/Gasoline 2,6376667 MJ/Km Average energy consumption by the vehicles using Gasoline 2,5793333 MJ/Km	March 2010/March 2011: Average energy consumption for the vehicles using Methan gas/Gasoline 0 MJ/Km Average energy consumption by the vehicles using Gasoline 0 MJ/Km	Not Assessable	Not Assessable
		March 2011/March 2012: Average energy consumption for the vehicles using Methane gas/Gasoline 2,6376667 MJ/Km Average energy consumption by the vehicles using Gasoline 2,5793333	March 2011/March 2012: Average energy consumption for the vehicles using Methane gas/Gasoline 0 MJ/Km Average energy consumption by the vehicles using Gasoline 0 MJ/Km	Not Assessable	Not Assessable

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
		MJ/Km			

The energy consumption, estimated by indicators 4 "Vehicles fuel efficiency/km per type of trip" and 5 "Fuel mix / km per type of trip" registered lower values than the Business Plan ones.
Indicator 4 "Vehicles fuel efficiency/km per type of trip" is lower than estimated due to the less number of kilometres yearly made by the fleet. Besides the slight increasing of kilometres done by the fleet 2011-2012 is balanced by the increasing of fuel costs.

- Indicator 5 "Fuel mix / km per type of trip" made evidence of the real composition of the fleet and of its real fuel consumption.

C2.3 Environment

Table C2.3.1: **Results obtained for the Indicators corresponding to area "environment"**

-

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
6. CO2 emissions/ per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; Ministry methodology: 133,88 g/vkm TREMOVE: 170,22 g/vkm)	March 2010/March 2011: Ministry methodology: 126,50 g/vkm TREMOVE: 165,16 g/vkm	March 2010/March 2011: 161,8 gCO_2/vkm	Not Assessable	+ 3,36 g/vkm
		March 2011/March 2012: Ministry methodology: 126,50 g/vkm TREMOVE: 165,16 g/vkm	March 2011/March 2012: 161,8 gCO_2/vkm	Not Assessable	+ 3,36 g/vkm
7. CO emissions/ per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; 7,2 g/vkm)	March 2010/March 2011: 7,19 g/vkm	March 2010/March 2011: 1,95 g/vkm	Not Assessable	+ 5,24 g/vkm
		March 2011/March 2012: 7,19 g/vkm	March 2011/March 2012: 1,95 g/vkm	Not Assessable	+ 5,24 g/vkm
8. NOx emissions/ per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; 1,2	March 2010/March 2011: 1,13 g/vkm	March 2010/March 2011: 0,57 g/vkm	Not Assessable	+ 0,56 g/vkm
		March 2011/March 2012: 1,13	March 2011/March 2012: 0,57	Not Assessable	+ 0,56 g/vkm

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
	g/vkm)	g/vkm	g/vkm		
9. Small particulate emissions/ per type of trip	No Ex Ante foreseen (From the business plan – theoretical value; (PM 2,5) 0,0018 g/vkm)	March 2010/March 2011: (PM 2,5) 0,0018 g/vkm	March 2010/March 2011: 0,0397 g/vkm	Not Assessable	- 379 0,0 g/vkm
		March 2011/March 2012: (PM 2,5) 0,0018 g/vkm	March 2010/March 2011: 0,0397 g/vkm	Not Assessable	- 379 0,0 g/vkm

Due to the small fleet environmental indicators were not considered significant in relation to emissions reduction in the city.
They were monitored as complementary indicators in order to verify how choices on vehicles typology, that could be influenced by different factors – such as special offers on cars, customer needs, etc., could have on impact on the environment. Brescia fleet has little differences in emissions respect the one estimated in the Business Plan.

C2.4 Transport

Table C2.4.1: **Results obtained for the Indicators corresponding to area "transport"**

•

<table>
<tr><th>Indicator</th><th>Before</th><th>After</th><th>BaU</th><th>Difference: After –Before</th><th>Difference: After – B-a-U</th></tr>
<tr><td rowspan="2">10. Quality of the service</td><td rowspan="2">No Ex Ante foreseen</td><td>June 2011:
<table><tr><th>Rating</th><th>%</th></tr><tr><td>Excellent</td><td>22</td></tr><tr><td>Very good</td><td>67</td></tr><tr><td>Good</td><td>11</td></tr><tr><td>Sufficient</td><td>0</td></tr><tr><td>Mediocre</td><td>0</td></tr><tr><td>Not Answered</td><td>0</td></tr><tr><td>TOTAL</td><td>100</td></tr></table></td><td>June 2011: 0 (no service)</td><td>Not Assessable</td><td>Not Assessable</td></tr>
<tr><td>April 2012
<table><tr><th>Rating</th><th>%</th></tr><tr><td>Excellent</td><td>16,7</td></tr><tr><td>Very good</td><td>55,5</td></tr><tr><td>Good</td><td>27,8</td></tr><tr><td>Sufficient</td><td>0</td></tr><tr><td>Mediocre</td><td>0</td></tr><tr><td>Not Answered</td><td>0</td></tr><tr><td>TOTAL</td><td>100</td></tr></table></td><td>April 2012: 0 (no service)</td><td>Not Assessable</td><td>Not Assessable</td></tr>
<tr><td>11. Average Modal Split - trips</td><td>(2008)
On foot 9,9 %
Bicycle 2,4 %</td><td>Not Assessable</td><td>(2012):
On foot 9,9 %
Bicycle 3,4 %</td><td>Not Assessable</td><td>Not Assessable</td></tr>
</table>

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
	PTW 3,0 % Car 58,3 % Bus 23,8 % Train 2,6 %		PTW 3,0 % Car 57,3 % Bus 23,8 % Train 2,6 %		
12. Vehicle Occupancy	No Ex Ante foreseen	June 2011 2 pass/car	June 2011: 1,7 pass/car	Not Assessable	+ 0,3 pass/car
		April 2012 1,57 pass/car	April 2012: 1,7 pass/car	Not Assessable	- 0,13 pass/car

Indicators 10 "Quality of the service" and 12 "Vehicle Occupancy" were collected through a survey addressed to the Car Sharing subscribers.

The survey was filled in mainly by new subscribers and. a very good judgement were made about the service.

Indicator 12 "Vehicle Occupancy" made evidence of the use of car sharing for individual trips.

Regarding Indicator 11 "Average modal split – trips" the small fleet have no influence on the modal split of the city, this complementary indicator is useful in order to monitor citizens less dependency of private car. As a matter of fact its reduction can favour car sharing development, individual attitude in using the car is evident also from indicator 12 "Vehicle Occupancy".

C2.5 Society

Table C2.5.1: **Results obtained for the Indicators corresponding to area "society"**

Indicator	Before	After	BaU	Difference: After –Before	Difference: After – B-a-U
13. Awareness Level	January 2010: 11%	April 2011: 11%	April 2011: 0 (no service)	+ 0%	+ 11%
		April 2012: 29%	April 2012: 0 (no service)	+ 18%	+ 29%
14. Acceptance Level	January 2010: 9%	April 2011: 13%	April 2011: 0 (no service)	+ 4%	+ 13%
		April 2012: 16%	April 2012: 0 (no service)	+ 7%	+ 16%

-
- There is a general increment in both accepance and awereness of the service this fact can be considered related to:
  - general dissemination activities carried out systematically by Muovosviluppo;
  - targeted campaigns and targeted offers made by Muovosviluppo;
  - a general good experience done by the present car sharing users

- ICS (Initiative Car Sharing) membership, that is wall known at National level.

Summary of the main CBA results (ref. Annex 3)

As this was considered a focus measure, a CBA was carried out, comparing the hypothetic situation without the car sharing service (reference case or Business-as-Usual scenario) with the actual present situation, including the implementation of the Car Sharing Civitas Measure (Car Sharing scenario). The reference year was set 2010, in which a private Company, charged by the Municipality of Brescia, implemented and manageed the car sharing service in the city. The whole period, taken into consideration by CBA to have a financing return, was set in 15 years (final CBA year: 2025).

The investment cost by Brescia Municipality (194,000 €) to support the car sharing Civitas measure was re-paid in 15 years, thanks emission and fuel saving, only if the total kms running by car sharing service were 1,526,420 kms. This means that, the car sharing service, with the low starting (2010 and 2011 monitorings: 16,022 kms and 44,142 kms), should increase yearly in the next 15 years of 28,8%,

In fact, only with this use increasing, the Net Present Value and the Benefit/Costs Ratio became respectively up zero and up one in 15 years.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	Start up the car sharing service in Brescia This objective can be considered achieved in full, as the Car Sharing service was kicked off in March 2010.	**
2	Reach maximum 10 cars This objective can be considered substantially achieved. *In fact the Car Sharing fleet is composed by 6 vehicles (April 2012)*	*
3	Reach maximum 7 reserved parking places This objective can be considered exceeded. *As a matter of fact, the Car Sharing service has 7 reserved parking places.*	***
4	Reach about 220 service subscribers. This objective can be considered exceeded. *As a matter of fact, the Car Sharing service subscribers were more than 290 (data referred to May 2012).*	***
5	A car sharing service for the citizens fully integrated within the Italian network ICS This objective can be considered achieved in full. *As a matter of fact, the Car Sharing service was integrated to the existing ICS Italian network.*	**
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full * = Exceeded**		

C4 Up-scaling of results

The car sharing service implemented in Brescia is already available for all ICS subscribers and to all Muovosviluppo subscribers. As a matter of fact the fleet is used all over the city and out of it.

C5 Appraisal of evaluation approach

The evaluation activities consisted in the data collection to calculate the selected indicators for the ex ante/ex post situation. The chosen set of indicators was subdivided into five categories: *Economy, Energy, Environment, Transport* and *Society*.
In the first one, the indicators regarded "Capital costs", "Average operating Revenues" and "costs" were chosen in order to collect information about the management of the service. These data were useful also for the CBA drawing up, as this was a focused measure.
As regards the categories *Energy* and *Environment*, they were considered as complementary indicators relevant only at local level and not representative of the measure effectiveness on the city:
The indicators of the category *Transport* were chosen in order to monitor the quality of the car sharing service (indicator 10) and the use of the service itself (indicator 12 "vehicle occupancy").
These information was provided by Muovosviluppo S.r.l., through on-line questionnaire addressed to the service subscribers.
The indicator 11"average modal split per trip"_ is based on ISTAT/SISTAN (National Italian Statistic) census.
Finally, indicators related to the category *Society* regarded the "Awareness" and the "Acceptance" of the citizens about the Car sharing service. These information was provided through a specific section of the questionnaire of the Municipality of Brescia, which regarded several Civitas measures.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1** – start up of Brescia car sharing service in March 2010, the service is managed by Muovosviluppo S.r.l.
- **Key result 2** – as regards the service, it was implemented with a fleet composed by six cars, half powered by natural gas; also, 7 reserved parking places were located in the city and the service reached more than 290 subscribers (data referred to May 2012).
- **Key result 3** - the car sharing service implemented in Brescia was fully integrated within the Italian network ICS ("Initiative Car Sharing"), in order to better link different cities with the car sharing service and to make standard the service in Italy (also as regards the car reservation procedure). As a matter of fact, the subscribers of different cities are able to use the service wherever it is implemented and integrated in ICS network.

C7 Future activities relating to the measure

The future activities related to the measure consist in upgrading of the service implementation trough:

- enlargement of the fleet purchasing also electric cars (taking in account customers suggestions);

- new fares depending on the service use agreed with companies

- enlargement of parking areas dedicated to Car Sharing to be located also in relation to the new PT network organization (the start up of the new metroline is foreseen by 2013 with a substantial reorganisation of LPT transport in Brescia).

D. Process Evaluation Findings

D.0 Focused measure

This measure was chosen as a focused one at the beginning of the project. The reasons of this choice are reported below:

	1	The possibility of carrying out a good Cost Benefit Analysis;
	2	The measure fitted into the city policy towards sustainable urban transport and/or towards sustainability in general;
	3	The measure was considered as an example measure.

D1 Deviations from the original plan

- **Number of cars -** The deviation from the original plan pointed out for this measure regarded the number of the cars of the fleet: in fact, a fleet of 10 cars was foreseen, but actual number of the cars was equal to 6.

D2 Barriers and drivers

D2.1 Barriers

Preparation phase

- **Planning barrier** –No one attended the first tender. Therefore the tender description was reviewed and refined by the Municipality of Brescia

Operational phase

- **Other barrier (service organization barrier) -** it was important to highlight that, considering the limited size of the car sharing fleet, the cars should be parked where it is taken. This was considered a barrier by users.

D2.2 Drivers

Preparation phase

- **Political/strategic driver** – Municipality of Brescia implemented the car sharing service in the city, due to the strong will to implement sustainable mobility in the city. This allowed also to develop a new smart and clean image of the Brescia.

Implementation phase

- **Spatial driver** - The good design and the localization of car sharing parking spaces helped to improve the service and to make it desirable for citizens.

Operational phase

- **Involvement driver** - Muovosviluppo shown a excellent flexibility towards the possible stakeholders (companies, public bodies, etc.). As a matter of fact, the company involved

several partners with personalized agreements, with different fares and discounts for employees, as personal use.

- **Involvement driver** – the activities carried out during the European Mobility Week allowed increasing involvement of citizens and users trough campaigns.

D2.3 Activities

Preparation phase

- **New tender** - As regards the first tender failure, a second tender was fulfil: as a matter of fact, the tender terms were changed, in order to public a more tempting one for the possible competitors.

Operational phase

- **Car sharing as a strategic activity for the city -** An important step consisted in including the car sharing service implementation into a running sustainability program (combined with the strategic actions).

D3 Participation

D.3.1 Measure partners

- **Muovosviluppo s.r.l -** as it was the winner of the second tender. The company managed the service (cars, on line reservation, ICS service integration, etc.) and the promotional targeted campaigns and the agreements with the several stakeholders in the city.

D.3.2 Stakeholders

- **Brescia citizens -** they were all potential users of the service, considering that it was implemented in all the city; in particular, they were involved in many dissemination campaigns, carried out also during the "European sustainable mobility week".

- **IKEA, Brescia University, Catholic University of the Sacred Heart, Banca Etica, Legambiente, Acli, Arci, Coop, Legacoop Italia, Public bodies, hotels etc.-** these were considered all stakeholders and the car sharing company Muovosviluppo carried out particular arrangements and discounts addressed to them.

D4 Recommendations

D.4.1 Recommendations: measure replication

- **"Market oriented" perspective** - The car sharing service in Italy is organized according to very precise standards and operational procedures which capitalized anexperience of more than 10 years. They cover all the aspects of a car sharing service, from the technological equipment to the contact center for the customers, from contractual forms to fares andpenalties, from vehicles availability to service procedures and so on. The Brescia service is compliant with these standards, procedures and norms, and consequntely is transferrable in a "market oriented" perspective. In fact it represents a consolidated service model which could be implemented in other realities..

D.4.2 Recommendations: process

- **Targeted dissemination campaigns** – considering that Brescia is a middle sized city, with a high property car rate, the targeted dissemination campaign is important, in order to better improve the service awareness and acceptance among the citizens; actually, it's difficult to target different groups of people, to which address the information campaign as they can be potentially interested to the car sharing service.

- **Investigate the interest among specialized companies** – before the implementation phase of a car sharing service, it's important to investigate the interest among the companies, which manage this kind of service, in order to draw up a desirable tender, more suitable both for the city and for the involved companies.

- **Integration with existing and new means of transport** – the localization of the reserved parking places is fundamental for the service success and for the subscribers increase. As a matter of fact, an in-depth study of the parking location allow the transport integration among different means of transport: this can help people to move in the city without their own car and to reach easily the car sharing stations.

- **Integration with existing Car Sharing network** – it's important to highlight that a car sharing service works better if fully integrated with the national car sharing network (if it existing).

- **Targeted agreements and discounts** – the agreements drawing up among the company and several categories (Public bodies, Universities, big companies, cooperatives, etc.) is important for the car sharing implementation, because it make more attractive the service for several categories, characterized by different needs of transport. Furthermore, it will help the spread of information about the implemented service.

Annex 1: Data used for the BaU building

The following data series has been used to build the graph showing the estimation of the total number of users moving without private means of transport reported in the section C1.3"Building the BaU scenario". That graph has been built in order to make overall considerations about a more general BaU scenario referred to the mobility solutions (already existing, new and future) offered by the city of Brescia.

Year	2005	2006	2007	2008	2009	2010
TPL passengers	38'008'558	39'760'208	41'459'439	42'692'823	42'668'471	42'553'535
On demand service passengers	14'977	16'569	17'143	16'473	16'649	16'097
Bike sharing subscribers	0	0	0	1040	1753	3149
total number of users moving without private means of transport (LPT + On Demand + BikeSharing)	38'023'535	39'776'777	41'476'582	42'710'336	42'686'873	42'572'781

Tab.A1.1: Data series used to build the graph showing the estimation of the total number of users moving without private means of transport

Data about the Car Sharing service passengers is available at the moment only for year 2011 and is 30 passengers.

Data about the metro passengers are taken from the simulations reported in the metrobus technical documents.

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
estimated metro passengers	215120	219422	223725	230178	232330	234481	236632	236632	236632	236632

Tab.A1.2: Estimated metro passengers

Annex 2: Ex ante and Ex Post data collection

- **Indicator 1 (Capital Costs)** – The ex ante is calculated using data provided by the business plan coming from the service operator. The business plan has been produced by "Muovosviluppo srl", a company coming from Padova, in occasion of their participation to the tender.

CONTO ECONOMICO		Anno 1
RICAVI (Fatturato + Contributi)	€	261.823
FATTURATO	€	79.859
Da entry fees aziendali	€	5.000
Da abbonamenti	€	14.908
Da tempo	€	23.439
Da Km	€	36.512
Contributo ICS	€	181.964
COSTI TOTALI	€	322.677
COSTI FLOTTA	€	55.802
Noleggio	€	20.708
RC-I-F-K- Tassa Prop.	€	13.806
Carburante	€	6.720
Lavaggi	€	1.968
Posti auto	€	-
Attrezzaggio posti auto (amm)	€	3.000
Call center	€	9.600
IT	€	21.620
Computer di bordo	€	2.720
Sw- Server (amm)	€	5.000
Smart- card	€	900
Altra IT	€	13.000
LAVORO	€	48.000
Responsabile operativo	€	15.000
R & S clienti		
Amministrazione / Gestione	€	27.000
Personale esterno (outsourcing)	€	6.000
ALTRI COSTI	€	197.255
RID		
Climaneutralità	€	547
Marketing 1to1	€	30.000
Pubblicità	€	100.064
Attrezzaggio sede (amm)		
Consulenze esterne	€	5.000
Adempimenti societari	€	3.000
PT + Phone	€	1.000
Enel	€	4.100
Affitto sede	€	6.000
Corsi di formazione	€	35.000
Cancelleria e modulistica		
Legali	€	8.000
Manutenzione e varie	€	4.544
DEBITI	€	90.982
Oneri /Proventi finanziari sui debiti	€	2.243
RISULTATO GESTIONALE ANTE IMPOSTE	-€	63.097
RISULTATO CUMULATO	-€	63.097

Tab.A2.1:. Extract from the business plan provided by the operator service

As can be seen in the table reported above, the indicator can be built though the sum of the following costs:

Capital costs	**€**

Fleet rent	20.708 €
Auto parking equipment	3.000 €
Computer on board	2.720 €
Software server	5.000 €
Smart cards	900 €
TOTAL	**32.328 €**

Tab.A2.2: data provided by the business plan coming from the service operator

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Capital costs	**€**
Fleet rent	15.486 €
Auto parking equipment	0.00 €
Computer on board	6.113 €
Software server	64.069 €
Smart cards	4.000 €
TOTAL	**89.668 €**

Tab.A2.3: data provided by the service operator

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Capital costs	**€**
Fleet rent	15.777 €
Auto parking equipment	0.00 €
Computer on board	1.597 €
Software server	31.252 €
Smart cards	1.213 €
TOTAL	**49.839 €**

Tab.A2.4: data provided by the service operator

- **Indicator 2 (Average Operating Revenues) -** As regards the data source, it can be taken in consideration the same business plan described above (indicator 1) and in particular the same table reported. The indicator is built as follows:

$$A = B/C$$

A = Average operational revenues for the service = 0,71 €/vkm
B = Total operational revenues for the service = 79.859 €
C = Total vehicle kms for the service in the first year= 112.000 vkm

(data provided by the business plan coming from the service operator).

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

A = B/C

A = Average operational revenues for the service = 1,49 €/vkm
B = Total operational revenues for the service = 28.833,53 €
C = Total vehicle kms for the service = 19.389 vkm

(data provided by the service operator)

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

A = B/C

A = Average operational revenues for the service = 1,24 €/vkm
B = Total operational revenues for the service = 67.159,39 €
C = Total vehicle kms for the service = 54.313vkm

(data provided by the service operator)

- **Indicator 3 (Average Operating Costs) -** As regards the data source, it can be taken in consideration the same business plan described above (indicator 1) and in particular the same table reported . The indicator is built as follows:

A = B/C

A = Average operating costs for the service = 2,16 €/vkm
B = Total operating costs for the service = 242.349 €
C = Total vehicle kms for the service in the first year = 112.000 vkm

Operating costs	**€**
Insurance taxes "RC"	13.806
Fuel	6.720
Car washes	1.968
Call centre	9.600
Personnel costs	48.000
Other costs	162.255
TOTAL	**242.349 €**

Tab.A2.5: data provided by the business plan coming from the service operator

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

A = B/C

A = Average operating costs for the service = 6,57 €/vkm
B = Total operating costs for the service = 127.475 €
C = Total vehicle kms for the service = 19.389 vkm

Operating costs	**€**
Insurance taxes "RC"	10.324
Fuel	612,73
Car washes	452,60
Call centre	8.812,85
Personnel costs	25.513,20
Other costs	81.759,30
TOTAL	**127.475€**

Tab.A2.6: data provided by the service operator

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

A = B/C

A = Average operating costs for the service = 2,60 €/vkm
B = Total operating costs for the service = 141.497,37 €
C = Total vehicle kms for the service = 54.313 vkm

Operating costs	**€**
Insurance taxes "RC"	16.450
Fuel	7.037,03
Car washes	576,00
Call centre	4.695,49
Personnel costs	17.380,00
Other costs	95.088,85
TOTAL	**141.497,37€**

Tab.A2.7: data provided by the service operator

- **Indicator 4 (Vehicles fuel efficiency/km per type of trip) –** The fleet, for the first year (as explained in the business plan) is composed by 8 vehicles and is composed by the following vehicles:

n. 2	Fiat Panda 1.2 Dynamic N.P.	Metano / Benzina	City car / City car compatte
n. 2	Fiat 500 1.2 Pop	Benzina	City car / City car compatte
n. 1	Fiat Punto Classic 1.2 N.P.	Metano / Benzina	City car / City car compatte
n. 1	Opel Zafira 1.6 16v ecoM	Metano / Benzina	Berline / Berline piccolo
n. 1	Fiat Doblò 1.4 Actual	Benzina	Vetture multifunzione trasporto persone e/o merci
n. 1	Fiat Doblò 1.4 Active	Benzina	City car / City car compatte Allestita per il trasporto Disabili

Tab.A2.8: Business plan fleet vehicles

To calculate this indicator the "Guide for the fuel saving and about the CO2 emissions[20]" has been taken as reference. This Guide has been released as regulation for the implementation of the European Directive 1999/94/CE[21] thanks to the collaboration among 3 Italian Government Departments: Ministero delle Attività Produttive, Ministero dell'Ambiente e della tutela del territorio e Ministero delle Infrastrutture e dei Trasporti (the picture below shows an extract of the tables that can be found in the Guide). The guide lines include for many car models several information, such as fuel consumption and CO2 emissions. Sometimes, information taken directly from the car producers have been taken as reference. Using calorific power for each kind of fuel, it has been possible to estimate the indicator, according to the formula below:

$$A = B/C$$

A = Average vehicle energy efficiency
B = Total energy consumed by the fleet
C = Total amount vehicle kms completed by the vehicles for the service = 112.000 vkm *

* data provided by the business plan coming from the service operator

Fuel type and unit of measure	**Calorific power [MJ/l MJ/Nm^3 MJ/kWh]**
Gasoline [l]	44
Gasoil [l]	42,5
Methan gas [m^3]	33,4
Electric [kWh]	3600
Methan gas density	*0,71 [kg/mc]*

Tab.A2.9: Fuel type and unit of measure

It's important to remark that indicator 4 can be expressed by the weighted average energy consumption (MJ/vkm) calculated for the Car Sharing fleet respect to the kms driven by each kind of car.

As regard the ex ante situation (given by the business plan analysis) we have the total kms driven by the whole hypothetical Car Sharing Fleet, therefore the indicator coincides with the average energy consumption.

[20] http://www.consumieclima.org/download/guida_risparmio_carburante_emissionico2.pdf

[21] DPR 17 febbraio 2003 n.84 "Regolamento di attuazione della direttiva n. 1999/94/CE

As regard the AFTER data collection, referred to the period March 2010 - March 2011, we know the actual kms driven by each car composing the car sharing fleet, therefore indicator 4 can be calculated using a weighted average.

Each vehicle consumes the following amount of energy:

Type of car	Fuel	consumption misto (Kg/100Km) or (l/100km)		Energy Consumption (MJ/km)	
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	Methan gas 4,8 Kg/100Km	Gasoline 6,2 (l/100km)	2,25	2,728
				2,489	
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	Methan gas 4,8 Kg/100Km	Gasoline 6,2 (l/100km)	2,25	2,728
				2,489	
Fiat 500 1.2 Pop	Gasoline	5,1 l/100 km		2,244	
Fiat 500 1.2 Pop	Gasoline	5,1 l/100 km		2,244	
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	6,6 Kg/100Km	6,3 (l/100km)	3,1	2,77
				2,935	
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	5,2 Kg/100Km	8,10 (l/100km)	2,44	3,564
				3,002	
Fiat doblò 1.4 Actual	Gasoline	7,4 (l/100km)		3,25	
Fiat doblò 1.4 Active	Gasoline	7,4 (l/100km)		3,25	
			Average Energy Consumption (MJ/km)	**2,737875**	

Tab.A2.10: Average Energy Consumption (MJ/km)

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

New fleet composition:

Type of car	Fuel	consumption misto (Kg/100Km)or(l/100km)		Average Energy Consumption (MJ/km)		Vkm driven by each kind of car	Energy consumed by the fleet [MJ]
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	Methan gas 4,8 Kg/100Km	Gasoline 6,2 (l/100km)	2,25	2,728	1.239	3.083,871
				2,489			
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	Methan gas 4,8 Kg/100Km	Gasoline 6,2 (l/100km)	2,25	2,728	3.971	9.883,819
				2,489			
Fiat 500 1.2 Pop	Gasoline	5,1 l/100 km		2,244		4.961	11.132,484
Fiat 500 1.2 Pop	Gasoline	5,1 l/100 km		2,244		4.754	10.667,976
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	6,6 Kg/100Km	6,3 (l/100km)	3,1	2,77	1.873	5.497,255
				2,935			

Fiat doblò 1.4 Actual	Gasoline	7,4 (l/100km)		3,25	2.591	8.420,75
				Totals	19.389	48.686,155

Tab.A2.11: Energy Consumption of the fleet (MJ)

B = Total energy consumed by the fleet = 48.686,155 MJ
C = Total amount vehicle kms completed by the vehicles for the service = 19.389 km
A = Weighted average vehicle energy efficiency = 2,51 MJ/vkm

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

As regard the second AFTER data collection, referred to the period March 2011 - March 2012, we know the actual kms driven by each car composing the car sharing fleet (two Fiat Panda 1.2 Dynamic N.P, two Fiat 500 1.2 Pop, Fiat Punto classic 1.2 N.P. and Fiat doblò 1.4 Actual), therefore indicator 4 can be calculated using a weighted average.

Fleet composition:

Type of car	**Fuel**	**consumption misto (Kg/100Km)or(l/100km)**		**Average Energy Consumption (MJ/km)**	**Vkm driven by each kind of car**	**Energy consumed by the fleet [MJ]**
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	Methan gas 4,8 Kg/100Km	Gasoline 6,2 (l/100km)	2,25 2,728 / 2,489	17.208	42.830,71
Fiat 500 1.2 Pop	Gasoline	5,1 l/100 km		2,244	22.473	50.429,41
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	6,6 Kg/100Km	6,3 (l/100km)	3,1 2,77 / 2,935	9.879	28.994,86
Fiat doblò 1.4 Actual	Gasoline	7,4 (l/100km)		3,25	4.753	15.447,25
				Totals	54.313	137.701,69

Tab.A2.12: Energy Consumption of the fleet (MJ)

B = Total energy consumed by the fleet = 137.702,23 MJ
C = Total amount vehicle kms completed by the vehicles for the service = 54.313 km
A = Weighted average vehicle energy efficiency = 2,53 MJ/vkm

- **Indicator 5 (Fuel mix / km per type of trip) –** This indicator can be considered as the average energy consumption per km, sorting by kind of fuel. According to the table reported above (indicator 4),

Type of car	**Fuel**	**Energy consumption (MJ/km)**
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	2,489
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	2,489
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	2,935

Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	3,002
Average energy consumption for the vehicles using Methan gas/Gasoline		**2,72875**
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat doblò 1.4 Actual	Gasoline	3,25
Fiat doblò 1.4 Active	Gasoline	3,25
Average energy consumption by the vehicles using Gasoline		**2,747**
Average energy consumption for the fleet		**2,737875**

Tab.A2.13: Data are provided by the operator service and have been taken from the business plan.

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Type of car	Fuel	Energy consumption (MJ/km)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	2,489
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	2,489
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	2,935
Average energy consumption for the vehicles using Methan gas/Gasoline		**2,6376667**
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat doblò 1.4 Actual	Gasoline	3,25
Average energy consumption by the vehicles using Gasoline		**2,5793333**

Tab.A2.13: Average energy consumption by the vehicles using Gasoline

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Type of car	Fuel	Energy consumption (MJ/km)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	2,489
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	2,489
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	2,935
Average energy consumption for the vehicles using Methan gas/Gasoline		**2,6376667**
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat 500 1.2 Pop	Gasoline	2,244
Fiat doblò 1.4 Actual	Gasoline	3,25
Average energy consumption by the vehicles using Gasoline		**2,5793333**

Tab.A2.14: Average energy consumption by the vehicles using Gasoline

- **Indicator 6 (CO2 emissions/ per type of trip)** – Both Italian laws (Ministry guide lines) and TREMOVE methodology are considered (Data which are required to run COPERT in different countries have been collected in the framework of the project "European Database of Vehicle Stock for the Calculation and Forecast of Pollutant and Greenhouse Gases Emissions with TREMOVE and COPERT" funded by the European Commission – DG Environment and executed by a consortium consisting of LAT/AUTh, KTI, Renault, E3M-Lab/NTUA, Oekopol, and EnviCon.).

  For each type of vehicle is considered the CO2 emissions.

  Using the Ministry methodology, the following table is to be considered to calculate the CO_2 emissions for passenger cars for each kind of vehicle:

  According to the values suggested by the Ministry methodology or cars constructors, the CO_2 average emissions produced by the fleet (considering only Gasoline powered cars, that produce), are:

Type of car	Fuel	CO2 emissions (g/vkm)
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	119
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	138
Fiat 500 1.2 Pop	Gasoline	119
Fiat 500 1.2 Pop	Gasoline	119
Fiat doblò 1.4 Actual	Gasoline	174
Fiat doblò 1.4 Active	Gasoline	174
Average CO2 emissions produced by the fleet (g/vkm)		**133,88**

Tab.A2.15: Average CO2 emissions produced by the fleet (g/vkm)

Using the TREMOVE methodology, the following table is to be considered to calculate the CO2 emissions for passenger cars for each kind of vehicle:

CO2 Emission (g/v km) for passenger cars		
Type	**Labelling**	**CO2**
Gasoline	Euro 0	289,95
Gasoline	Euro 1	202,21
Gasoline	Euro 2	194,48
Gasoline	Euro 3	181,24
Gasoline	Euro 4	170,22
Gasoline	Euro 5	160,10
Diesel	Euro 0	192,03
Diesel	Euro 1	203,87
Diesel	Euro 2	190,72
Diesel	Euro 3	174,52
Diesel	Euro 4	153,66

Diesel	Euro 5	161,95
Diesel	Euro 6	161,84

Tab.A2.16: CO2 Emission (g/v km) for passenger cars

According to the table above, the CO_2 average emissions produced by the fleet (hypothized in the business plan) are reported below:

Type of car	Fuel	Labeling (Euro)	CO2 emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	170,22 g/vkm
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	170,22 g/vkm
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 4	170,22 g/vkm
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	EURO 4	170,22 g/vkm
Fiat 500 1.2 Pop	Gasoline	EURO 4	170,22 g/vkm
Fiat 500 1.2 Pop	Gasoline	EURO 4	170,22 g/vkm
Fiat doblò 1.4 Actual	Gasoline	EURO 4	170,22 g/vkm
Fiat doblò 1.4 Active	Gasoline	EURO 4	170,22 g/vkm
AverageCO2 emissions produced by the fleet (g/vkm)			170,22 g/vkm

Tab.A2.17: Average CO2 emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Ministry methodology:

Type of car	Fuel	CO2 emissions (g/vkm)
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	119
Fiat 500 1.2 Pop	Gasoline	119
Fiat 500 1.2 Pop	Gasoline	119
Fiat doblò 1.4 Actual	Gasoline	174
Average CO2 emissions produced by the fleet (g/vkm)		**126,50**

Tremove methodology:

Type of car	Fuel	Labeling (Euro)	CO2 emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	170,22
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	170,22
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	160,1
Fiat 500 1.2 Pop	Gasoline	EURO 5	160,1

Fiat 500 1.2 Pop	Gasoline	EURO 5	160,1
Fiat doblò 1.4 Actual	Gasoline	EURO 4	170,22
AverageCO2 emissions produced by the fleet (g/vkm)			165,16

Tab.A2.18-19: Average CO2 emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Ministry methodology:

Type of car	Fuel	CO2 emissions (g/vkm)
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Panda 1.2 Dynamic N.P.	Methan gas/Gasoline	114
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	119
Fiat 500 1.2 Pop	Gasoline	119
Fiat 500 1.2 Pop	Gasoline	119
Fiat doblò 1.4 Actual	Gasoline	174
Average CO2 emissions produced by the fleet (g/vkm)		**126,50**

Tremove methodology:

Type of car	Fuel	Labeling (Euro)	CO2 emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	170,22
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	170,22
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	160,1
Fiat 500 1.2 Pop	Gasoline	EURO 5	160,1
Fiat 500 1.2 Pop	Gasoline	EURO 5	160,1
Fiat doblò 1.4 Actual	Gasoline	EURO 4	170,22
AverageCO2 emissions produced by the fleet (g/vkm)			165,16

Tab.A2.20-21: Average CO2 emissions produced by the fleet (g/vkm)

- **Indicator 7 (CO emissions/ per type of trip)** – This indicator is defined as the annual average CO emission per vehicles-km by vehicle and fuel types. For each type of vehicle is considered the CO emissions.

Using the COPERT methodology, the following table is to be considered to calculate the emission factor for passenger cars for each kind of vehicle:

Measure title: **Car Sharing in Brescia**

City: **BRESCIA** *Project:* **MODERN** *Measure number:* **06.05**

Emission factors for passenger cars

Source : COPERT IV

Type	Technology	CO	NMVOC	NOx	N2O	NH3	Pb	PM2.5
Units	g/km	g/km	g/km	g/km	g/km	g/km		g/km
Notes		Given as THC-CH4	Given as NO2 equivalent					
Gasoline <1.4 l	PRE ECE	39.2	3.65	1.89	0.010	0.0025	1.33E-06	0.0024
Gasoline <1.4 l	ECE 15/00-01	30.5	3.05	1.89	0.010	0.0025	1.14E-06	0.0024
Gasoline <1.4 l	ECE 15/02	22.8	2.94	2.06	0.010	0.0025	1.09E-06	0.0024
Gasoline <1.4 l	ECE 15/03	23.2	2.94	2.23	0.010	0.0025	1.09E-06	0.0024
Gasoline <1.4 l	ECE 15/04	13.6	2.51	2.02	0.010	0.0025	9.71E-07	0.0024
Gasoline <1.4 l	Open Loop	11.9	2.22	1.49	0.010	0.0025	1.04E-06	0.0024
Gasoline <1.4 l	PC Euro 1 -91/441/EEC	4.23	0.564	0.441	0.023	0.0731	9.37E-07	0.0024
Gasoline <1.4 l	PC Euro 2 -94/12/EEC	2.39	0.301	0.242	0.012	0.0958	9.28E-07	0.0024
Gasoline <1.4 l	PC Euro 3 -98/69/EC I	2.14	0.169	0.098	0.005	0.0276	9.50E-07	0.0011
Gasoline <1.4 l	PC Euro 4 -98/69/EC II	0.710	0.123	0.062	0.005	0.0276	9.95E-07	0.0011
Gasoline 1.4 - 2.0 l	PRE ECE	39.2	3.80	2.47	0.010	0.0025	1.60E-06	0.0024
Gasoline 1.4 - 2.0 l	ECE 15/00-01	30.5	3.19	2.47	0.010	0.0025	1.34E-06	0.0024
Gasoline 1.4 - 2.0 l	ECE 15/02	22.8	3.081	2.33	0.010	0.0025	1.28E-06	0.0024
Gasoline 1.4 - 2.0 l	ECE 15/03	23.2	3.08	2.43	0.010	0.0025	1.28E-06	0.0024
Gasoline 1.4 - 2.0 l	ECE 15/04	13.8	2.66	2.58	0.010	0.0025	1.14E-06	0.0024
Gasoline 1.4 - 2.0 l	Open Loop	6.68	1.73	1.26	0.010	0.0025	1.25E-06	0.0024
Gasoline 1.4 - 2.0 l	PC Euro 1 -91/441/EEC	3.93	0.645	0.441	0.023	0.0731	1.12E-06	0.0024
Gasoline 1.4 - 2.0 l	PC Euro 2 -94/12/EEC	2.18	0.349	0.243	0.012	0.0958	1.09E-06	0.0024
Gasoline 1.4 - 2.0 l	PC Euro 3 -98/69/EC I	1.96	0.193	0.098	0.005	0.0276	1.14E-06	0.0011
Gasoline 1.4 - 2.0 l	PC Euro 4 -98/69/EC II	0.658	0.136	0.062	0.005	0.0276	1.17E-06	0.0011
Gasoline >2.0 l	PRE ECE	39.2	4.01	3.70	0.010	0.0025	1.94E-06	0.0024
Gasoline >2.0 l	ECE 15/00-01	30.5	3.41	3.70	0.010	0.0025	1.50E-06	0.0024
Gasoline >2.0 l	ECE 15/02	22.8	3.30	2.62	0.010	0.0025	1.58E-06	0.0024
Gasoline >2.0 l	ECE 15/03	23.2	3.30	3.44	0.010	0.0025	1.58E-06	0.0024

Emission factors for passenger cars

Source : COPERT IV

Type	Technology	CO	NMVOC	NOx	N2O	NH3	Pb	PM2.5
Units	g/km	g/km	g/km	g/km	g/km	g/km		g/km
Notes		Given as THC-CH4	Given as NO2 equivalent					
Gasoline >2.0 l	ECE 15/04	13.8	3.51	2.80	0.010	0.0025	1.44E-06	0.0024
Gasoline >2.0 l	PC Euro 1 -91/441/EEC	3.33	0.520	0.419	0.023	0.0731	1.43E-06	0.0024
Gasoline >2.0 l	PC Euro 2 -94/12/EEC	1.74	0.273	0.226	0.012	0.0958	1.49E-06	0.0024
Gasoline >2.0 l	PC Euro 3 -98/69/EC I	1.58	0.157	0.091	0.005	0.0276	1.35E-06	0.0011
Gasoline >2.0 l	PC Euro 4 -98/69/EC II	0.549	0.116	0.058	0.005	0.0276	1.59E-06	0.0011
Diesel <2.0 l	Conventional	0.713	0.162	0.561	0.000	0.0012	2.04E-06	0.246
Diesel <2.0 l	PC Euro 1 -91/441/EEC	0.449	0.051	0.691	0.003	0.0012	1.77E-06	0.0877
Diesel <2.0 l	PC Euro 2 -94/12/EEC	0.333	0.036	0.726	0.006	0.0012	1.85E-06	0.0594
Diesel <2.0 l	PC Euro 3 -98/69/EC I	0.097	0.020	0.780	0.010	0.0012	1.74E-06	0.0412
Diesel <2.0 l	PC Euro 4 -98/69/EC II	0.097	0.016	0.601	0.010	0.0012	1.74E-06	0.0342
Diesel >2.0 l	Conventional	0.713	0.162	0.890	0.000	0.0012	2.04E-06	0.246
Diesel >2.0 l	PC Euro 1 -91/441/EEC	0.449	0.077	0.691	0.003	0.0012	2.39E-06	0.0877
Diesel >2.0 l	PC Euro 2 -94/12/EEC	0.333	0.110	0.726	0.006	0.0012	2.39E-06	0.0594
Diesel >2.0 l	PC Euro 3 -98/69/EC I	0.097	0.019	0.780	0.010	0.0012	2.39E-06	0.0412
Diesel >2.0 l	PC Euro 4 -98/69/EC II	0.097	0.016	0.601	0.010	0.0012	2.39E-06	0.0342
LPG	Conventional	6.75	1.10	2.31	0.000	0.0100	n.a.	n.a.
LPG	PC Euro 1 -91/441/EEC	3.80	0.771	0.444	0.024	0.0230	n.a.	n.a.
LPG	PC Euro 2 -94/12/EEC	2.65	0.369	0.199	0.013	0.0120	n.a.	n.a.
LPG	PC Euro 3 -98/69/EC I	2.22	0.206	0.115	0.005	0.0050	n.a.	n.a.
LPG	PC Euro 4 -98/69/EC II	1.04	0.100	0.063	0.005	0.0050	n.a.	n.a.
2-Stroke	Conventional	13.1	10.0	0.642	0.008	0.0019	n.a.	n.a.
Hybrid Gas 1.4-2.0 l	PC Euro 4 -98/69/EC II	0.001	0.021	0.009	0.005	0.0276	n.a.	n.a.

Tab.A2.22: Emission factors for passenger cars

According to the table above, the CO average emissions produced by the fleet (hypothized in the business plan) are reported below:

Type of car	Fuel	Labeling (Euro)	CO emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 4	0,71
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	EURO 4	0,658
Fiat 500 1.2 Pop	Gasoline	EURO 4	13,6
Fiat 500 1.2 Pop	Gasoline	EURO 4	13,6
Fiat doblò 1.4 Actual	Gasoline	EURO 4	13,8
Fiat doblò 1.4 Active	Gasoline	EURO 4	13,8
AverageCO emissions produced by the fleet (g/vkm)			**7,2 g/vkm**

Tab.A2.23: Average CO emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Type of car	Fuel	Labeling (Euro)	CO emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,71
Fiat 500 1.2 Pop	Gasoline	EURO 5	13,6
Fiat 500 1.2 Pop	Gasoline	EURO 5	13,6
Fiat doblò 1.4 Actual	Gasoline	EURO 4	13,8
AverageCO emissions produced by the fleet (g/vkm)			**7,19**

Tab.A2.24: Average CO emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Type of car	Fuel	Labeling (Euro)	CO emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,71
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,71
Fiat 500 1.2 Pop	Gasoline	EURO 5	13,6
Fiat 500 1.2 Pop	Gasoline	EURO 5	13,6
Fiat doblò 1.4 Actual	Gasoline	EURO 4	13,8
AverageCO emissions produced by the fleet (g/vkm)			**7,19**

Tab.A2.25: Average CO emissions produced by the fleet (g/vkm)

- **Indicator 8 (NOx emissions/ per type of trip) –** For each type of vehicle is considered the NOx emissions.

Using the COPERT methodology, the following table is to be considered to calculate the NOx emissions for passenger cars for each kind of vehicle:

Type of car	Fuel	Labeling (Euro)	NOx emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 4	0,062
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	EURO 4	0,062
Fiat 500 1.2 Pop	Gasoline	EURO 4	2,02
Fiat 500 1.2 Pop	Gasoline	EURO 4	2,02
Fiat doblò 1.4 Actual	Gasoline	EURO 4	2,58
Fiat doblò 1.4 Active	Gasoline	EURO 4	2,58
Average NOx emissions produced by the fleet (g/vkm)			**1,2 g/vkm**

Tab.A2.26: Average NOx emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Type of car	Fuel	Labeling (Euro)	NOx emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,062
Fiat 500 1.2 Pop	Gasoline	EURO 5	2,02
Fiat 500 1.2 Pop	Gasoline	EURO 5	2,02
Fiat doblò 1.4 Actual	Gasoline	EURO 4	2,58
Average NOx emissions produced by the fleet (g/vkm)			**1,13**

Tab.A2.27: Average NOx emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Type of car	Fuel	Labeling (Euro)	NOx emissions (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,062
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,062
Fiat 500 1.2 Pop	Gasoline	EURO 5	2,02
Fiat 500 1.2 Pop	Gasoline	EURO 5	2,02
Fiat doblò 1.4 Actual	Gasoline	EURO 4	2,58

Average NOx emissions produced by the fleet (g/vkm)	**1,13**

Tab.A2.28: Average NOx emissions produced by the fleet (g/vkm)

- **Indicator 9 (Small particulate emissions/ per type of trip)** – For each type of vehicle is considered the PM2.5 emissions.

  Using the COPERT methodology, the following table is to be considered to calculate the Particulate concentrations for passenger cars for each kind of vehicle:

Type of car	Fuel	Labeling (Euro)	Particulate concentrations (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 4	0,0011
Opel Zafira 1.6 16v ecoM	Methan gas/Gasoline	EURO 4	0,0011
Fiat 500 1.2 Pop	Gasoline	EURO 4	0,0024
Fiat 500 1.2 Pop	Gasoline	EURO 4	0,0024
Fiat doblò 1.4 Actual	Gasoline	EURO 4	0,0024
Fiat doblò 1.4 Active	Gasoline	EURO 4	0,0024
Average Particulate concentrations produced by the fleet (g/vkm)			**0,0018 g/vkm**

Tab.A2.29: Average particulate concentrations emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2010 – March 2011:

Type of car	Fuel	Labeling (Euro)	Particulate concentrations (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,0011
Fiat 500 1.2 Pop	Gasoline	EURO 5	0,0024
Fiat 500 1.2 Pop	Gasoline	EURO 5	0,0024
Fiat doblò 1.4 Active	Gasoline	EURO 4	0,0024
Average Particulate concentrations produced by the fleet (g/vkm)			**0,0018**

Tab.A2.30: Average particulate concentrations emissions produced by the fleet (g/vkm)

AFTER DATA COLLECTION referred to the period March 2011 – March 2012:

Type of car	Fuel	Labeling (Euro)	Particulate concentrations (g/vkm)
Fiat Panda 1.2 ynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Panda 1.2Dynamic N.P.	Methan gas/Gasoline	EURO 4	0,0011
Fiat Punto classic 1.2 N.P.	Methan gas/Gasoline	EURO 5	0,0011
Fiat 500 1.2 Pop	Gasoline	EURO 5	0,0024
Fiat 500 1.2 Pop	Gasoline	EURO 5	0,0024
Fiat doblò 1.4 Active	Gasoline	EURO 4	0,0024
Average Particulate concentrations produced by the fleet (g/vkm)			**0,0018**

Tab.A2.31: Average particulate concentrations emissions produced by the fleet (g/vkm)

- **Indicator 10 (Quality of the service)** – This indicator is defined as the user's perception of the overall quality of the service provided and is collected through a specific survey among the CS users.

FIRST DATA COLLECTION (JUNE 2011)

Data to be collected for this indicator can derive both from a survey lead in internet open to everyone (on the Car Sharing dedicated web site) and newsletter sent to the subscribers. The survey was lead in June 2011 (the first newsletter was sent on 1st June and a second one on 24th June). Notwithstanding the involvement of people, only 10 of the 30 CS users (18% of the total number of subscribers) answered the questionnaire. The specific question able to monitor the quality of service is "How do you rate the quality of car sharing service"? The perception of the service quality has been measured on a five-point scale, such as: Excellent, Very good, Good, Sufficient, Mediocre. The obtained results are the following:

Rating	%
Excellent	22
Very good	67
Good	11
Sufficient	0
Mediocre	0
Not Answered	0
TOTAL	100

Tab.A2.32: The perception of the service quality

SECOND DATA COLLECTION (APRIL 2012)

Data to be collected for this indicator can derive both from a survey lead in internet open to everyone (on the Car Sharing dedicated web site). The survey was lead in April 2012, only 18 of the 287 CS users answered the questionnaire. The specific question able to monitor the quality of service is "How do you rate the quality of car sharing service"? The perception of the service quality has been

measured on a five-point scale, such as: Excellent, Very good, Good, Sufficient, Mediocre. The obtained results are the following:

Rating	**%**
Excellent	16,7
Very good	55,5
Good	27,8
Sufficient	0
Mediocre	0
Not Answered	0
TOTAL	100

Tab.A2.33: The perception of the service quality

- **Indicator 11 (Average Modal Split - trips) –** The "modal split" has to be intended as the percentage of how systematic movements (Home-work and home-school) take place inside Brescia and from outside. Using data coming from ISTAT/SISTAN census referred to 1991-2001, the modal split for the city of Brescia has been settled.

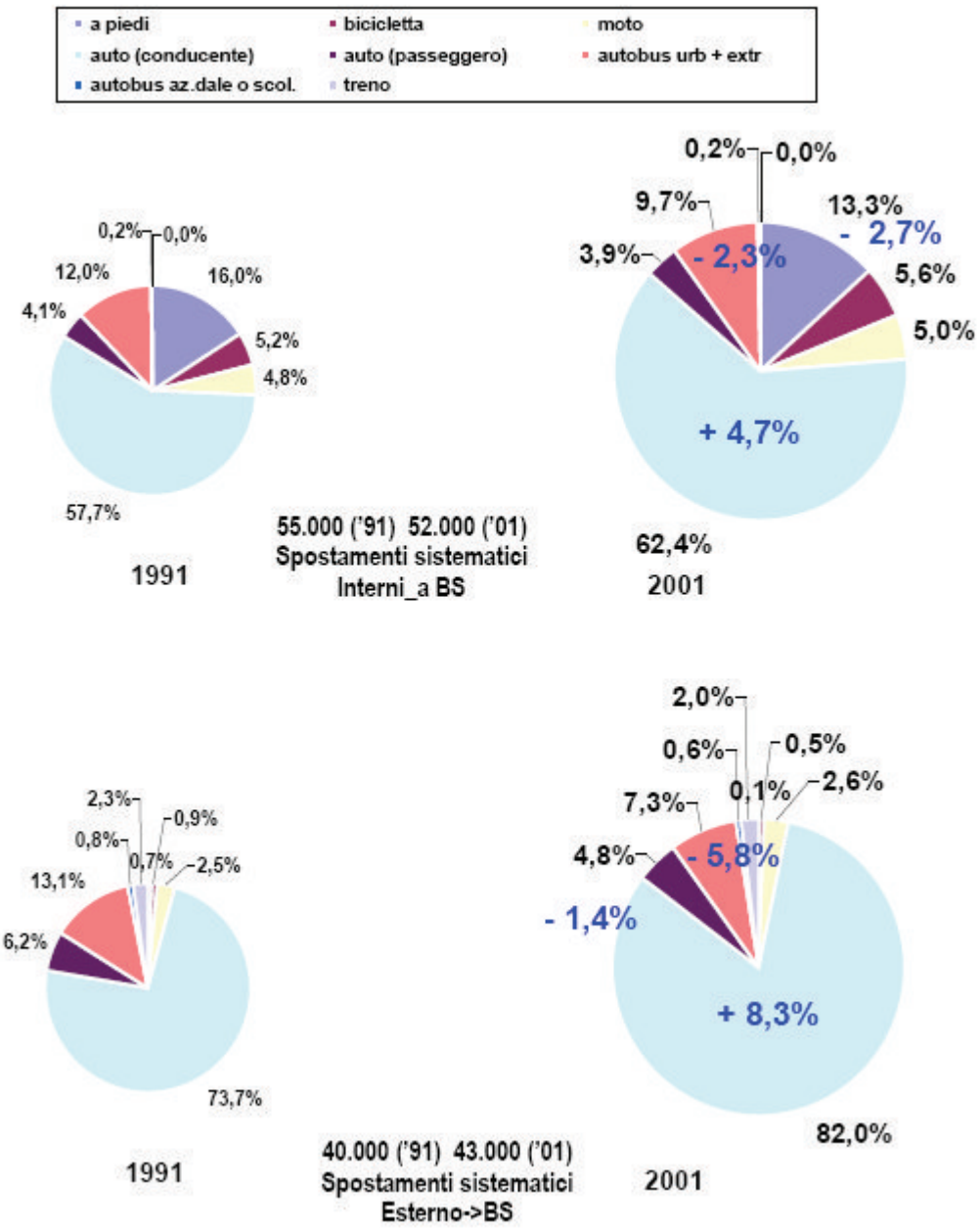


Fig.A2.1: Modal split referred to the home-work systematic movements internal and external to Brescia

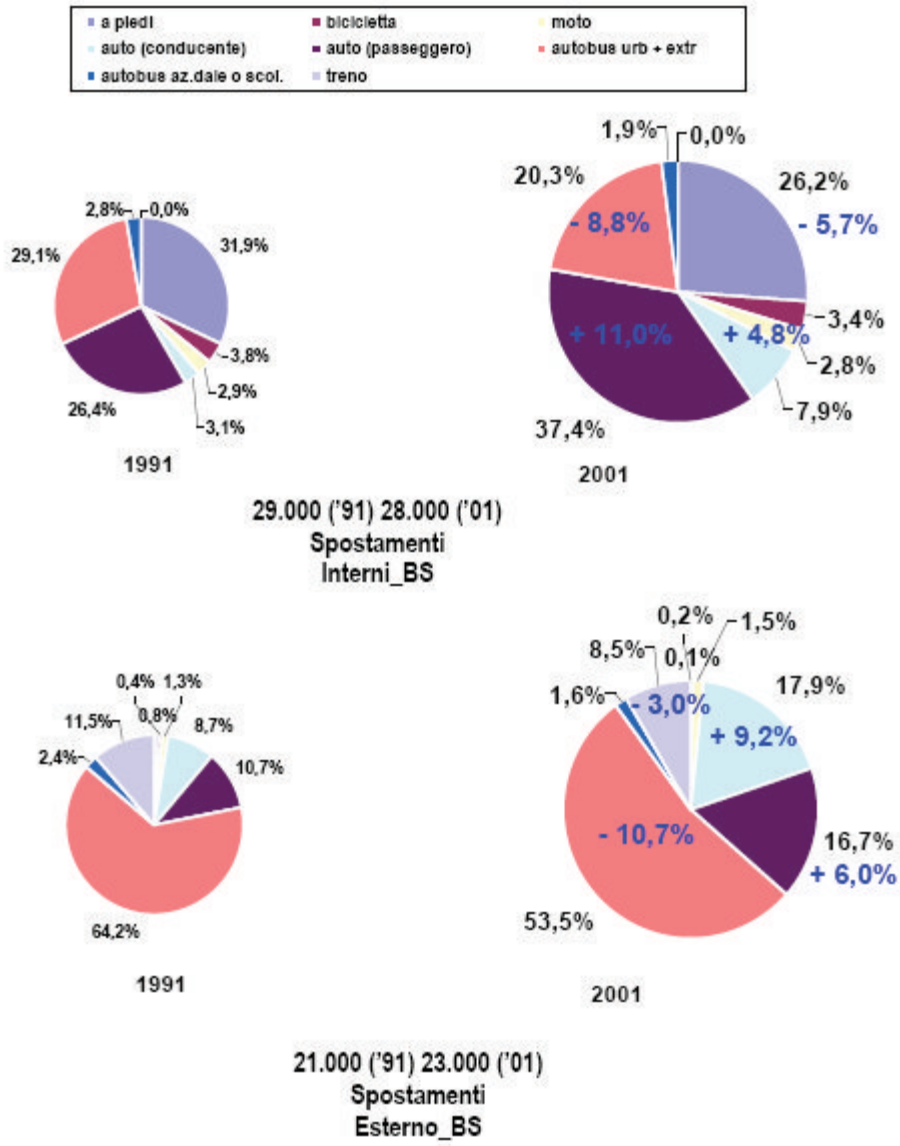


Fig.A2.2: Modal split referred to the home-school systematic movements internal and external to Brescia

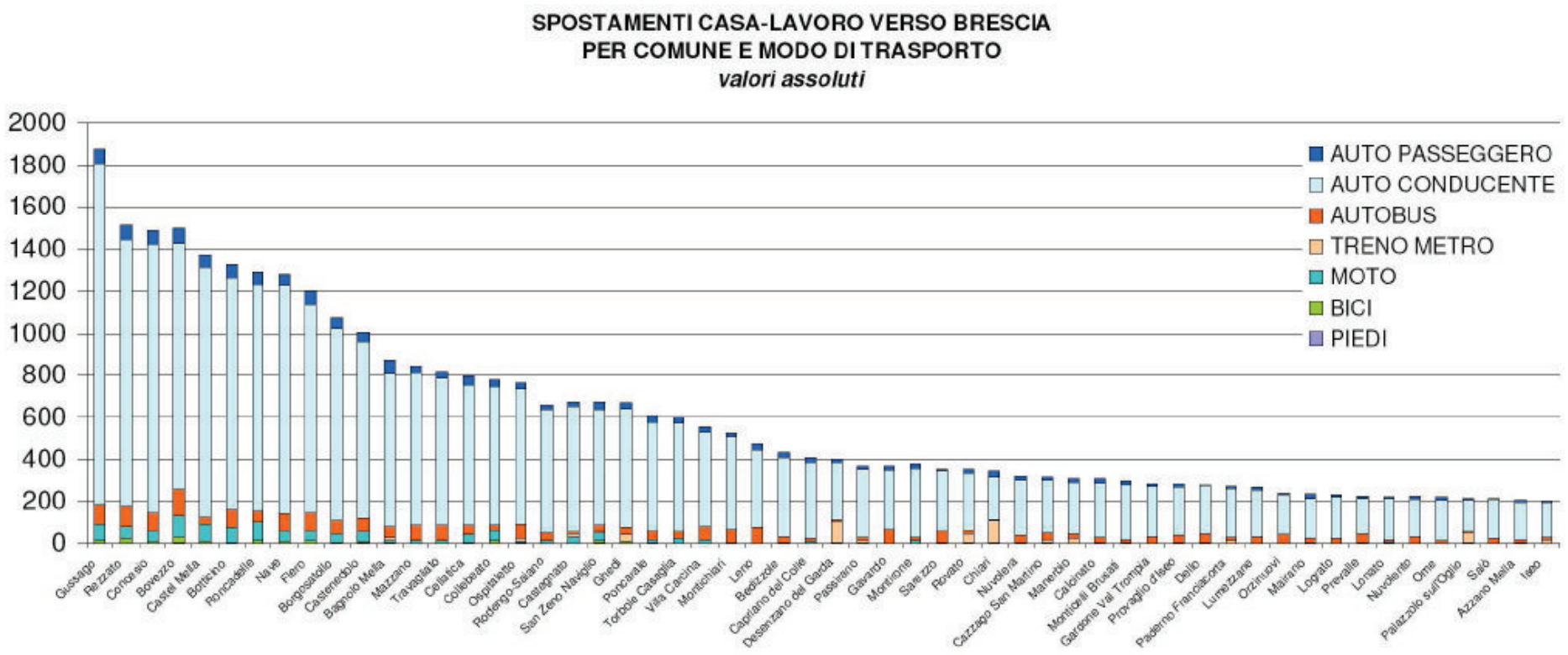


Fig.A2.3: Modal split referred to the home-work systematic movements external to Brescia by municipalities – absolute values

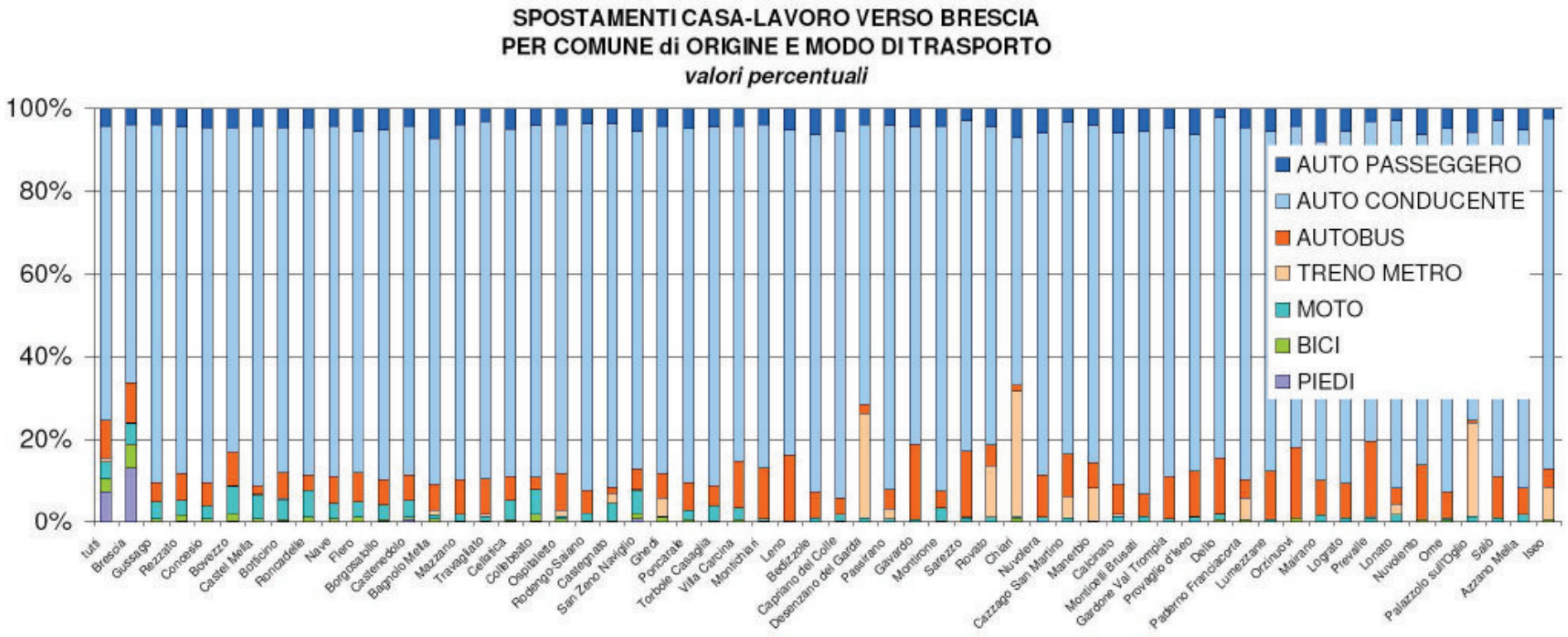


Fig.A2.4: Modal split referred to the home-work systematic movements internal and external to Brescia - percentages

Summarizing data presented above, the following average modal split has been set:

On foot **9,9 %**
Bicycle **2,4 %**
PTW **3,0 %**
Car **58,3 %**
Bus **23,8 %**
Train **2,6 %**

As regards data collection frequency, the same anlysis will be undertaken in occasion of the next Istat census (2011). The official publication of results implies long and hard-working elaborations. Consequently we're not sure to obtain the necessary official information in time, i.e. within the end of CIVITAS, foreseen in 2012. In that case, an estimation based on the traffic flows, on PT and on Bike/Car sharing trends (Istat draft versione of the results) could be made.

- **Indicator 12 (Vehicle Occupancy)** – This indicator considers the average people on board and is collected through a specific survey among the CS users. For this indicator the Ex ante data collection is not scheduled. Anyway, the first data collection can be scheduled on June 2011, and the ex post situation can be calculate in June 2012 and it is referred to data provided by the service operator.

AFTER SITUATION - FIRST DATA COLLECTION (JUNE 2011)

Data to be collected for this indicator can derive both from a survey lead in internet open to everyone (on the Car Sharing dedicated web site) and newsletter sent to the subscribers. The survey was lead in June 2011 (the first newsletter was sent on 1st June and a second one on 24th June). Notwithstanding the involvement of people, only 10 of the 30 CS users (18% of the total number of subscribers) answered the questionnaire. The specific question able to monitor the vehicles occupancy is "How many people usually travel with you"? The possible answers were: I travel alone, 2 people besides me, 3 people besides me, 4 people besides me. The obtained results are the following:

Answers	**%**
I travel alone	0
2 people besides me	11
3 people besides me	0
4 people besides me	0
Not Answered	89
TOTAL	100

Tab.A2.34: Vehicle Occupancy

AFTER SITUATION - FIRST DATA COLLECTION (APRIL 2012)

Data to be collected for this indicator can derive both from a survey lead in internet open to everyone (on the Car Sharing dedicated web site). The survey was lead in April 2012, only 18 of the 287 CS users answered the questionnaire. The specific question able to monitor the vehicles occupancy is "How many people usually travel with you"? The possible answers were: I travel alone, 2 people besides me, 3 people besides me, 4 people besides me. The obtained results are the following:

Answers	**%**
I travel alone	16,7
2 people besides me	22,2
3 people besides me	0
4 people besides me	0
Not Answered	61,1
TOTAL	100

Tab.A2.35: Vehicle Occupancy

- **Indicator 13 (Awareness Level)** – Some questions about car sharing have been inserted in the questionnaires elaborated for the measures 05.02 and 05.03. The target area is extended to the whole urban area of Brescia. The representative sample is to be chosen among the resident population. The sample size is of about 600 families, to be selected among the personal data of the Municipality (this allows a statistical significance of more than the 90%). The method used for questionnaires collection initially scheduled (in Evaluation plan) has been slightly modified: besides the face to face interviews, as the survey based on face to face interviews required more time than the scheduled, to collect a significant ex-ante before the implementation of the measure, a faster procedure that slightly differs from the initial one scheduled has been choosen: the questionnaires have been administered by phone. The sample size characteristics are the same described above. The company's duty is to administer the questionnaires by phone, to collect them, to enter data in a database and to elaborate the results.

EX ANTE SITUATION (March 2010)

Results elaboration: To reach the goal of 600 filled in questionnaires, the company contacted 787 families. Only 220 of them answered to the phone calls but thanks to the fact that families are generally composed by more than one members, has been collected totally **601 filled in questionnaires**. The questionnaires has been administered **from 5th February to 3rd March 2010**.

Do you know that in Brescia a Car Sharing service will be implemented?	
NO	619 (89%)
YES	74 (11%)
TOTAL	693 (100%)

Tab.A2.36: Awareness level

AFTER SITUATION (April 2011)

Do you know that a Car Sharing service has been implemented in Brescia?	
NO	562 (89%)
YES	69 (11%)
TOTAL	631 (100%)

Tab.A2.37: Awareness level

AFTER SITUATION (April 2012)

Do you know that a Car Sharing service has been implemented in Brescia?	
NO	69 (71%)
YES	28 (29%)
TOTAL	97 (100%)

Tab.A2.38: Awareness level

- **Indicator 14 (Acceptance Level) -** see description indicator 13.

EX ANTE SITUATION (March 2010)

According to your mobility needs, would you be interested into this service?	
NO	631 (91%)
YES	62 (9%)
Total	693 (100%)

Tab.A2.39: Acceptance level

AFTER SITUATION (April 2011)

According to your mobility needs, would you be interested into this service?	
NO	549 (87%)
YES	82 (13%)
Total	631 (100%)

Tab.A2.40: Acceptance level

AFTER SITUATION (April 2012)

According to your mobility needs, would you be interested into this service?	
NO	554 (84%)
YES	103 (16%)
Total	657 (100%)

Tab.A2.41: Acceptance level

Annex 3: Cost Benefit Analysis

Evaluation period for CBA

- Defining reference case for CBA

  CBA has been carried out comparing the hypothetic situation without the car sharing service (reference case or Business-as-Usual scenario) with the effective present situation, including the implementation of the Car Sharing Civitas Measure (Car Sharing scenario).

- Defining lifetime of the measure

  The reference year is 2010, in which a private Company, charged by the Municipality of Brescia, implements and managers the car sharing service inside the town. The whole period, taken into consideration by CBA to have a financing return, is 15 years (final CBA year: 2025).

- Discount rate

  The average yearly interest rate estimated in the 15 years period of CBA (2010-2025) is 3,5%.

Method and values for modification

The Measure (introduction of the car sharing service), using last generation new cars with lower consumptions/emissions, allows to reduce fuel and pollution than old private cars assumed to be used in the B.A.U. scenario. Fuel reduction has been included in the economic benefits as operating cost saving at collective level, because it contributes towards the "expenses reduction" of imported goods from foreign countries.

From the carried out monitoring activity, the total kms run with car sharing measure are 16.022 km (year 2010) and 44.142 (year 2011). The yearly increasing rate of the kms run by car sharing service should equal 28,8%, in order to re-pay the investment costs (Municipality financing) in 15 years (NPV at 2025>0). Adopting this yearly increase, the total kms run by car sharing in 15 years should be 1.526.420 kms.

- Description of how the impacts are monetised

  Fuel saving revenues: the average fuel consumption, referred to a car with medium cubic capacity that runs in urban network, is estimated 11 km/l; the fuel cost adopted by CBA is 0,6 € (economic cost excluding taxes and referred to year 2010).

  Emissions costs:

  The emission quantities of the main environmental polluting agents are shown in Table 2.6.2.a for the different car types with medium cubic capacity (runs in urban network): grams/km of carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM) and carbon dioxide (CO2).

	GASOLINE CAR				GASOIL CAR				CAR SHARING
EMISSION FACTOR	EURO1	EURO2	EURO3	EURO4	EURO1	EURO2	EURO3	EURO4	(average)
CO emission factor (g/km)	10,52	8,52	8,96	3,90	1,00	0,37	0,26	0,19	0,10
NOx emission factor (g/km)	0,59	0,31	0,21	0,11	1,21	0,87	0,76	0,44	0,08
PM emission factor (g/km)	-	-	-	-	0,13	0,09	0,05	0,03	-
CO2 emission factor (g/km)	385,90	385,90	385,90	347,30	276,50	276,50	276,50	248,90	165,00

Tab.A3.1: Polluting emission factors of the different car types (source: Euro normative)

The percentage of the different car types usually running in Brescia town in 2010 without car sharing service is shown in the following Table 2.6.2.b:

GASOLINE CAR				GASOIL CAR			
EURO1	EURO2	EURO3	EURO4	EURO1	EURO2	EURO3	EURO4
4%	17%	12%	21%	1%	6%	16%	23%

Tab.A3.2: Car distribution in Brescia province in 2010 (source: ACI)

The money return of the environmental benefits has been carried out basing on EU data; in particular the figures (total external costs in urban zone) referred to the main polluting agents (CO, NOx, PM and CO2) taken into consideration in the CBA, are shown in Table A3.3.c and are referred to €2010.

EMISSION TYPE	ESTERNAL COST (€2010/kg)
CO emission (*)	0,004
NOx emission (**)	3,755
PM emission (**)	434,164
CO2 emission (**)	0,110

Tab.A3.3: Money return of the main polluting agents (€2010/Kg)

Source: (*) Astra – Scenario Low External Cost - 2005

(**) HEATCO, D5 Proposal for harmonised Guidelines – Brussels, 2006

- References of values used
  - ACI statistics (2010)
  - Astra – Scenario Low External Cost - 2005
  - HEATCO, D5 Proposal for harmonised Guidelines – Brussels, 2006

Life time cost and benefit

	Cases for comparison	Cost (e.g. €200,000)
Year 0 (2010)	Car Sharing measure	€ 60,000
	Reference case (or BAU)	-
Year 1 (2011)	Car Sharing measure	€ 70,000
	Reference case (or BAU)	-
Year 2 (2012)	Car Sharing measure	€ 64,000
	Reference case (or BAU)	-

Tab.A3.4: Capital cost in the evaluation period (not discounted)

	Cases for comparison	Values (e.g. €200,000)
Year 0	Car Sharing measure	€ 643
	Reference case (or BAU)	€ 877
Year 1	Car Sharing measure	€ 1,772
	Reference case (or BAU)	€ 2,416
Year 2	Car Sharing measure	€ 2,282
	Reference case (or BAU)	€ 3,112
Year 3	Car Sharing measure	€ 2,939
	Reference case (or BAU)	€ 4,008
Year 4	Car Sharing measure	€ 3,785
	Reference case (or BAU)	€ 5,162
Year 5	Car Sharing measure	€ 4,876
	Reference case (or BAU)	€ 6,648
Year 6	Car Sharing measure	€ 6,280
	Reference case (or BAU)	€ 8,563
Year 7	Car Sharing measure	€ 8,088
	Reference case (or BAU)	€ 11,029
Year 8	Car Sharing measure	€ 10,418
	Reference case (or BAU)	€ 14,206
Year 9	Car Sharing measure	€ 13,418
	Reference case (or BAU)	€ 18,297
Year 10	Car Sharing measure	€ 17,282

	Reference case (or BAU)	€ 23,567
Year 11	Car Sharing measure	€ 22,260
	Reference case (or BAU)	€ 30,354
Year 12	Car Sharing measure	€ 28,670
	Reference case (or BAU)	€ 39,096
Year 13	Car Sharing measure	€ 36,927
	Reference case (or BAU)	€ 50,355
Year 14	Car Sharing measure	€ 47,562
	Reference case (or BAU)	€ 64,858
Year 15	Car Sharing measure	€ 61,260
	Reference case (or BAU)	€ 83,537

Tab.A3.5: Operation cost/savings from fuel reductions in the evaluation period (not discounted)

	Cases for comparison	Values (e.g. €200,000)
Year 0	Car Sharing measure	€ 297
	Reference case (or BAU)	€ 734
Year 1	Car Sharing measure	€ 817
	Reference case (or BAU)	€ 2,021
Year 2	Car Sharing measure	€ 1,053
	Reference case (or BAU)	€ 2,603
Year 3	Car Sharing measure	€ 1,356
	Reference case (or BAU)	€ 3,353
Year 4	Car Sharing measure	€ 1,747
	Reference case (or BAU)	€ 4,318
Year 5	Car Sharing measure	€ 2,250
	Reference case (or BAU)	€ 5,562
Year 6	Car Sharing measure	€ 2,898
	Reference case (or BAU)	€ 7,164
Year 7	Car Sharing measure	€ 3,732
	Reference case (or BAU)	€ 9,227
Year 8	Car Sharing measure	€ 4,807
	Reference case (or BAU)	€ 11,885
Year 9	Car Sharing measure	€ 6,191

	Reference case (or BAU)	€ 15,308
Year 10	Car Sharing measure	€ 7,974
	Reference case (or BAU)	€ 19,716
Year 11	Car Sharing measure	€ 10,271
	Reference case (or BAU)	€ 25,395
Year 12	Car Sharing measure	€ 13,229
	Reference case (or BAU)	€ 32,708
Year 13	Car Sharing measure	€ 17,039
	Reference case (or BAU)	€ 42,128
Year 14	Car Sharing measure	€ 21,946
	Reference case (or BAU)	€ 54,261
Year 15	Car Sharing measure	€ 28,266
	Reference case (or BAU)	€ 69,889

Tab.A3.6: Savings from reductions of environmental emissions (not discounted)

Measure title: Mobility Management Actions in Brescia

City: Brescia *Project:* Modern *Measure number:* 06.05

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Reference Measure - Business as Usual: traditional transport without car sharing service implementation																
Investment costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel costs	877	2.416	3.112	4.008	5.162	6.648	8.563	11.029	14.206	18.297	23.567	30.354	39.096	50.355	64.858	83.537
Emissions costs	734	2.021	2.603	3.353	4.318	5.562	7.164	9.227	11.885	15.308	19.716	25.395	32.708	42.128	54.261	69.889
Civitas Measure: with implementation of car sharing service																
Investment costs (1)	60.000	70.000	64.000	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel costs	643	1.772	2.282	2.939	3.785	4.876	6.280	8.088	10.418	13.418	17.282	22.260	28.670	36.927	47.562	61.260
Emissions costs	297	817	1.053	1.356	1.747	2.250	2.898	3.732	4.807	6.191	7.974	10.271	13.229	17.039	21.946	28.266
Civitas Measure vs Reference Measure																
Investment costs (1)	- 60.000	- 70.000	- 64.000	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel saving revenues (2)	234	644	830	1.069	1.376	1.773	2.284	2.941	3.788	4.879	6.284	8.094	10.426	13.428	17.295	22.276
Emissions cost saving (3)	437	1.204	1.550	1.997	2.572	3.313	4.267	5.495	7.078	9.117	11.742	15.124	19.479	25.090	32.315	41.622
TOTAL	- 59.329	- 68.152	- 61.620	3.066	3.948	5.085	6.550	8.437	10.866	13.996	18.027	23.218	29.905	38.518	49.611	63.899
OVERALL TOTAL	- 59.329	- 127.481	- 189.101	- 186.036	- 182.088	- 177.002	- 170.452	- 162.015	- 151.149	- 137.153	- 119.127	- 95.909	- 66.003	- 27.486	22.125	86.024
TOTAL BENEFIT	671	1.848	2.380	3.066	3.948	5.085	6.550	8.437	10.866	13.996	18.027	23.218	29.905	38.518	49.611	63.899
TOTAL COST	60.000	70.000	64.000	-	-	-	-	-	-	-	-	-	-	-	-	-
INTEREST RATE	3,5%															
NET PRESENT VALUE	- 57.323	- 120.944	- 176.521	- 173.850	- 170.526	- 166.389	- 161.240	- 154.833	- 146.860	- 136.939	- 124.591	- 109.226	- 90.105	- 66.309	- 36.697	154
BENEFITS/COSTS RATIO	0,01	0,02	0,03	0,04	0,06	0,09	0,12	0,16	0,22	0,29	0,39	0,51	0,66	0,86	1,11	1,44
I.R.R.												-8,7%	-4,9%	-1,7%	1,1%	3,5%

NOTES:
(1) Financing support by Brescia Municipality for car sharing implementation
(2) Fuel saving due to the lower consumption of the new cars used by car sharing service than old private cars used in B.a.U. (without car sharing service)
(3) Emissions saving due to new cars used by car sharing service than old private cars used in B.a.U. (without car sharing service)

Tab.A3.7: Lifetime cost/benefit of the reference measure/case and car sharing civitas measure (discounted)

Summary of CBA results

Table 2.6.5 shows the main results of CBA (net present value, benefits/costs ratio, investment rate return), referred to year 2025 (CBA period: 15 years).

COST/BENEFIT ANALYSIS	2025
TOTAL KM RUNNING (km)	1.526.420
INTEREST RATE	3,5%
NET PRESENT VALUE (€ 2010)	154
BENEFITS/COSTS RATIO	1,44
I.R.R.	3,5%

Tab.A3.8: CBA results between Car Sharing Civitas Measure and Refernce Measure/BaU (year 2025)

The investment cost by Brescia Municipality (194,000 €) to support the car sharing civitas measure is re-paid in 15 years, thanks emission and fuel saving, only if the total kms running by car sharing service are 1,526,420 kms.

This means that, the car sharing service, with the low starting (2010 and 2011 monitorings: 16,022 kms and 44,142 kms), should increase yearly in the next 15 years of 28,8%, in order to can monitor 1,526,420 kms at 2025 and reach the cumulative value of 6,673,219 kms in 15 years (2010-2025).

In fact, only with this use increasing, the Net Present Value and the Benefit/Costs Ratio become respectively up zero and up one in 15 years.

The Investment Return Rate at 2025 results 3,5%, practically equal to the estimated Interest Rate (3,5%).