Executive summary

The city of Monza, through TPM, Trasporti Pubblici Monzesi, partner in ARCHIMEDES project and former provider of Public Transport service in the city, has developed a study for the delivery of a hybrid bus. Exploiting outcomes of the study for the most suitable bus to Monza needs, it has been decided to test the VanHool in series hybrid bus, model A330Hyb in particular, through a leasing contract activated by NET, Nord Est Trasporti, which, in the meanwhile, has become the new Public Transport provider.

Unfortunately, Van Hool, which has scheduled the delivery of the bus by January 2011, communicated a delay in the procurement, so in replacement of this bus it was decided to test the IVECO Citelis Hybrid bus, which presented the same technical features. The bus was presented in May 2011 and, after a training period for drivers, it was put into operation on Line Z206, one of the most frequented lines in Monza, connecting the eastern area of the city, very densely populated, with the city centre, the hospital and the University.

After summer 2011, the hybrid bus presented major anomalies which caused too frequent stops of the bus and consequent repairs in workshop, being a prototype originally intended for the French market. For this reason, after NET complains, IVECO replaced the prototype bus with a second generation one, which, although presenting the same technical features, has now fully entered into the production chain, so it does no longer present the manufacturing defects shown by the prototype. The new bus started to be operational in May 2012, after completing all administrative accomplishments, and has been tested until December 2012, in order to test its performances both in summer and winter conditions.

Key result 1 - Hybrid bus reported higher mileage from 23% to 38% if compared with a traditionally diesel fuelled bus.

Key result 2 - Emissions connected to the use of diesel fuel were significantly reduced (since the hybrid bus uses less fuel), although particulate emissions increased due to the fact that no particulate filter was installed on the vehicle.

Key result 3 – Thanks to the press coverage and to the replacement of the first bus with a second generation one, awareness of people about the implementation of the measure, about technical features of the bus and the improvement of the quality of service has significantly increased.

Lessons learned

As a premise, it must be said that when ARCHIMEDES project was submitted, the demonstration stage of the measure was in charge to TPM, which managed PT in Monza as a company 100% owned by the Municipality. For these reasons, future choices about vehicles' procurement could be somehow addressed by Comune of Monza, as the sole shareholder of the society. After the merging of TPM with NET, the capacity of Comune of Monza to influence choices about future procurements of a private company, in no way connected to the decision-making dynamics of the Municipality, is virtually non-existent. For this reason, initial expectations of replacing the entire PT fleet with hybrid vehicles proved too optimistic if compared to the later evolution of design events.

The immaturity of hybrid technology has implied problems in the implementation of the measure, firstly as far as times of procurement were concerned, and secondly for the technological problems presented by the first bus delivered. While writing this report, the bus is circulating regularly and this reflects the fact that hybrid vehicles are now fully entered in the production chain.

Nevertheless, Monza experience has been very useful to understand problems which can arise when testing a new technology. First of all, it proved useful to consult different suppliers, since this allowed a quick decision to replace Van Hool bus when this could not be delivered in due time. For this reason, in case of a massive replacement of traditionally fuelled buses with hybrid vehicles, it will be important to verify the production capacity of the chosen supplier. Last but not least, trade press and web coverage have proved very useful in order to raise awareness about the implementation of the measure: in future, dissemination could push other cities, PT companies or even private companies to test hybrid technology, so exploiting Monza experience.

Measure title: **Hybrid Bus in Monza**

City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **7**

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A Introduction

A1.1 Objectives

The measure objectives are:

(A) High level / longer term:

- To make Public Urban Transport cleaner reducing emissions and human exposure to air pollution

(B) Strategic level:

- To gain best practice examples from other cities who have implemented a hybrid bus and to develop a technical specification for the delivery of a hybrid bus.

(C) Measure level:

(1) To reduce emissions value with respect to traditionally diesel fuelled buses in order to to reduce the environmental impact of Public Transport fleet in the City, especially for greenhouse gases (GHGs), and to have an awareness raising effect on other local fleet operators and individual citizens.

(2) To test performances of the hybrid bus, in order to verify if decisions about future procurements by Public Transport (PT) companies can shift towards hybrid technology.

A1.2 Target groups

- Owners of public transport Companies
- Users of public transport
- Citizens

A2 Description

This measure is focused on testing new technologies for a cleaner PT:

Task 11.1.6 Hybrid Bus Specification Study:

TPM has undertaken a study to gain best practice examples from other cities who have implemented hybrid buses (resulted in Deliverable R.7.1) and to develop a technical specification for the delivery of a hybrid bus that has been demonstrated in task 1.11. After examining all the different hybrid technologies, the Italian marketplace has been investigated in order to exploit the experience of other cities which have already tested hybrid vehicles. Many PT companies in Italy are moving towards cleaner vehicles and, in order to identify the most suitable vehicle to be tested in Monza, retailers operating with hybrid technology applied to PT vehicles have been consulted.

Task 1.11 Hybrid Bus

Comune of Monza, through NET as a subcontractor, has leased and operated one hybrid bus in Monza, with a battery pack powering electric motors according to the best available technology at the moment. At the beginning it has been decided to test a Van Hool vehicle, which seemed the most suitable bus to be procured according to the needs of the City of Monza and to the currently available

technology. Unfortunately, Van Hool communicated they would have been able to deliver the bus only in September/October 2011, which was too late to meet the ARCHIMEDES schedule. Therefore, in order to achieve the milestones scheduled for the measure, it was decided to investigate to go back to the marketplace and find another suitable hybrid bus to test as a replacement for the Van Hool bus: it was identified the IVECO Citelis Hybrid bus, which is the vehicle actually operating on Line Z206, one of the most used in Monza, since it connects the eastern area of the city, very densely populated, to the city centre, and to the Hospital and to the University.

A3 Person in charge for evaluation of this measure

Name of person	Simonetta Vittoria
Name of organisation	Comune of Monza
Direct telephone	0039 039 2832839
e-mail	mobilita@comune.monza.it

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **New conceptual approach -** The introduction of a hybrid bus in the Public Transport fleet will serve as a test to pave the way to the promotion of this alternative vehicle, in order to start investigating new technologies aimed at reducing the environmental impact of Public Transport fleets in the city.
- **Targeting specific user groups** – The promotion of the use of the hybrid bus beyond PT TPM fleet can be addressed to other Public Transport Companies; also PT users will be more motivated to use PT knowing the low environmental impact of new type of vehicles; in addition, all citizens could benefit from the the low environmental impact
- **New policy instrument –** In the last years Italian Government has been developing incentive measures favouring the purchase of ecological vehicles, and the introduction of hybrid buses could act as a showcase to stimulate the use of these alternative vehicles.
- **New organizational arrangements or relationships -** New agreements could be developed with firms producing hybrid vehicles in order to individuate the best available technology at the moment for introducing this innovative vehicle in Monza.

B2 Planning of Research and Technology Development Tasks

TPM has investigated actual market through contacts with hybrid bus suppliers but mostly with Italian Public Transport companies which have already implemented such a kind of alternatively fuelled bus, with the aim of undertaking a study to gain best practice examples from other cities similar to Monza in dimensions and traffic congestion typology, so to develop a technical specification for the delivery of a hybrid bus. Findings of the study have been transferred in Deliverable R.7.1.

- **Stage 1: Analysis of market and contacts with hybrid bus producers and PT companies** *(M13 - M16)* –Actual market has been deeply investigated through contacts with hybrid bus suppliers and Italian PT companies which have already equipped their fleet with hybrid buses in order to define which technology is more suitable at the moment.
- **Stage 2: Defining the type of hybrid bus to be purchased** *(M17- M23)* – A study has been conducted in order to investigate technical characteristics of different brands and models offered by producers. Exploiting outcomes of the study the most suitable bus to be procured, according to the needs of the city of Monza and to the available technology at the moment, it has been decided to test the VanHool in series hybrid bus, model A330Hyb in particular. The reasons for choosing Van Hool can be summarized in the following points:
    - the streets of the town of Monza and of neighbouring ones are in some parts difficult to drive through because they are "historical" and show a narrow roadway, so 18 metre buses cannot be tested;
    - in some areas of the town the bus has to make just one manoeuvring because it cannot reverse. For this reason the turning radius declared in technical sheets of the different models proposed by retailers has been taken into consideration. Not all the buses could satisfy this need;
    - the chosen vehicle should transport the highest number of passengers in comparison with diesel buses. Thus excluding 18 metre buses, which would be barely adaptable to the peculiar streets of Monza, the capacity declared by retailers became a key decision criterion.
    - NET, the PT company which is actually managing the PT service in Monza, can rely on a garage located in TPM premises in Monza where the fleet running in the city is serviced; even during the demonstration phase the garage should be able to give emergency assistance and also ordinary maintenance suggested by the retailer itself. This is why it has been chosen to test an electric/diesel hybrid bus since mechanics have already experienced with such type of mechanisms.
    - LPG, methane, and hydrogen buses have been rejected: it was not possible to build in TPM premises tanks suitable to contain any kind of gas (LPG or methane) in this location: the supply in service stations would not be easy because vehicles would be forced to travel for many kilometres to find one; travelling with an empty tank would be very expensive due to higher costs of time and staff.

B3 Situation before CIVITAS

No vehicles with potentials of zero emission driving within the inner city are currently available in Monza. About 73 buses owned by NET go through Monza every day only to pursue Urban Public Transport Service. The fleet is constituted of 20 Euro0 buses, 6 Euro1 buses, 29 Euro2 buses, 8 Euro3 buses, 1 Euro4 bus, 5 EEV buses. There is a high expectation by the citizens that the Public Transport fleet could be the benchmark in terms of best practices for Sustainable Mobility, especially for air pollution.

B4 Actual implementation of the measure

Stage 1: Leasing of the hybrid bus - *(M24- M31)* - This stage will involve the purchase of one hybrid bus, and the completion of administrative accomplishments (registration, insurance etc.). According to the results of the study, a Van Hool A330 Hyb should have been leased, since technical characteristics and delivery times had been considered the most suitable for the city of Monza and for ARCHIMEDES timing. The delivery of the bus was scheduled by January 2011 and put into operation after administrative accomplishments in March 2011. During meetings between NET (who is supporting the demonstration stage of the measure)

and Van Hool, Van Hool communicated they would have been able to deliver the bus only in September/October, so too late according to ARCHIMEDES schedule. In order to achieve the milestones scheduled for the measure, it was then decided to investigate the marketplace in order to find another suitable hybrid bus to test in replacement of the Van Hool bus: it has been identified the IVECO Citelis Hybrid bus. After being decorated with CIVITAS and ARCHIMEDES logos, the bus has been presented to the city and to the press on May 3rd 2011. It has also been presented during Monza Consortium Meeting in May to all delegates of the cities participating in ARCHIMEDES.

Figure 1 : Presentation of first Hybrid Bus in Consortium meeting in Monza in May 2011

Stage 2: Operation of the hybrid bus *(M32 – M36)* – The new bus started to be operational on route Z206, one of the most frequented PT lines in Monza, which connects the eastern part of the city, densely populated, to the city centre, the Park, the hospital and the University.

The line Z206 is split into two complementary lines which share the same route for the first part of the journey, starting from hospital until Via Buonarroti towards the eastern/south-eastern area of the city: at this point the traditional Z206 (indicated in Figure 1 with the black line) connects the Hospital and the University with the eastern area of Monza (Via Borsa, Via Luca della Robbia, Viale Sicilia and Via Pompei), and Z266 (indicated in Figure 1 with the blue line) connects the Hospital and the University with the south-eastern area of Monza (Via Buonarroti and Viale delle Industrie, where the prison is also located).

Each part of the line has a frequency of 20 minutes all day long from Monday to Saturday (which means every 10 minutes for the common section, since the timetables are staggered); additionally in peak hours there are periods where the line frequency is 10 minutes (5 in the common part of the journey), whereas on Sunday it is every 30 minutes (15 in the common section).

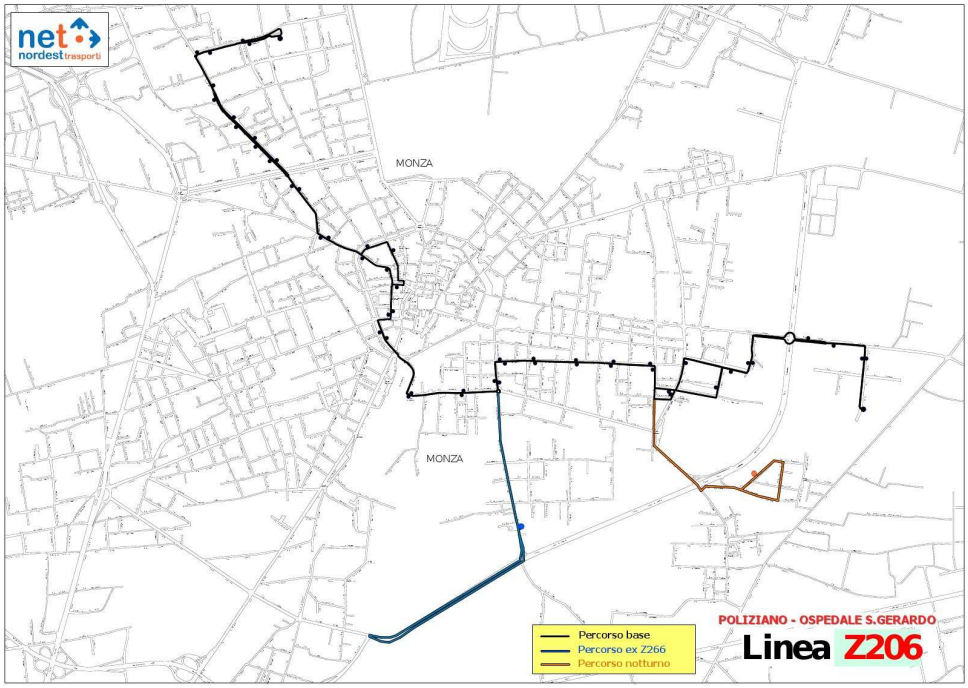

Figure 1 – Line Z206 route

Figure 2 shows how the route of line Z206 intersects with the locations on the chosen CIVITAS Corridor where several ARCHIMEDES measures are being implemented (Measure 78, AVL/AVM in Monza, Measure 79, Bus Traveller Information, Measure 81, UTC System in Monza and Measure 82, Public Transport Priority in Monza).

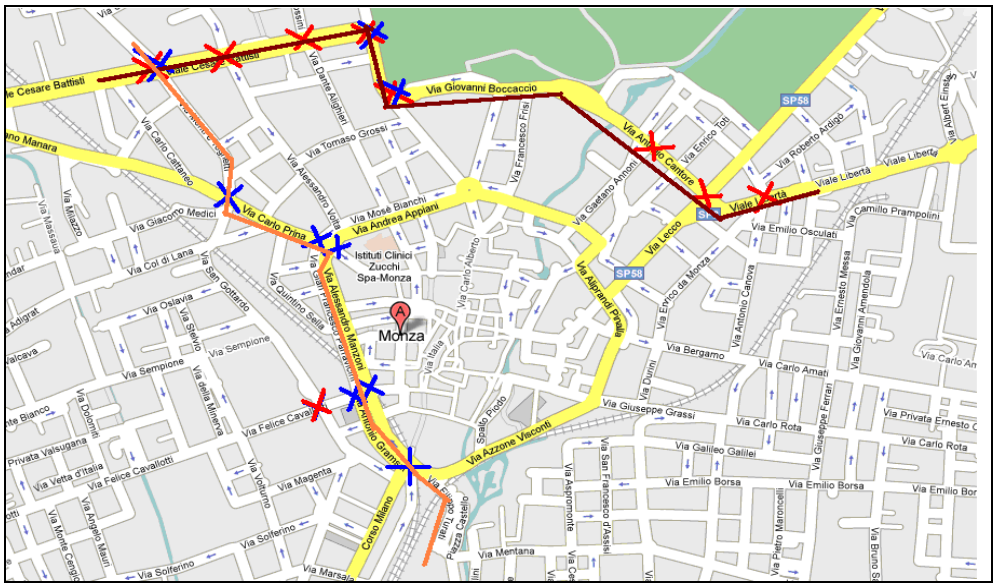

Figure 2 – Line Z206 along CIVITAS Corridor

Stage 3: Drivers' training *(M33)* - Due to the innovative equipment of the hybrid bus compared with rest of the conventional NET fleet, it has been necessary to plan training for both drivers and maintenance technicians.

The first training stage has involved the managers of the workshop and one driver who is usually employed to train new ATM/NET drivers, in order to train him about driving techniques for this particular vehicle.. Staff from IVECO, supplier of the hybrid bus, was employed in this training stage, during which a general explanation of the particular characteristics of the bus and its use were presented to NET's staff. The training activities were held in May 2011 in NET's premises in Monza (former TPM depot) for a whole morning.

The second training stage involved specific training for bus drivers in order to have the hybrid bus operational on Line Z206. During this stage, which has involved 32 drivers, 12 two hour sessions (1 hour for theory and 1 hour for practice) were held in May and June 2011. Other sessions will soon start in order to train all drivers employed at NET's Monza premises.

Stage 4: Technical problems during demonstration stage *(M38 – M44)* – After summer 2011, the hybrid bus has presented a number of technical problems. Since the hybrid bus delivered in Monza by IVECO was a prototype originally intended for the French market, some interventions have been necessary to upgrade the vehicle and make it suitable for registration under Italian law. Furthermore, some minor adjustments have been realized to make the vehicle match the ATM/NET fleet standards.

First of all, the bus is not air-conditioned and it has been necessary to change windows in order to have a better ventilation of the interior of the vehicle, since in hot days the temperature was too high for the journey to be comfortable.

Interventions on the electrical system of the vehicle, aimed at both improving the performance of the bus and at adapting it to ATM/NET's standards, have been made. More specifically:

- the stop booking system resets when the bus is moving and not when doors open and close at the bus stop. This implies that, if a bus stop is booked and the bus halts before

reaching it (for instance for a red traffic light) and then starts moving again, the system resets and the stop has to be re-booked;

- the plug in the battery compartment is 24 V and different from the kind installed on ATM/NET fleet;
- electric displays of booked stop are present only in the front and in the rear of the vehicle, but they are missing in the centre; moreover, their functioning is connected to the opening of the second door only;
- buzzer of booked stop is different from the kind installed on ATM/NET fleet /with three bips);
- sealing of hatches for ventilation in the vehicle is activated simultaneously when the start and stop system activates;
- doors' blocking system when the bus is moving has been activated.

Other interventions have concerned:

- electric displays of booked stop have been translated from French to Italian;
- front tow hook and fuel filler have been modified according to ATM/NET's standard
- behind the driver's seat the niche dedicated to the placement of the stamping machine has been resized, since its dimensions were too small;
- the location for disabled people on a wheelchair has been equipped with seat belts and with a panel with buttons to book stops;
- labels indicating emergency exit have been positioned on side windows.

Although all these problems were solved, there were still some anomalies in the systems' management software that caused the continuous lighting of warning lights, which caused too frequent stops of the bus and consequent repairs in workshop. For this reason, in February 2012 NET wrote a very harsh letter to IVECO complaining about the frequent problems the bus was presenting, highlighting that, since May 2011, the bus had circulated only for 43 days out of 266, covering only 7.388 km. Such a situation would have involved problems with the demonstration of the measure and, more specifically, with a sound evaluation of the vehicle and of its performances.

Stage 5: Supply of a second generation bus *(M44 – M51)* – After NET complains, IVECO has immediately activated procedures to replace the prototype bus with a second generation one, which, although presenting the same technical features of the first one, has now fully entered into the production chain, so it does no longer present the manufacturing defects shown by the prototype. The new bus started to be operational in May 2012, after completing all administrative accomplishments, and will be tested until December 2012, in order to test its performances both in summer and winter conditions.

Figure 3 – Second IVECO hybrid bus (front)

Figure 4 – Second IVECO hybrid bus (rear)

B5 Inter-relationships with other measures

The measure is related to measure 4 of Donostia – San Sebastian.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and indicators

C1.1.0 Scope of the impact

The indicators chosen in the table below were selected as directly related to the introduction of the measure. The indicators relate to:

Economy – The subcategory of benefits has not been considered because not applicable, since the introduction of a on hybrid vehicle should not have any impact on revenues for the PT company (e.g. the number of tickets sold does not depend on the propulsion used). On the other hand, as far as costs are concerned, only capital costs have been considered, since the introduction of a single hybrid bus in a fleet for a short testing period will not alter operating and maintenance costs afforded by the PT company. Nevertheless, some considerations about operating and maintenance costs have been assessed in Section C2.1.

Energy – Fuel consumption has been evaluated and compared with consumptions of a traditionally diesel fuelled bus.

Environment – estimated emissions of the hybrid bus and noise perception has been considered comparing them with the estimated emissions and noise of traditional diesel fuelled buses. As far as air quality is concerned, the introduction of a unique hybrid bus will have no impact on a measurable level.

Society – Awareness is very important since sensitivity of people to environmental issues could push towards a modal shift in favour of Public Transport in consideration of the increased interest shown by PT companies for environment.

Transport – The introduction of the hybrid bus will impact on the perception of the quality of service, but not on other indicators related to safety and transport system.

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C1.1.1 Selection of indicators

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	ECONOMY					
2b		**Costs**	Capital Costs	Capital costs	Costs sustained to develop the supply infrastructure	Money amount, quantitative
	ENERGY					
3		**Energy Consumption**	Fuel Consumption	Vehicle fuel efficiency	Fuel used per vkm, per vehicle type	MJ/vkm, quantitative, derived or measurement
	ENVIRONMENT					
8			Emissions	CO2 emissions	Kg of CO2 emitted	Kg, quantitative, derived
9				CH4 emissions	Kg of CH4 emitted	Kg, quantitative, derived
10				N2O emissions	Kg of N2O emitted	Kg, quantitative, derived
11				Particulate emissions	PM10 and/or PM2.5 per vkm by type	G/vkm, quantitative, derived
12			Noise	Noise perception	Perception of noise	Index (%), qualitative, collected, survey
	SOCIETY					
13		**Acceptance**	Awareness	Awareness level	Awareness of the policies/measures	Index (%), qualitative, collected, survey
	TRANSPORT					
19			Quality of service	Quality of service	Perception of quality of service	Index, qualitative, collected, survey

C1.1.2 Methods for evaluation of indicators

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No.	INDICATOR	TARGET VALUE	Source of data and methods	Frequency of Data Collection
2b	Capital Costs	Comparing capital costs of a hybrid bus/ traditional diesel bus	The investment done has been compared to the one sustained for the purchase of a traditional diesel powered bus.	Once, at intervention completed
3	Energy consumption	Reducing fuel consumption	Consumptions of a hybrid bus on urban route has been calculated and compared with consumptions of a diesel fuelled EEV bus, both operating on the same urban route and covering the same mileage.	Data were collected at the end of the project comparing performances the hybrid and diesel fuelled buses.
8-9-10-11	Emissions	Reducing emissions of air pollutants and greenhouse gases	The simulating method provided by United Kingdom DEFRA has been used to estimate emissions of the hybrid bus and compare them with emissions of a diesel fuelled EEV bus.	Data were collected at the end of the project comparing performances the hybrid and diesel fuelled buses.
12	Noise	Evaluating produced noise	The noise produced by the hybrid bus has been compared with the noise produced by a traditional bus according to what reported in the technical brochures.	Data were obtained through technical brochures' information at the end of the project.
13-14	Awareness	Evaluating users' awareness of the demonstration of the hybrid bus	Surveys to measure awareness level of users of Public Transport Service in order to measure whether people actually change their behaviour or their attitude because of the use of the hybrid bus. Surveys have been organized at bus stops with interviewers who have asked people about their perception of the new service. The sample considered has been of 240 people in the before survey and of 236 people in the after survey (details in Annex 1 to the present report). The face to face method reduces percentage of mistakes in the survey.	Data have been collected twice during the project (at the start of demonstration tasks and at the end of the project)
19	Quality of service	Achieving a better quality of transport service	Surveys have been conducted to verify if users' perception of the overall quality of the service may improve through the introduction of clean vehicles in PT fleets. Surveys have been organized at bus stops with interviewers who have asked people about their perception of the new service. The sample considered has been of 240 people in the before survey and of 236 people in the after survey (details in Annex 1 to the present report). The face to face method reduces percentage of mistakes in the survey.	Data have been collected twice during the project (at the start of demonstration tasks and at the end of the project)

C1.1.3 Planning of before and after data collection

EVALUATION TASK	INDICATORS INVOLVED	COMPLETED BY (DATE)	RESPONSIBLE ORGANISATION AND PERSON
Defining the investment to be sustained to purchase a hybrid bus	Capital Costs	Month 34 (only after data)	Comune of Monza – Simonetta Vittoria
Calculating the reduction of energy consumption of hybrid buses	Energy consumption	Month 34 (before data) Month 48 (after data)	Comune of Monza – Simonetta Vittoria
Evaluating emissions of hybrid bus	Emissions	Month 34 (before data) Month 48 (after data)	Comune of Monza – Simonetta Vittoria
Measuring actual noise emissions	Noise	Month 34 (before data) Month 48 (after data)	Comune of Monza – Simonetta Vittoria
Measuring awareness level of users on the hybrid bus	Awareness	Month 32 (before data) Month 45 (after data)	Comune of Monza – Simonetta Vittoria
individuating users' perception of the quality of provided service	Quality of service	Month 32 (before data) Month 45 (after data)	Comune of Monza – Simonetta Vittoria
D12.2 Baseline and first results from data collection	All indicators	Month 34	Comune of Monza – Simonetta Vittoria
D12.3 Draft results template available	All indicators	Month 49	Comune of Monza – Simonetta Vittoria
D12.4 Final version of results template available	All indicators	Month 51	Comune of Monza – Simonetta Vittoria

C1.2 Establishing a Baseline

Before the involvement of Monza in ARCHIMEDES, some choices in favour of clean fuels had already been taken:

- at the beginning of 2007, particulate filters were installed on all diesel buses of TPM fleet, in order to reduce PM10 emissions (by up to 90-95% reduction);
- in January 2008 9 EEV buses were procured (first ones to be delivered at a higher cost if compared with Euro 4 buses);
- an approach to a demonstration of hydrogen/diesel technology already tested in the USA on trucks had been made, but it had not been developed because of the merger with NET.

No vehicles with potentials of zero emission driving within the inner city are currently available in Monza, even though during the four years of ARCHIMEDES project and after the merging between TPM and NET the PT fleet in Monza has been updated with other six EEV buses.

C1.3 Building the Business-as-Usual scenario

As already explained, TPM, when was still in charge of the PT service in Monza, had already taken some choices in favour of clean vehicles, more specifically by installing particulate filters on all Euro 3 and 4 buses. The same has been done by NET, which in the latest period has procured 16 EEV buses for the urban service, as well as using EEV buses also for extraurban service: the revamping of the fleet, by the way, is also included in the contractual obligations that PT companies have taken with the Province of Milan, before, and of Monza and Brianza, after.

The Business as Usual scenario would mean that the PT company which is managing the service in Monza, even without testing a hybrid bus, would in any case modernize the fleet by procuring cleaner vehicles or by installing particulate filters on elder buses. It can be therefore assumed that the levels of pollution and fuel consumption would tend however to decrease, although the zero level of pollutant emissions would not be achieved.

For this reasons, Business as Usual scenario concerning capital costs, energy and emissions indicators has been estimated assuming that the efficiency situation achieved would not be altered with reference to the before scenario

C2 Measure results

In this section the results achieved are shown.

C2.1 Economy

Indicator	Before (Euro 3- 4 with APF - EEV)	B-a-U (date)	After (Hybrid)	Difference: After –Before	Difference: After – B-a-U
No. 2A: Capital Cost	230.000 €	Not applicable	395.000 €	+ 165.000 €	Not applicable

As it can be seen, hybrid buses are much more expensive than EEV buses, which are now replacing former Euro 3 and 4 buses in PT fleets . However, it must be considered that the original cost of an Euro 4 bus (about 175.000 €) increased along time due to the installation of particulate filters and to constructions costs to adapting it to ATM/NET's standards, as better explained in Section B4, so it has been considered equal to costs of an EEV bus.

An appraisal has been done also for maintenance and operating costs of the hybrid bus, even though these indicators have not been specifically assessed in this evaluation report, without considering the

test of the first bus delivered by IVECO, whose problems were so significant that it was necessary to replace it.

Since only one bus was tested (and for a rather short period at the moment of writing the present report), operating and maintenance costs were not altered at all because they have been absorbed by costs usually afforded by the PT company for ordinary operation and maintenance of the whole fleet.

Therefore, such an appraisal can prove useful in order to compare operating and maintenance costs after a normal lifecycle of the vehicle (about 12 years, according to literature) and when the investment afforded by the PT company may produce a significant increase in costs.

As for operating costs, it must be considered that personnel's costs (mechanics, drivers, trainers and administrative personnel) are the same indipendently from the kind of bus put into operation, so no significant changes can be assessed

As far as maintenance costs are concerned, on the other hand, traditionally diesel fuelled buses are equipped with a termic engine and with a transmission system which normally require (during the vehicle lifecycle) about 30.000 € for maintenance (usually replacement of both equipments). Hybrid buses are expected to have lower maintenance costs due to reduced stress and maintenance on mechanical components such as brake linings, which may extend brake life by 50 – 100 percent. In addition, the electric drive has fewer parts, therefore requiring less maintenance than a traditional transmission. Nevertheless, but during hybrid buses' lifecycle batteries replacement will be necessary. Lithium –Ion batteries have indicatevely a of 5 - 7 years. The replacement costs, however, are to some extent unknown at this point. Battery technology is rapidly evolving so the cost of batteries in the future will depend on the latest technology and costs when it is time to replace the batteries.

C2.2 Energy

Indicator	Before (CITELIS IVECO EEV Bus)	B-a-U (date)	After (Hybrid)	Difference: After –Before	Difference: After – B-a-U
No. 3: Vehicle fuel efficiency	1,806 km/l (average consumption of EEV bus)	Not applicable	2.23 km/l (average consumption of hybrid bus)	+ 0.424 km/l	Not applicable

According to what IVECO has communicated as supplier of the bus actually operating in Monza, the hybrid bus should provide quantifiable fuel savings: specifically a reduction of 39% at 11,5 kph average speed and a reduction of 29% at 25 kph average speed has been evaluated .

Starting from this information, which is also reported in the technical brochure of the hybrid bus provided by IVECO (attached as Annex no. 2 to the present document), results achieved during the testing of the unique hybrid bus which has been made operational in Monza were examined and proved significant savings in terms of fuel consumption. More specifically, in the below table mileage covered by the hybrid bus is put in relation with fuel consumption. Data were collected for each month of operation from June 2012 to September 2012 by NET and compared with data of a traditionally diesel fuelled EEV bus operating on the same route and covering the same distance: it can be assessed that the hybrid bus reported higher mileage from 23% to 38% (average 30%), with full air conditioning running on both vehicles.

MONTH	KM	FUEL CONSUMPTION KM/L	
June	3.000		2,08
July	4.250		2,14
August	4.750		2,2
September	4.100		2,51
TOTAL	**16.100**	**Average**	**2,23**

Table 1 - Hybrid bus consumption km/l

More specifically, whilst the EEV bus consumed 8915 litres of fuel (16.100 km divided by 1,806 km/l), the hybrid bus consumed 7220 litres of fuel (16.100 km divided by 2.23 km/l).

C2.3 Environment

Indicator	Before (EEV)	B-a-U (date)	After (Hybrid)	Difference: After –Before	Difference: After – B-a-U
No. 8: CO2 emissions	23686 kg	Not applicable	**19183 kg**	**-4503 kg**	Not applicable
No. 9: CH4 emissions	8 kg	Not applicable	**6 kg**	**- 2 kg**	Not applicable
No. 10: N2O emissions	170 kg	Not applicable	**138 kg**	**- 32 kg**	Not applicable
No. 11: Particulate emissions	0,04 gr/km	Not applicable	**0,25 gr/km**	**+ 0, 21 gr/km**	Not applicable
No. 12: Noise perception (Value concerns rear noise)	71 db(A)	Not applicable	**69 db (A)**	**- 2 db (A)**	Not applicable

With the introduction of a unique hybrid bus in the city, reduction in greenhouse gas emissions on a city level will be extremely limited. Nevertheless, an attempt to assess greenhouse gas emissions has been made using the simulating method provided by United Kingdom DEFRA (Department for Environment, Food and Rural Affairs), in order to establish a baseline in an upscaling perspective.According to this method, Greenhouse Gases (GHGs) can be measured by recording emissions at source by continuous emissions monitoring or by estimating the amount emitted by multiplying activity data (such as the amount of fuel used) by relevant emissions conversion factors. Conversion factors allow activity data (in this case, litres of fuel used) to be converted into kilograms of carbon dioxide equivalent (CO2e).

CO2e is a universal unit of measurement that allows the global warming potential of different GHGs to be compared. For this reason, starting from data concerning fuel consumption shown in Section C2.2, litres of fuel consumed by a diesel fuelled EEV bus were compared with the litres of fuel consumed by the hybrid bus, assuming that the mileage covered is the same for the two vehicles, both operating on the same Public Transport line. By dividing the mileage covered by the average fuel consumption (km/l) results shown in next page **Errore. L'autoriferimento non è valido per un segnalibro.** and in Table 3 have been achieved.

As results show, the hybrid bus tested in Monza proved definitely less polluting than an EEV bus covering the same mileage on the same Public Transport route.

Table 2 - EEV bus GHGs emissions

Standard Road Transport Fuel Conversion Factors				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel used*	Total units used	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit
Petrol (average biofuel blend)*		litres		2,2332	0,0033	0,0058	2,2423	0,4750	2,7173
Petrol (100% mineral petrol)		litres		2,3051	0,0033	0,0059	2,3144	0,4638	2,7782
Diesel (average biofuel blend)*		litres		2,5636	0,0009	0,0190	2,5835	0,5837	3,1672
Diesel (100% mineral diesel)	7220	litres		2,6569	0,0009	0,0191	2,6769	0,5644	3,2413
Compressed Natural Gas (CNG)		kg		2,7188	0,0040	0,0016	2,7244	0,4224	3,1468
Liquid Petroleum Gas (LPG)		litres		1,5301	0,0007	0,0018	1,5326	0,1918	1,7244
Total									

Table 3 – Hybrid bus GHGs emissions

CO_2	CH_4	N_2O	Total Direct GHG
Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
19.183	6	138	19.327
19.183	**6**	**138**	**19.327**

According to constructing data, particulate emissions seem to increase due to the fact that no particulate filter is installed on hybrid vehicles, whilst rear noise decreases of 2 db .

C2.4 Transport

In order to evaluate core indicators concerning transport and society, and to assess mobility habits of surveyed people, two qualitative surveys were conducted before (May 2011) and after (June 2012) the start of the implementation stage of the measure.

The first survey, which was conducted on the 4 most frequented PT urban lines and in some neuralgic locations of the city, has interested 240 people in order to analyze their knowledge and their opinion about public transport improvements in progress in Monza thanks to ARCHIMEDES project, as well as detecting potential interest and perception about measures' development and which of the on going measures are considered mostly impacting on respondents mobility habits on going projects (even if they are not known)

A questionnaire of 23 questions was elaborated by statistic technicians according to Municipality of Monza's requirements and concerned not only measure no. 7, but also measures no. 19, no. 79 and no. 82.

In June 2012 the second survey was realized on 236 people using public transport at Monza, on lines 206, 266, 202, 201 and at two main bus stop (Piazza Castello e Via Manzoni). The interview had the scope to assess awareness of the implementation of the measure as well as eventual changing of habits in using public transport and in quality of service. The opinions of the respondents were acquired through a questionnaire designed ad hoc.

The sample size guarantees the statistic reliability of the survey, according to the following parameters:

- Significance level: 95%
- Error margin – 5% .

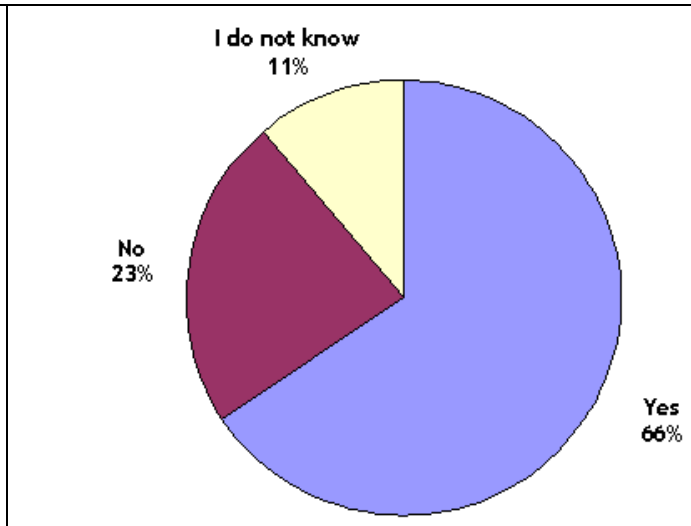
In this section results of the two surveys will be summarized, whilst all findings from the interviews are shown in the annex 1 to the present document.

Indicator	Before (May 2011)	B-a-U	After (June 2012)	Difference: After – Before	Difference: After – B-a-U
No. 19: Quality of service	**66%** think the hybrid bus can improve quality of service	Not applicable	**87,3%** think the hybrid bus can improve quality of service	**+ 21,3%**	Not applicable

	23% think it will not **11%** does not know		**0,8%** think it will not **11,9%** does not know	**- 22,2%** **+ 0,9%**	

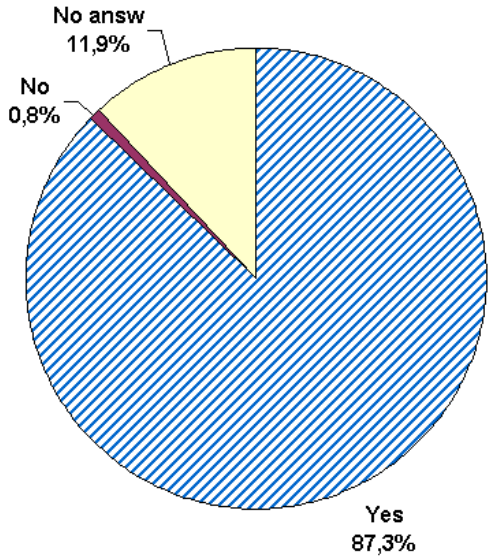
From results of the survey it may be seen that, as soon as the second hybrid bus started to circulate regularly people's perception of the fact that the use of clean vehicles may improve quality of service increased significantly.

Below graphs explaining findings of the surveys are reported.

Do you think that the introduction of hybrid buses in the PT fleet could improve the quality of service? **INDICATOR NO. 19 (Quality of service)**	

Graph 1 - Quality of service - May 2011 Survey

Do you think hybrid bus is useful to improve quality of service? (236 answ.)



Graph 2 - Quality of service – June 2012 Survey

C2.5 Society

Table C2.5.1: Social indicators

In the qualitative surveys described in Section C2.4, questions about social indicators have been asked in order to evaluate awareness of the service. During the after survey, also questions concerning the awareness of some technical features of the hybrid bus have been asked to interviewed.

In this section results of the two surveys will be summarized, whilst all findings from the interviews will be shown in the annex 1 to the present document.

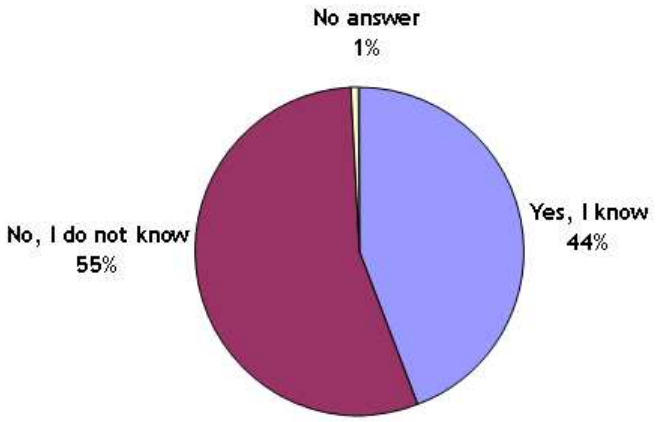
Indicator	Before (Sept 2010)	B-a-U (date)	After (Sept 2012)	Difference After – Before	Difference: After – B-a-U
Indicator no. 14 – Awareness	**44%** know Comune of Monza is testing the hybrid bus **55%** doesn't **1%** does not answer **52%** of informed people (**106**) knew through local press, **26%** through word of mouth, **11%** through other means and **9 %** through Municipality website		**50.4%** know Comune of Monza is testing the hybrid bus **49.6%** doesn't Almost all informed people (**117 out of 119**) knew about the hybrid bus by seeing it on the road **81,8%** know the hybrid bus is less polluting and **82,6%** think a hybrid fleet can improve air quality **90** people (**out of 119**) find the bus is not noisy**, 66** think it does not vibrate, **111** find it more comfortable, **32** more beautiful, but **100** people do not have the perception it's less polluting	**+ 6,4%** **- 5,4%** **Not applicable**	

As results of the two surveys demonstrate, awareness of people about the hybrid bus and its features increased significantly. This may depend in part on the fact that the livery of the bus is totally different from other buses circulating in Monza (green instead of blue or orange), so it is easier for people to notice it and to have the will to test it. On the other hand, it must be noticed that, although surveyed people are aware that hybrid buses are less polluting, once they use it they do not have the perception of this feature. This means that it will be necessary to inform people about results of the test, in order to demonstrate the real improvement of air quality which might be achieved through the introduction of clean vehicles in PT fleet: such an information could be useful to pave the way to an increase in the use of PT, but also to a greater sensitivity in the choice of a private car, orienting towards the purchase of environment friendly vehicles.

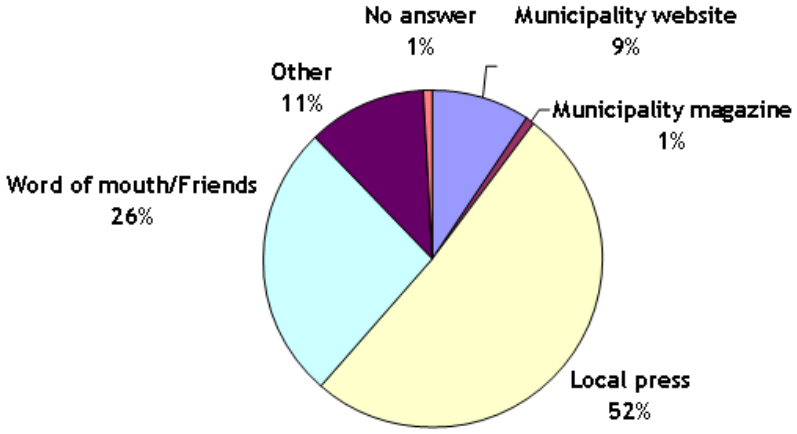
In the below graphs 3 to 9, the findings of the two surveys are shown in deeper detail.

Measure title: **Hybrid Bus in Monza**

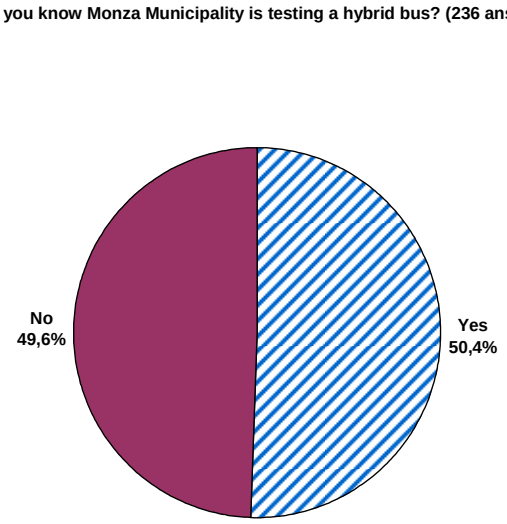
City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **7**

Question asked	Answers
Do you know Comune of Monza is testing a hybrid bus? **INDICATOR NO. 14 (Awareness)**	

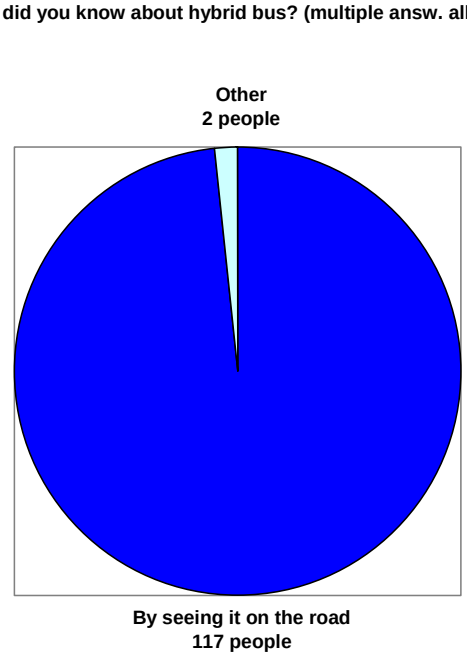
Graph 3 - Awareness of the measure - May 2011 survey

If you are informed about the hybrid bus, how did you know? **INDICATOR NO. 14 (Awareness)** SAMPLE SIZE FOR THIS QUESTION IS OF 106 RESPONDANTS	

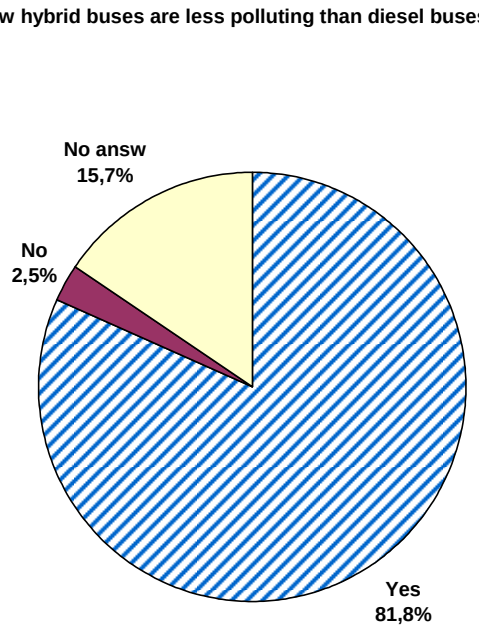
Graph 4 – Means of knowledge – May 2011 survey



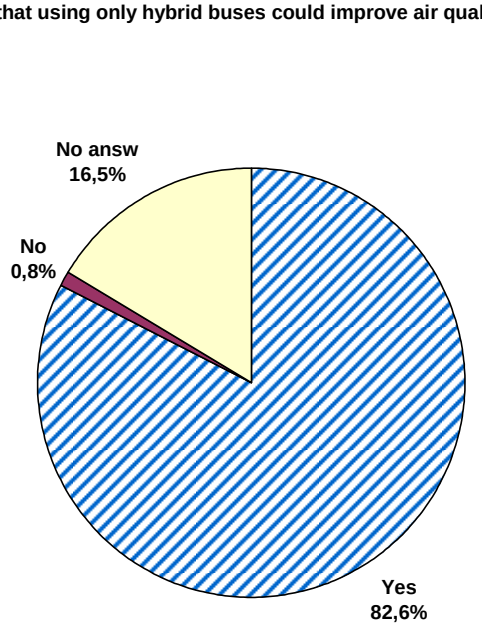
Graph 5 - Awareness of the measure - June 2012 survey



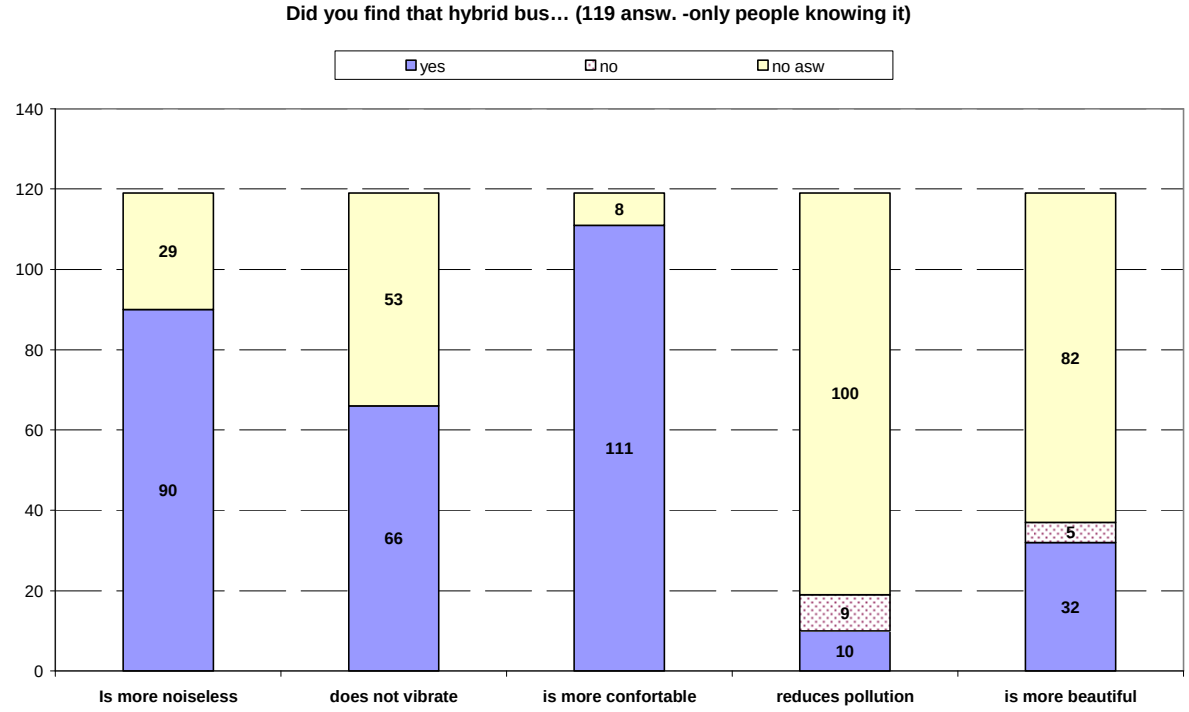
Graph 6 - Means of knowledge – June 2012 survey



Graph 7 – Awareness about pollution – June 2012 survey



Graph 8 – Air quality improvement – June 2012 survey



Graph 9 – Knowledge of Hybrid bus features – June 2012 survey

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
2B	Comparing capital costs of a hybrid bus with a traditional diesel powered bus	★★
3	Reducing fuel consumption	★★
8-9-10-11	Reducing emissions of air pollutants and greenhouse gases	★
12	Evaluating produced noise	★
13-14	Evaluating users' awareness of the implementation of the hybrid bus	★★
19	Evaluating users' perception of the opportunity to achieve a better quality of transport service	★★
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C4 Up-scaling of results

Upscaling of the measure can be realized following two steps: first of all, fleets of all PT companies operating in Monza should be made up of sole hybrid vehicles; secondly, also fleets operating in other cities and in Lombardia should be upgraded with hybrid buses.

If this intervention, which obviously implies very huge investments in a period of financial crisis, was realized, it can be assumed that fuel consumption and emissions would significantly decrease, in a higher extent according to the higher number of hybrid vehicles put in circulation, although maybe some problems as for procurement of a large quantity of hybrid vehicles could arise. Therefore, it

could be necessary to investigate production capacity of the different suppliers to verify if such an increase in the demand can be satisfied.

Moreover, a deep cost-benefit analysis will have to be approached by PT companies in order to assess if costs to face for hybrid buses' procurement, maintenance and operation are compensated by savings in terms of fuel consumption and image value.

C5 Appraisal of evaluation approach

Evaluation activities have been aimed at :

- collecting data about performances of the hybrid bus, in terms of fuel consumption and emissions, comparing them with those of a diesel fuelled EEV bus;
- evaluating impact of capital costs;
- checking the level of knowledge of the measure implementation between users of public transport.

Such an approach is in concordance with the measure objectives, and data collection procedures have been adequate in order to collect necessary data to evaluate results of the implementation. Main difficulties have concerned the evaluation of the impact of operating and maintenance costs because of the short duration of the test and since only one vehicle was tested: for this reason it was assumed that operating and maintenance costs were not altered at all because they have been absorbed by costs usually afforded by the PT company for ordinary operation and maintenance of the whole fleet.

Although there is still no clear agreement on the most suitable procedure for measuring-modelling the emission, results concerning emissions have been however assessed, deriving them through a simulating method provided by United Kingdom DEFRA: even though they may appear not particularly significative on a city level, they can however be considered an important baseline and an interesting source of information to evaluate overall results of the implementation of the measure in a upscaling perspective.

C6 Summary of evaluation results

In spite of all problems faced during the implementation stage of the measure, which will be deeply investigated in Section D, results achieved, even though the hybrid bus has been tested for a limited period, can nevertheless be considered satisfactory. The measure has succeeded in its main objective, which was to demonstrate fuel savings and emissions reductions by the use of a hybrid bus.

More specifically, the following results are worthy of being highlighted:

- hybrid bus reported higher mileage from 23% to 38% if compared with a traditionally diesel fuelled bus;
- emissions connected to the use of diesel fuel were significantly reduced (since very little fuel is used by the hybrid bus), although particulate emissions increased due to the fact that no particulate filter is installed on the vehicle;
- as soon as the second bus started to circulate daily, awareness of people about the implementation of the measure, about technical features of the bus and the improvement of the quality of service has significantly increased.

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C7 Future activities relating to the measure

The hybrid bus is going to be tested until December 2012, in order to test its performances both in summer and winter conditions.

After completing the test, it will be important to decide whether results achieved make it worth investing on clean vehicles, in order to understand if the benefits gained by this innovative vehicle are greater than the increased costs that would be linked to making this the standard future replacement of the whole conventional bus fleet.

The latest rise in price of fuel (often seen by Italian Government as a lever to increase incomes) has not been supported by the State or local authority (regions, provinces, cities) in order to give more contractual compensation (in case of call for tenders) or more grants (in case of in house providing) to managing companies; these could do anything but counting higher operating deficits.

Moreover, the actual financial crisis does not allow even large-sized PT companies (ATM Milan, AMT Genoa, GTT Turin, COTRAL Rome, etc), which have since now shown particular sensitiveness towards the problem of pollution and a great interest in hybrid technology, to activate huge investments to renew their fleets with innovative vehicles.

For this reason, a deep cost-benefit analysis will be necessary for PT companies (who are responsible for vehicles' procurement) before deciding wheter to focus their investments on hybrid technology or to continue in purchasing EEV buses. Operating and maintenance costs will have to be evaluated after a longer testing period, in order to understand if the introduction of hybrid buses in a PT fleet involve overcosts. Further purchases of hybrid buses will depend not only on the experience achieved during ARCHIMEDES demonstration stage, but also on the availability of other suppliers, the price difference with the conventional buses and the development of the hybrid technology.

D Process Evaluation Findings

D.0 Focused measure

X	0	No focussed measure
	1	Most important reason
	2	Second most important reason
	3	Third most important reason

D1 Deviations from the original plan

The only deviation from the original plan concerned the brand of hybrid bus adopted, as better described in Section B.4.

D2 Barriers and drivers

Public Transport in Italy is not in perfect health: for this reason most companies show negative budget sheets. The ticket sale proceeds reach the 18-20 of budget % in the worst cases and the 31-35% in the best ones.

The latest rise in price of fuel (often seen by Italian Government as a lever to increase incomes) has not been supported by the State or local authority (regions, provinces, cities) in order to give more contractual compensation (in case of call for tenders) or more grants (in case of in house providing) to managing companies; these could do anything but counting higher operating deficits.

The splitting of the marketplace is high: there are too many small companies which manage some hundreds of thousands or millions of kilometres, whilst very few large-sized companies manage millions of kilometres.

Small companies had to face with deregulation, on the one hand, and with the rise in prices, on the other, and certainly have no available funds to renew their fleets or to experiment hybrid vehicles whose cost is 50% higher when compared with traditional diesel buses.

Disappointingly, the actual financial crisis does not allow even large-sized PT companies (ATM Milan, AMT Genoa, GTT Turin, COTRAL Rome, etc), which have since now shown particular sensitiveness towards the problem of pollution and a great interest in hybrid technology to activate huge investments to renew their fleets with innovative vehicles.

Moreover, Monza experience has taught that this new technology, although quite spread in cars' production, is still at an experimental stage as far as collective transport vehicles are concerned. Many retailers are still testing their vehicles and technical problems are so frequent that if market does not achieve full maturity this will represent a hindrance to a correct diffusion of hybrid vehicles but, principally, to a reduction of their cost which is still much higher than that of traditionally diesel powered buses.

D.2 Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Problem related –** During the research stage of the measure, it proved rather difficult to obtain information about the state of hybrid technology by providers, since in many

cases hybrid technology is just being experimented and worldwide crisis has forced manufacturers to revise investments and to diminish the number of stored buses. Another problem has been to get up-to-date information, the pros and the cons of the various solutions adopted by manufacturers and to obtain in the short period a hybrid bus to test on the run.

- **Institutional** – The merging of TPM with NET resulted in a delay by NET in devoting resources to the ARCHIMEDES project measures due to pressing administrative accomplishments following the merger

Implementation phase

- **Problem related** – Van Hool was not able to deliver the hybrid bus according to the schedule, so it was necessary to investigate the marketplace to identify another suitable bus to be tested in Monza

- **Positional** – The circumstance that only one hybrid bus was being tested in Monza was a hindrance to the procurement of the vehicle, since retailers would favour PT companies intentioned in investing in hybrid technology for their whole fleets.

Operation phase

- **Technological** – The hybrid bus presented major anomalies which caused too frequent stops of the bus and consequent repairs in workshop, being a prototype originally intended for the French market.

- **Organizational** – Delay in providing a second generation bus due, on the one hand, to the numerous attempts to solve problems in workshop, and, on the other, to the difficulty in finding in a very short time an available vehicle to be diverted to Monza demonstration in spite of already scheduled deliveries.

D.2.2 Drivers

Preparation phase

- **Involvment** – The strong commitment of TPM in delivering the study acted as a flywheel for the research stage and proved very useful to identify the most suitable bus for the city of Monza

- **Technological** – The new technology could raise sensitiveness towards sustainable mobility in urban context

Implementation phase

- **Communication** – Strong commitment of IVECO, hybrid bus retailer, which helped in disseminating the initiative, through a wide informative campaign, resulting in a considerable coverage in the local and national press, as well as on trade press.

- **Organizational** – description text description text description text description text

Operation phase

- **Positional** – NET's strong commitment in testing the hybrid technology was the most important driver in this stage to push IVECO to meet their commitments by providing a second generation bus

- **Strategic** – The risk of having a bad evaluation report about the hybrid bus when testing activities by important PT companies may represent a mainspring to develop the new technology and provide new orders, has pushed IVECO to overcome problems and to provide the second bus.

D.2.3 Activities

Preparation phase

- **Planning** – A deep market analysis was conducted by TPM to identify the most suitable bus to be tested in the city of Monza

- **Problem related** – Interventions needed to recover the delay caused by the merging of TPM with NET were deeply analized and explained to the European Commission during a review meeting in order to give assurance of the commitment of the city of Monza to implement the measure

Implementation phase

- **Problem related** – Meetings with NET aimed at investigating the marketplace to find a suitable hybrid bus to be tested in Monza which could be procured in a very short time, due to the already accumulated delay in the implementation of the measure
- **Organizational** – Training sessions for both drivers and maintenance technicians have been planned by NET, employing staff from IVECO, supplier of the hybrid bus.

Operation phase

- **Technological –** Activities aimed at solving technological problems presented by the first hybrid bus delivered have been carried out through IVECO workshop.

- **Problem related** – Once it has been clear that defaults of the hybrid bus would not have allowed a sound evaluation of the vehicle's performances, meetings have been held in order to find a quick solution for continuing the implementation of the measure

- **Planning** – A rigid schedule of actions to be accomplished in order to have the new hybrid bus operational as soon as possible has been defined in agreement with NET and IVECO.

D.3 Participation

D.3.1. Measure Partners

- **Comune of Monza –** Mobility and Transportation Office Department (leading role).
- **TPM** – Former PT operator for the city of Monza, TPM has been in charge of the research stage of the measure (principal role in research stage).

- **NET** – PT operator, as subcontractor, has procured the hybrid bus and has been in charge of the whole demonstration stage of the measure (principal role in demonstration stage)

D.3.2 Stakeholders

- **Other PT Companies -** Other PT companies could be interested in the demonstration of a hybrid bus in order to test a more ecological type of vehicle in their fleets
- **Owners of public and private fleets** – The example of NET could serve as a showcase for owners of public and private fleets to test hybrid vehicles

D.4 Recommendations

D.4.1 Recommendations: measure replication

In Italy medium-sized cities are generally affected by the same problems concerning traffic and pollution. Positive results in terms of fuel savings and reduction of emissions achieved in Monza can push other cities to test hybrid technology. The introduction of hybrid vehicles in the PT fleet could serve as an important driver for people to shift towards public transport, on the one hand, but also for private companies to upgrade their fleet with hybrid vehicles, on the other.

During the implementation stage of the measure the city of Monza enjoyed the proximity to Milan and the fact that ATM (the PT company operating in Milan) has a stake in NET, the PT Company operating in Monza: ATM wanted to test hybrid technology in Milan, a larger city, where transportation and traffic problems are definitely bigger, so it was easier to find retailers wanting to use the city of Milan as a demonstration site for their technology. For this reason Monza could exploit the opportunity to join the test of hybrid technology already operational in Milan.

Whilst the opportunity of joining Milan in testing hybrid technology has served as a good lesson, it must be said that initial expectations of replacing the entire PT fleet in Monza with hybrid vehicles proved too optimistic if compared to the later evolution of the demonstration stage. As a matter of fact, when ARCHIMEDES project was submitted, the demonstration stage of the measure was in charge to TPM, which managed PT in Monza as a company 100% owned by the Municipality. For this reasons, future choices about vehicles' procurement could be somehow addressed by Comune of Monza, as the sole shareholder of the society. After the merging of TPM with NET, the capacity of Comune of Monza to influence choices about future procurements of a private company, in no way connected to the decision-making dynamics of the Municipality, is virtually non-existent.

The immaturity of hybrid technology has implied problems in the implementation of the measure, firstly as far as times of procurement were concerned, and secondly for the technological problems presented by the first bus delivered. Now that hybrid vehicles are fully entered in the production chain, these kind of problems should be overcome.

Therefore, the following recommendations can prove useful for cities wanting to exploit Monza experience:

- **Sharing with PT companies the intention to shift towards hybrid technology**- An agreement with involved PT companies, who are in charge of future procurements, is essential to achieve the goal of increasing the number of hybrid buses in PT fleets.
- **Joining several cities in the test** – In order to to have more purchasing power with providers, it is useful to verify if other cities are willing to test hybrid technology: this can ensure a greater interest on the part of the producers, who are more willing to provide a large amount of vehicles, rather than few vehicles for one or few medium-sized cities.
- **Consultation of several providers –** In order to have the opportunity to choose between the different kind of buses available on the marketplace, it can prove very useful to consult

different suppliers, since this can allow to choose the best solution to be adopted according to the needs of each city.

- **Verification of production capacity** – Considered that worldwide crisis has forced manufacturers to revise investments and to diminish the number of stored buses, it is important, before activating a process of replacement of traditionally fuelled buses with hybrid vehicles, to verify the production capacity of the chosen supplier, in order to avoid the problem faced by Monza when Van Hool informed they would not have delivered the bus in due time.

D.4.2 Recommendations: process

- **Involvement -** Involving all partners (PT company, bus supplier, drivers) in such a pilot experiences proved highly useful to create an adequate framework for innovation.
- **Communication** – In Monza experience trade press and web coverage have proved very useful in order to raise awareness and to push other cities, PT companies or even private companies to about the implementation of the measure: in future, dissemination could push other cities, PT companies or even private companies to test hybrid technology, so exploiting Monza experience.

ANNEX 1 TO MERT NO. 7

Hybrid Bus in Monza

In order to evaluate core indicators concerning transport and society, and to assess mobility habits of surveyed people, two qualitative surveys were conducted before (May 2011) and after (June 2012) the start of the implementation stage of the measure.

The first survey, which was conducted on the 4 most frequented PT urban lines and in some nevralgic locations of the city, has interested 240 people in order to analyze their knowledge and their opinion about public transport improvements in progress in Monza thanks to ARCHIMEDES project, as well as detecting potential interest and perception about measures' development and which of the on going measures are considered mostly impacting on respondents mobility habits on going projects (even if they are not known)

A questionnaire of 23 questions was elaborated by statistic technicians according to Municipality of Monza's requirements and concerned not only measure no. 7, but also measures no. 19, no. 79 and no. 82.

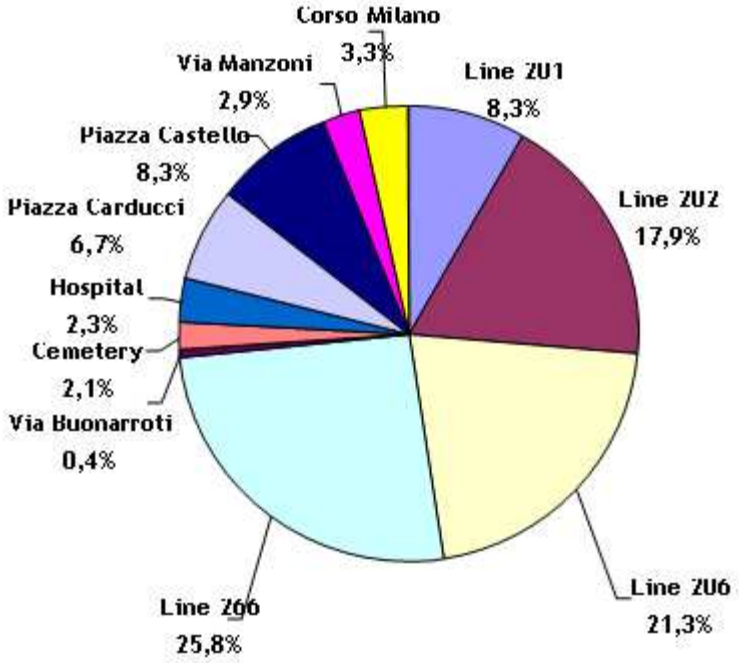
In June 2012 the second survey was realized on 236 people using public transport at Monza, on lines 206, 266, 202, 201 and at two main bus stop (Piazza Castello e Via Manzoni). The interview had the scope to assess awareness of the implementation of the measure as well as eventual changing of habits in using public transport and in quality of service. The opinions of the respondents were acquired through a questionnaire designed ad hoc.

The sample size guarantees the statistic reliability of the survey, according to the following parameters:

- Significance level: 95%
- Error margin – 5% .

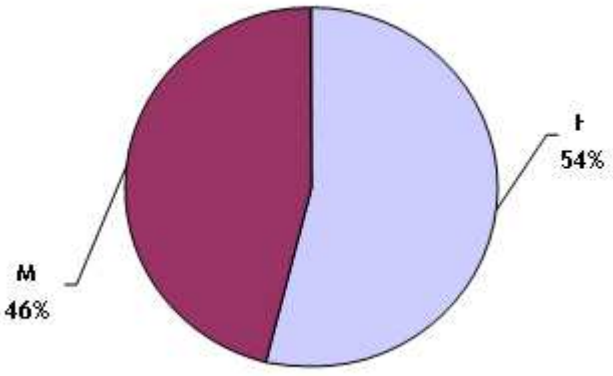
BEFORE DATA – May 2011 (sample size- 240 people)

Graph no. 1 shows the percentages of surveyed people for each public transport line and each city location.



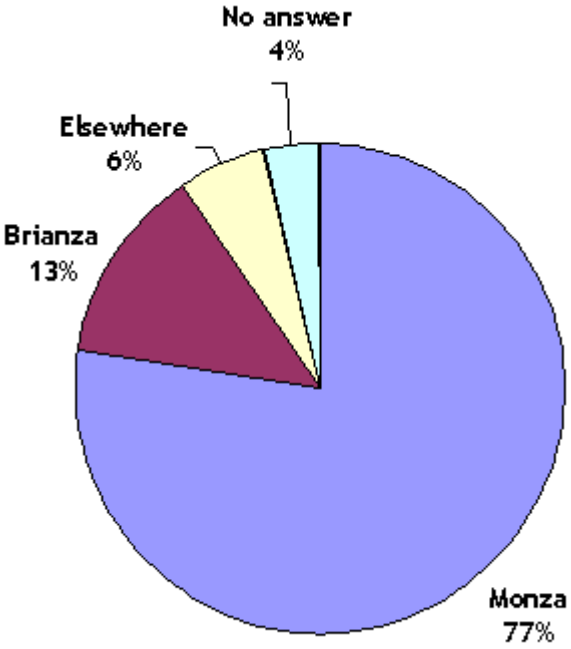
Graph 10 - Percentage of surveyed people for each PT line and location

The sample size (240 people) was made up by 46% of males and 54% of females.



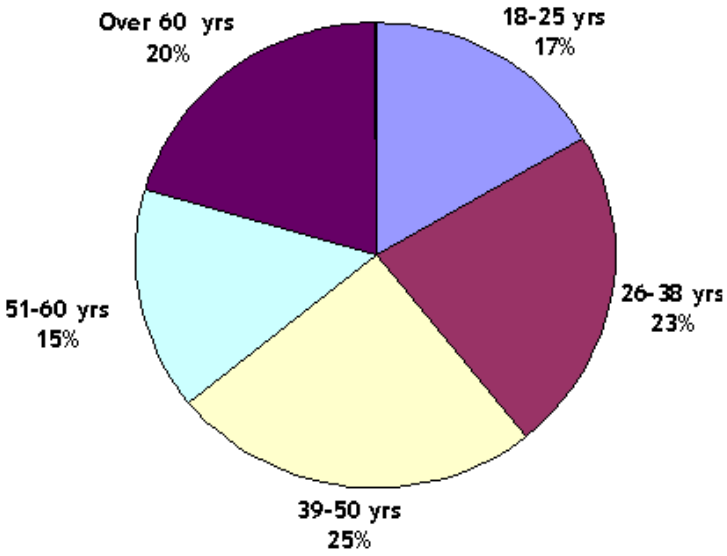
Graph 11 - Sex of surveyed people

77% of surveyed people live in the city of Monza, 13% live in Brianza and 6% live elsewhere: 4% of the sample did not answer to the question.



Graph 12 - Residence of surveyed people

Age of surveyed people is shown in the below graph.



Graph 13 - Age of surveyed people

The following graph shows the professional condition of interviewed people: several different conditions are represented, even though the 30% of surveyed people did not answer.

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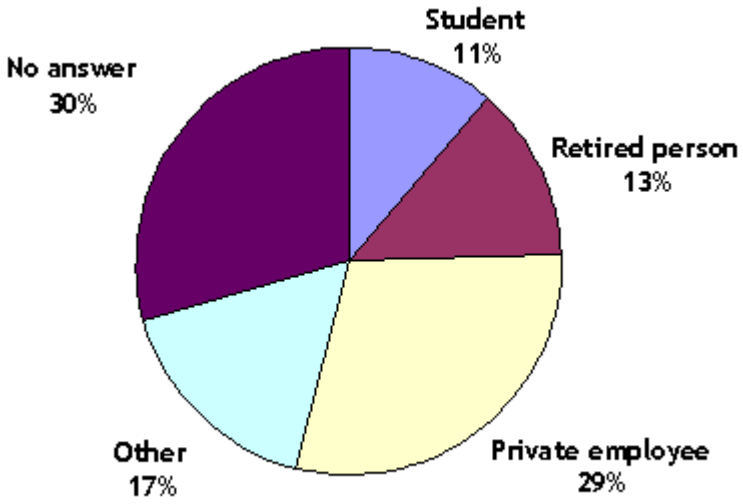
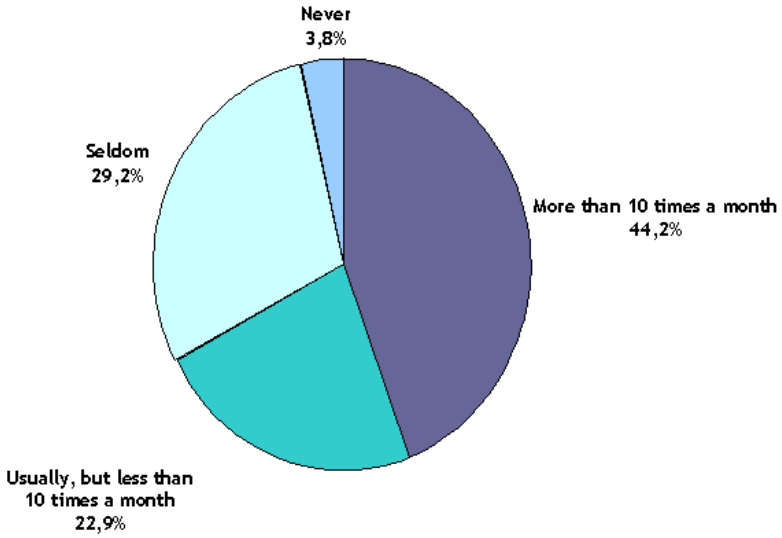
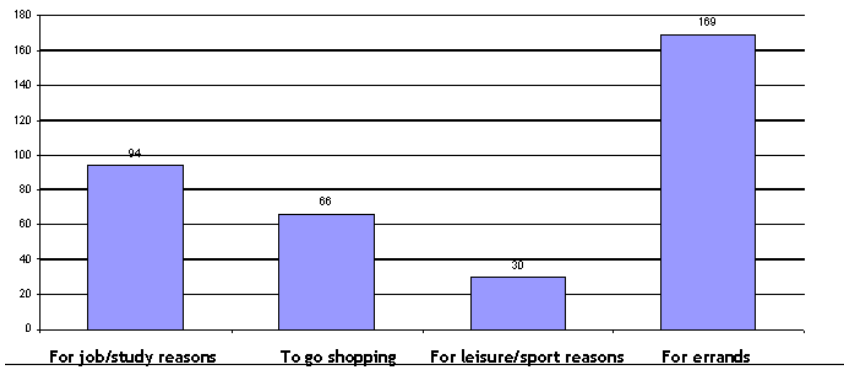


Mobility habits

Question asked	Answers
How often do you use public transport?	
Why do you use public transport?	

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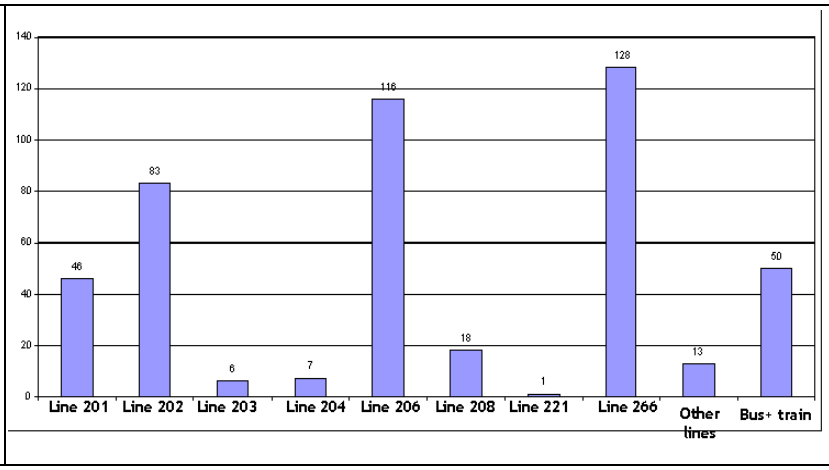
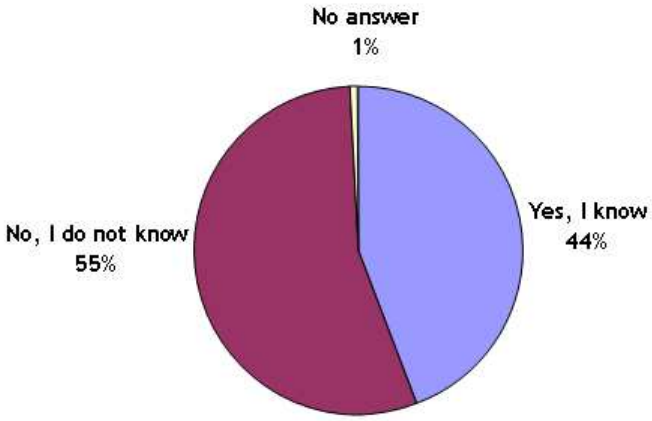
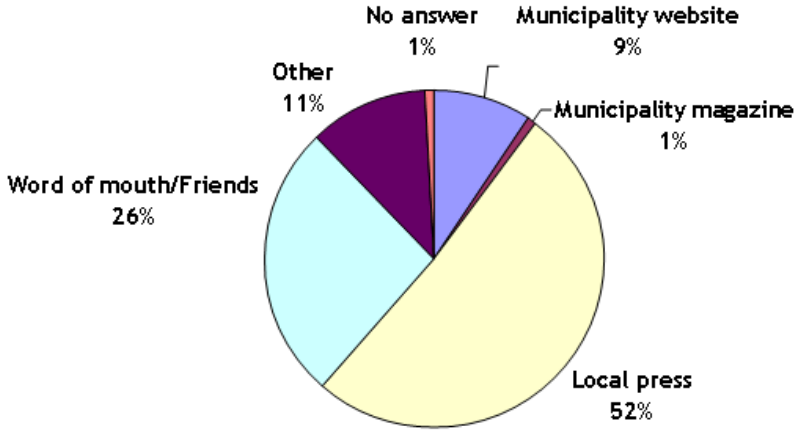
Which line do you use more often?	

Question asked	Answers
Do you know Comune of Monza is testing a hybrid bus? **INDICATOR NO. 14 (Awareness)**	
If you are informed about the hybrid bus, how did you know? **INDICATOR NO. 14 (Awareness)** SAMPLE SIZE FOR THIS QUESTION IS OF 106 RESPONDANTS	

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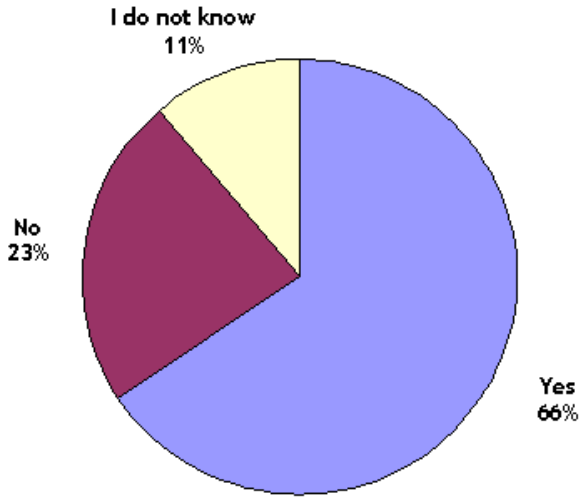
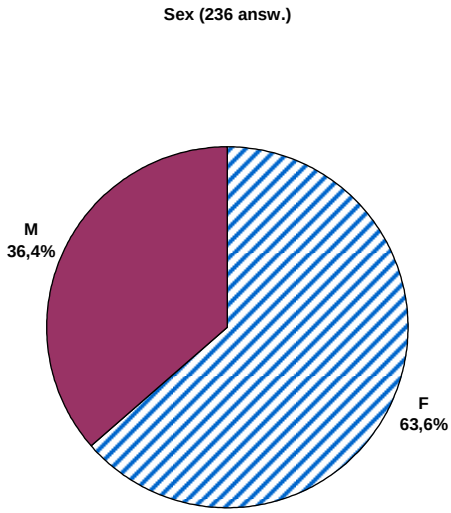
Do you think that the introduction of hybrid buses in the PT fleet could improve the quality of service? **INDICATOR NO. 19 (Quality of service)**	

AFTER DATA – June 2012 (sample size – 236 people)

SEX OF SURVEYED PEOPLE



AGE OF SURVEYED PEOPLE

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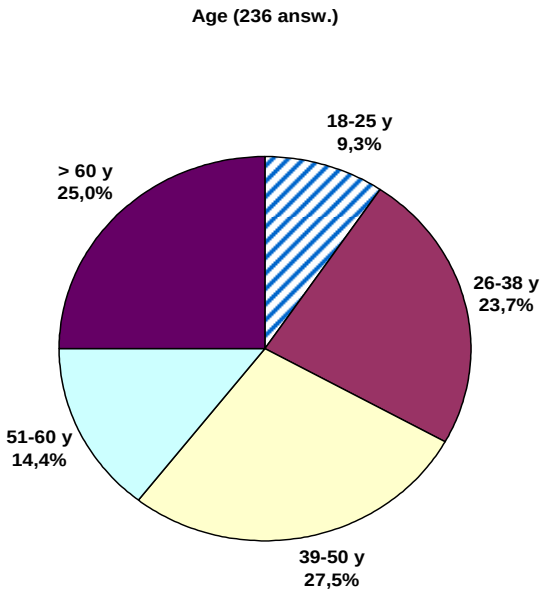
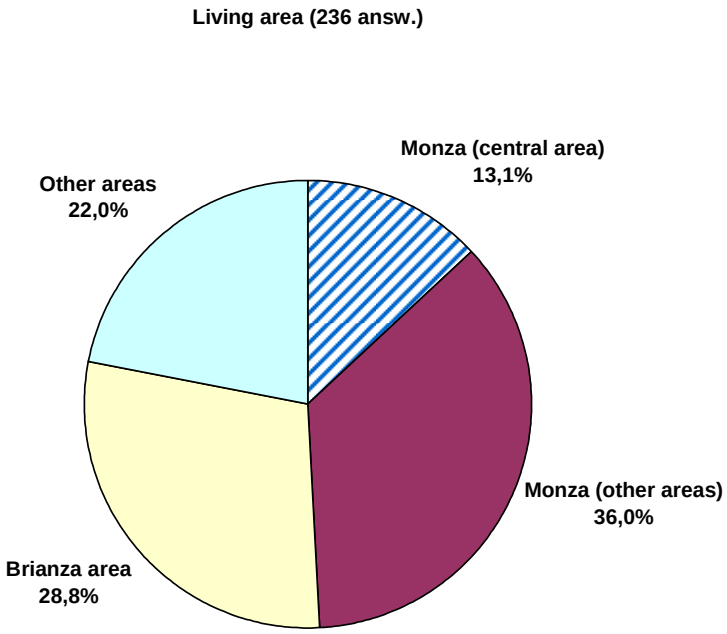


LIVING AREA



PROFESSIONAL CONDITION

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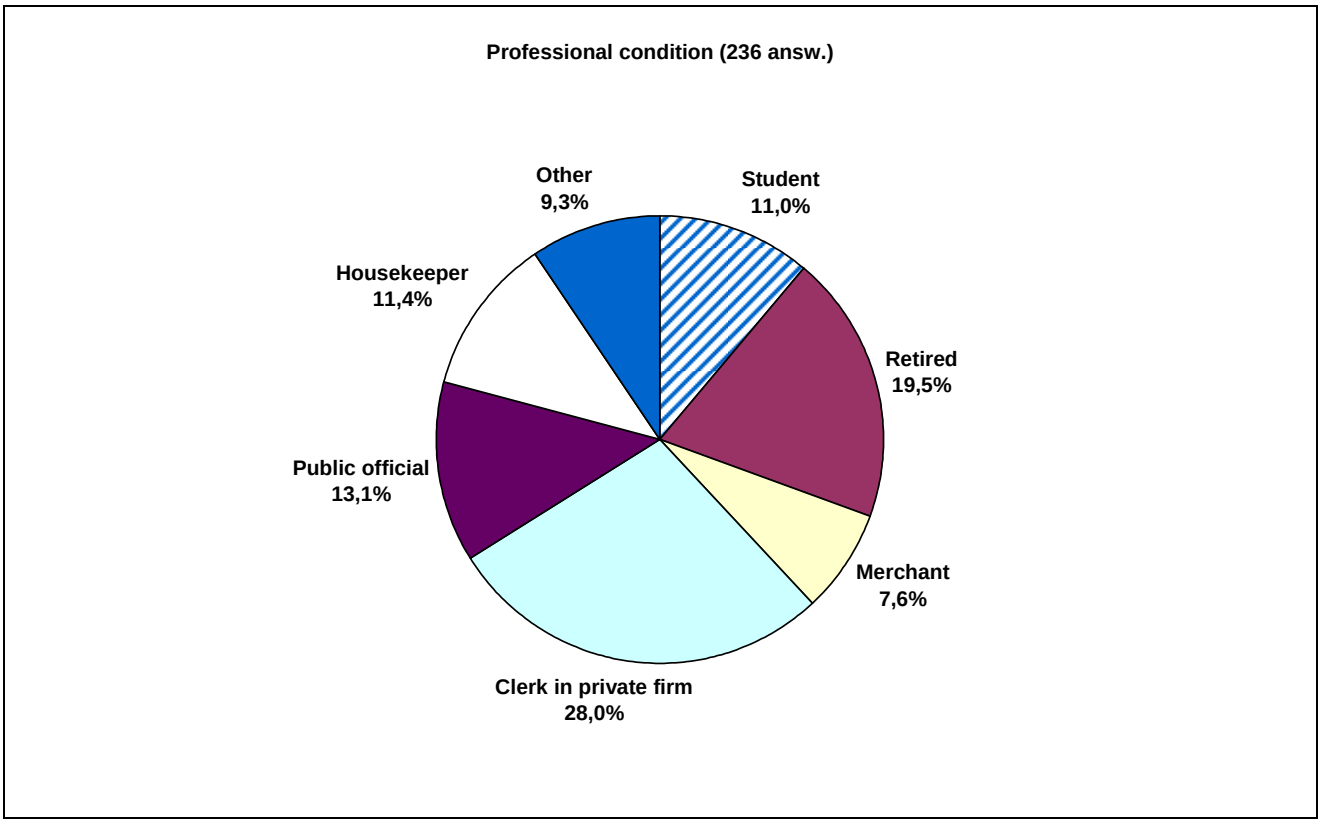

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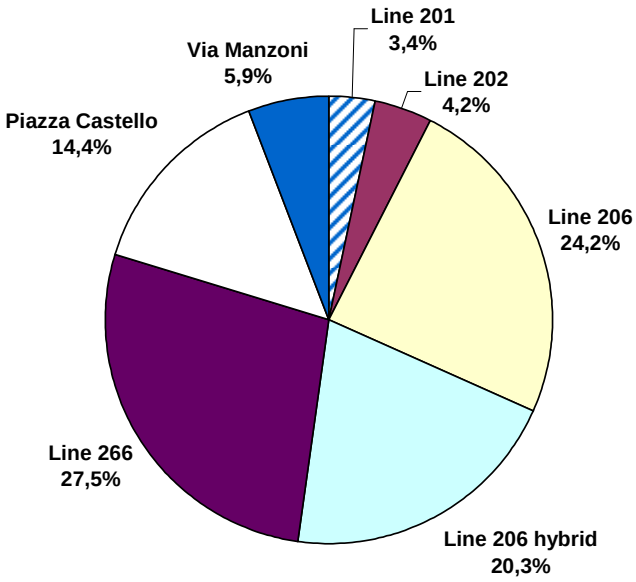
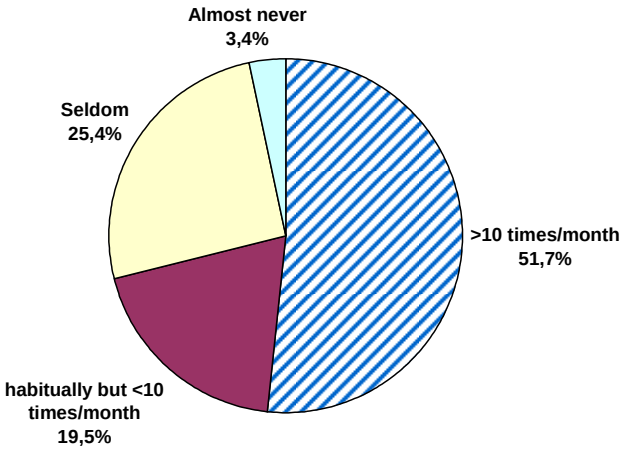
INTERVIEW SITE

Place of the interview (236 answ.)



MOBILITY HABITS

How often do you use public transport at Monza? (236 answ.)



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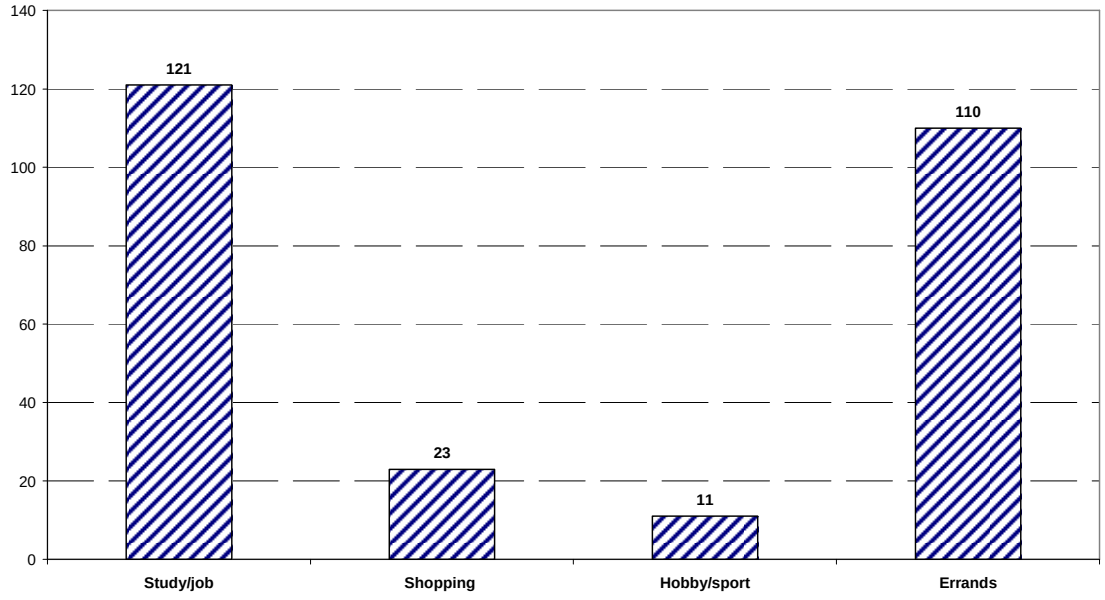
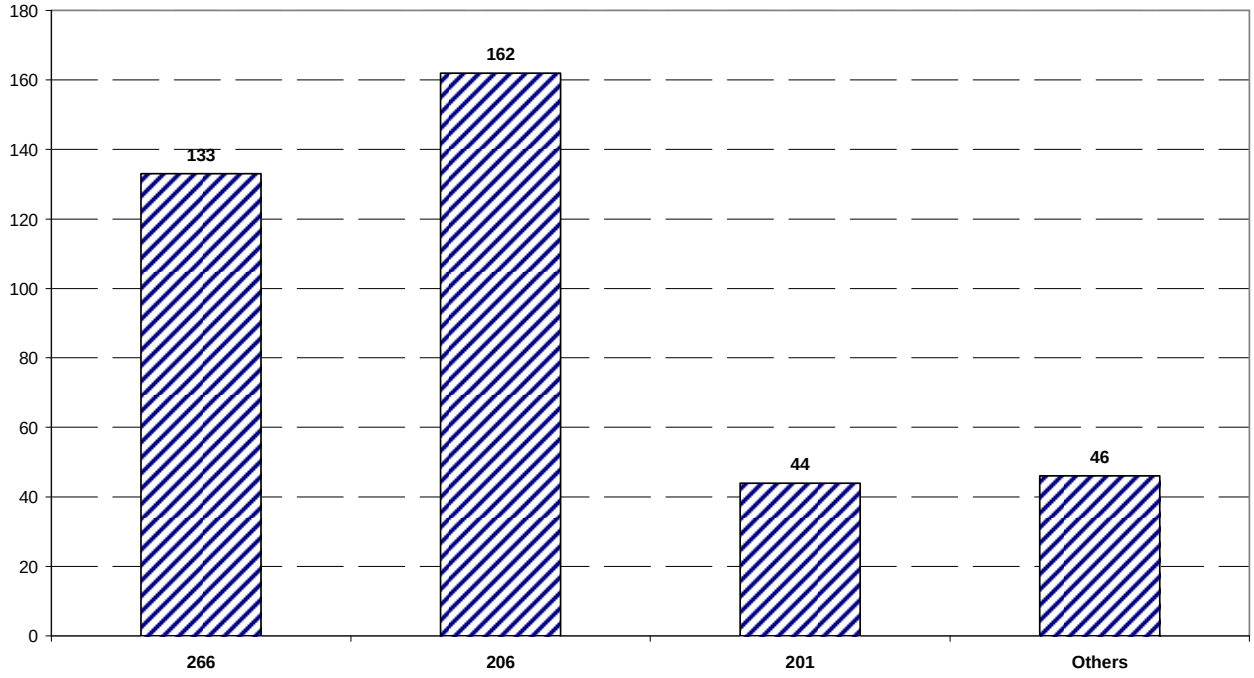
MOBILITY HABITS

Reasons to use public transport at Monza (multiple answ. allowed)



MOBILITY HABITS

Lines habitually used (multiple answ. Allowed) 236 people



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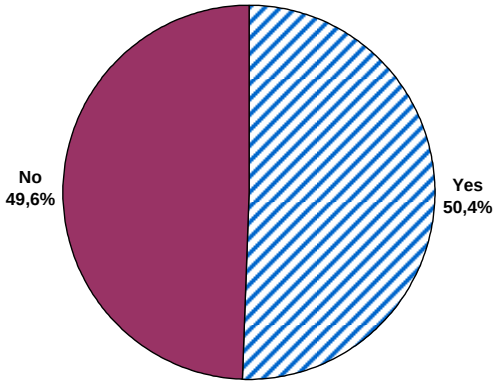
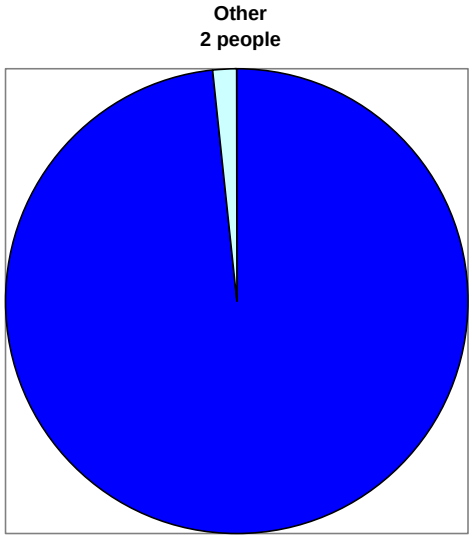
Do you know Monza Municipality is testing a hybrid bus? (236 answ.)



How did you know about hybrid bus? (multiple answ. allowed)



Measure title: **Hybrid Bus in Monza**

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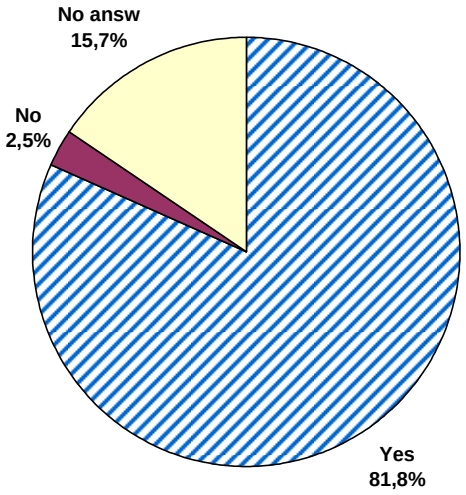
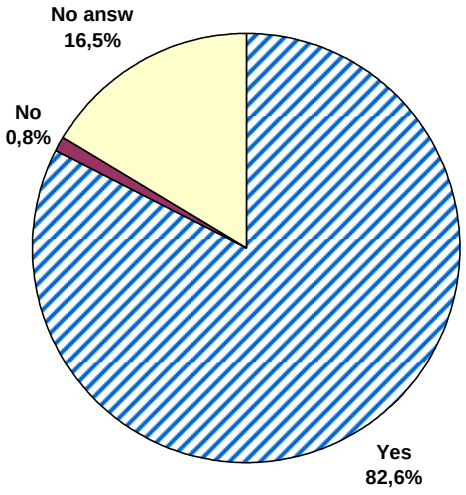
Do you know hybrid buses are less polluting than diesel buses? (236 answ.)



Do you think that using only hybrid buses could improve air quality? (236 answ.)



Measure title: **Hybrid Bus in Monza**

City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **7**