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Catch-MR
Metropolitan Regions

5. Newsletter – March 2012

CATCH-MR (Cooperative approaches to transport challenges in Metropolitan Regions) is an INTERREG IVC project running from January 2010 until December 2012 with a total budget of approximately Euro 2 million.

Workshop from 19 to 21 September 2011 in Rome. Renewable energy in transport

Renewable energy in transport: the fifth workshop in Rome, Italy

The fifth workshop within the framework of the CATCH-MR project was held in Rome (Italy), from 19th to 21st September 2011, during the European Mobility Week, an annual awareness raising campaign (from 16th to 22nd September) that aims to make citizens aware of the use of public transport, cycling, and sustainable mobility in general.

The Rome workshop was co-organized by two project partners – the Provincial Government of Rome and Bic Lazio – in the wonderful Spazio Europa venue, in order to discuss and exchange good practice on renewable energy in transport.

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About Catch-MR

Catch-MR, Cooperative approaches to transport challenges in Metropolitan Regions, is an INTERREG IVC project running from January 2010 until December 2012 with a total budget of Euro 2 million. The aim of this european project is to explore and adapt sustainable transport solutions for metropolises and their surrounding regions.

Twelve partners take part in the project, representing seven Metropolitan Regions (MR):

- Capital Region Berlin-Brandenburg (DE)
- Central Hungary (HU)
- Göteborg Region Association of Local Authorities (SE)
- Ljubljana Urban Region (SI)
- Metropolitan Region Vienna (AT)
- Oslo/Akershus (NO)
- Province of Rome (IT)

The project follows an integrated approach encompassing three themes:

- reducing the need to travel within the regions through coordinating transport and land use
- increasing the share of public transport
- increasing the use of renewable energy in transport

The partners pursue these objectives by identifying and promoting good practice. In the end of the project, the partners will present a Guide on efficient mobility and sustainable growth in Metropolitan Regions. Thereby, they will contribute with a joint approach applicable to Metropolitan Regions in general.
For more information visit *www.catch-mr.eu*

1 The workshop

The Rome workshop was opened by a welcome speech by the Councillor of Transport and Mobility Policies – Amalia Colaceci – and the introductory speeches by Frank Segebade (Capital Region Berlin-Brandenburg – lead partner) and Gian Paolo Manzella (EU Office Coordinator).

Welcome session at Palazzo Valentini - From left: Frank Segebade, Amalia Colaceci, Gian Paolo Manzella

The workshop was organised in two sessions focusing on the following two topics: mobility management policies and strategies to spread the use of renewable energy in transportion. Each session had a set of presentations first and then attendees were asked to discuss the topics in groups.

This paper underlines the commonalities emerged and tries to draw overall conclusions. It is structured like the workshop: first a report of speakers' key messages on mobility management measures; then the outcomes of group discussions on mobility management; then a few technological solutions to better manage mobility, which were not mentioned during the workshop but are worth considering; then speakers' key messages on renewable energy and its use; then the outcomes of group discussions on renewable energy; and lastly, some conclusions.

Both group sessions discussed the same set of topics:

- criteria to select policies and measures
- challenges
- solutions
- the financial framework
- vision

Group discussions are reported following the structure above.

1.1 Mobility management measures

Presentations were given by representatives from Vienna, Rome, Ljubljana, and Budapest to introduce the mobility management measures they either implemented or plan to implement.

Mobility management measures to promote a modal shift toward more sustainable modes can be divided into two groups: pull measures – to enhance the attractiveness of more sustainable modes – and push measures – to decrease the attractivenes of less sustainable modes. Less sustainable modes include private cars – because of congestion, environmental impact, and inefficient space use – and motorbikes – mostly because of their terrible impact on road safety.

Although measures and their implementation vary from city to city, they may be summarised in four main groups of pull measures and one group of push measures.

The four groups of pull measures are:

- better public transportation (PT)
- cycling
- information
- boosting public transportation

The first group is the one that is most traditionally addressed. To achieve a low modal share of private cars and motorbikes, an **efficient public transport system** is necessary. Measures to improve PT quality and comfort range from network reorganisation to the construction of new PT-dedicated infrastructure, the reservation of corridors on previously shared infrastructure, the improvement in service frequency and rolling stock quality for greater comfort and "green" appeal. However, if low quality public transportation encourages people to rely on private modes, high quality public transportation does not usually attract more users. For this reason, a combination of additional measures is also required. Good quality PT is the foundation of a sustainable mobility strategy but cannot be the only strategy measure.

Under the **cycling** heading, there are a number of measures to improve the modal share of cycling in cities. Several cities decided to make cycling more attractive in different ways; some of them tried to spread bike sharing, some others decided to improve their cycle track network, and others to provide for more bicycle parking at train or metro stations. How-

ever, the common view emerged is that cycling, in medium to large cities, needs to be complementary to public transportation, as it cannot cover the entire length of all trips. Intermodality – cycling + PT – is necessary to significantly improve the modal share of cycling as well as that of public transportation.

The **Information** heading gathers the largest number of measures, ranging from ICT (Information and Communication Technologies) for public transportation to give users real-time information, to integrated multimodal Web-based and mobile phone trip-planning services, to provide increasingly better integrated static information for commuters.The common idea of all these measures is that public transportation and intermodality requires more knowledge than private cars to be used effectively and that such knowledge needs to be made easily accessible.

Boosting public transportion is specifically relevant to greater urban areas where there are sprawling outskirts and suburbs. Providing high frequency and high quality public transportion in such areas is expensive and inefficient, hence new forms of public transportation are often required, ranging from on-demand services to one-way car-sharing, car-pooling, and ride-sharing. They all share the same need for innovation and intensive use of ICTs.

Push measures, on the other hand, were mentioned most of the time as being necessary. However, road pricing was the only push measure mentioned beside parking pricing – which is already extensively used everywhere and is no longer even considered as a required management measure. An option considered by many of the cities was to introduce either congestion charging schemes in central urban areas or environmental charging. Some cities already have rationing policies in place to limit access to city centres.

1.2 Renewable energy measures

Presentations were given by representatives from Göteborg, Akershus, Oslo, and Berlin-Brandenburg to introduce the measures they either implemented or plan to implement in order to foster the use of renewable energy in transport.
Two technologies – biogas and battery electric vehicles – were discussed in depth. Others like hybrids, hydrogen, biodiesel were mentioned as well. Biogas was referred as a promising technology because it is produced from landfill and agricultural waste and an already working technology can be used with.

In order to be used in vehicles, it should be either in a gaseous or liquid state. Liquid biogas has a higher energy density but requires a bulkier storage facility. It is therefore much more indicated for freight applications where space is less of a problem and higher energy density is required. The use of biogas can be fostered through the eco-labelling of vehicles and fuels. A biogas powered vehicle has an eco-label that besides allowing it to access restricted traffic zones also identifies it as eco-friendly means of transport. This is part of the “regulation through revelation” policy that, in principle, would increase the use of eco-labelled vehicles and fuels because customers would mainly chose eco-labelled transport means, thus compelling more and more carriers to get their eco-label.

Battery Electric Vehicles (BEVs) are one promising technology to decouple energy production from energy use in transport. The burden of reducing CO2 (and other) emissions is transferred from vehicles to electric power generation.

In order to foster a widespread use of BEVs, some Metropolitan Regions have developed a number of incentives to encourage their purchase and use: reserved car parking places, free-parking, bus lane access, tax incentives, and so on.

An option to facilitate the use of BEVs is smart battery charging at all locations, thereby allowing to plan even complex and long trips while solving the range issue which, to date, remains the Achilles’ heel of BEVs.

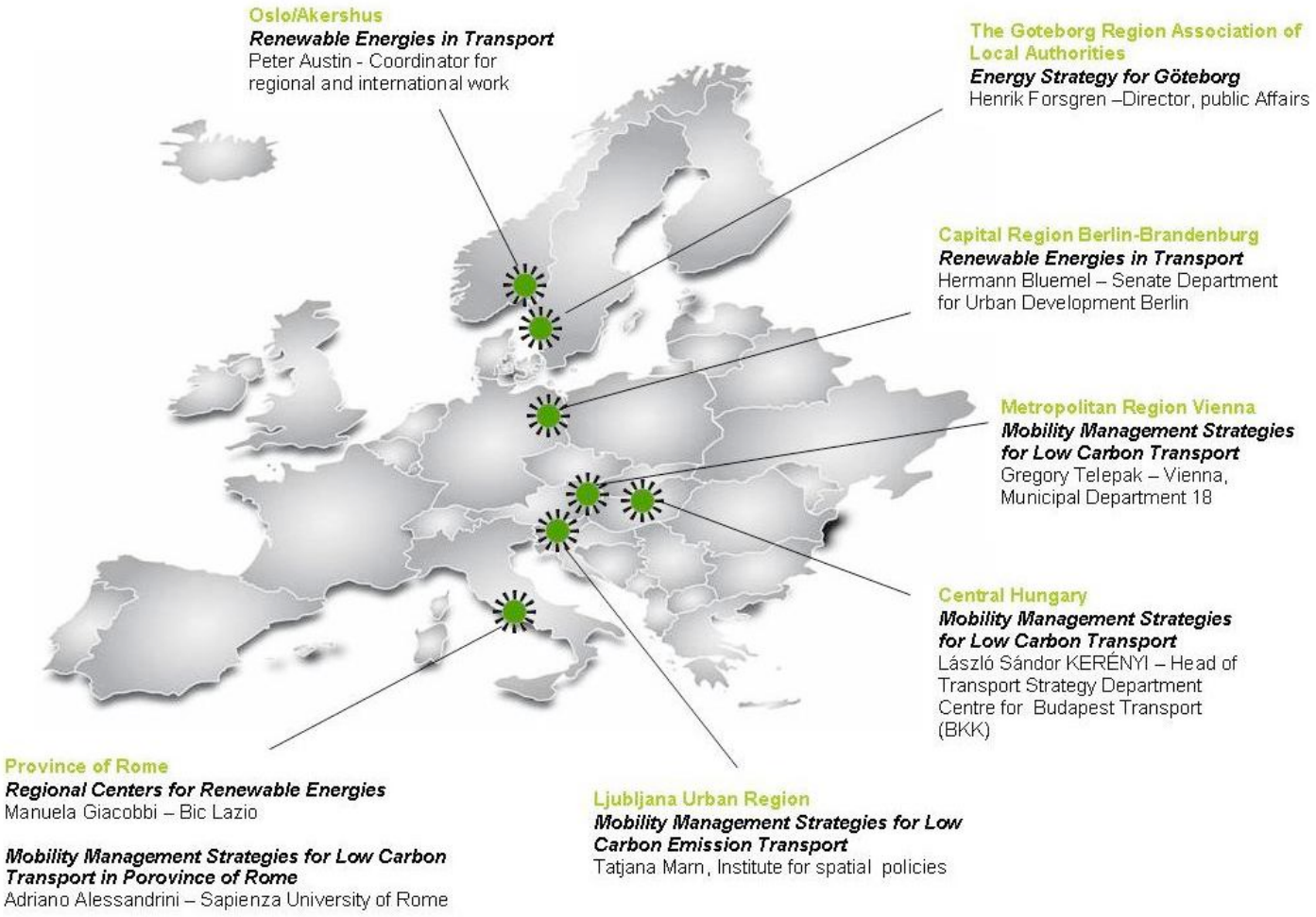
An in-depth evaluation of BEVs and their impact on the local and global ecosystems is needed, because BEVs are not a sustainable solution in all instances. A thorough eco-balance is required to calculate

whether travelling by BEVs rather than by internal combustion vehicles would really provide an overall benefit for the environment.

After the presentations, attendees broke into groups to discuss renewable energy sources and their application in cities and towns. The conclusion was that, in the long term, renewable energy sources will replace conventional ones. The key issue is knowing when and how to best accelerate this process. Any technical solution may be appropriate. In the long run, this is less a technical issue than a political matter and the most successful technology will probably be the one that has got the attention of policy makers.

At a time of financial crisis, the bigger economic picture will need to be considered. Future technological solutions will be chosen based on their cost-effectiveness.

Here is a map of the workshop presentations



1.3 Bic Lazio activities

During the last few years, the Regional Government of Latium has planned a number of actions in the energy field.

In particular, main strategic and sectoral goals were set in the 2006 Regional Energy Plan (PER), including the three 20/20/20 indicators for 2020 (a 20% reduction in CO2 emissions, a 20% increase in energy saving, and a 20% increase in energy supply from renewable sources), in accordance with EU policies.

In its implementating phase, the Regional Energy Plan has been complemented by other sectoral Plans, namely the Regional Mobility, Transport, and Logistics Plan (PRMTL), while also inspiring other initiatives by individual Departments. For instance, the Economic Development, Research, and Innovation Department has promoted a number of opportunities for SMEs or research centres willing to invest in energy production from renewable sources, funded by Regional Plans under the ERDF for the last two programming periods (2000-06 and 2007-13).
Similarly, the SMEs, Trade and Crafts Department has designed a number of actions to foster energy efficiency and saving across all provinces. Actions have been planned according to available resources or production systems and in partnership with local stakeholders. For instance, one initiative concerned the construction of pilot plants with a view to establishing a biomass cluster for the production of biogas and biodiesel in the agroenergy district of Latini Valley, a struggling industrial area located at the border of the Rome and Frosinone Provinces.

The initiative that may be considered as the most relevant one is the “Renewable Energy Plan” issued by the Regional Environment Department in 2006. The Plan consisted of 4 key development fields: 2 research projects (one on Organic Photovoltaic Cells in partnership with “Tor Vergata” University and one on Hydrogen in partnership with “La Sapienza” University) and 2 operating actions aimed at increasing the use of renewable energy sources. For the latter, two revolving funds were established throughout the years, in order to make access to credit easier for businesses and citizens.
In order to check the actual implementation of the Kyoto requirements, the Renewable Energy Plan

Regional hub for biomasses and energy efficiency in Colleferro

also introduced a regular control of the regional energy audit, by calculating the energy produced from fossil fuels and combustible renewables, as well as energy consumption by sector.

The ultimate goal was to single out possible actions and policies for reaching greater efficiency across the energy system in the Latium region. A comparison between the energy audits of 2006 and 2009 showed 3 main trends: a) the massive collapse in the share of energy produced from fossil fuels (from 90% to 44%), mainly due to the closing or discontinuation of some thermal power plants; b) a slight increase in the share of energy produced from renewable sources (from 4.9% to 5.8 %); c) a consequent tremendous growth in the share of energy imported from other regions for regional consumption (from 12% to 57%).

In the short term, however, no significant change in energy source shares seems likely to occur, since the transport sector accounts for 47.7% of final energy consumption: 98.9% of this share is oil fuels.
The above-mentioned partnerships with Rome Universities, alongside the Latini Valley pilot project, eventually led to the establishment of 4 Regional Hubs for research on and testing of energy solutions based on the use of renewable sources.

The Regional Hub For Hydrogen Technology Research and Development – based in Civitavecchia (north of Rome) – deals with research on the hydrogen cycle, for both stationary (storage) and mobility (vehicle fuel supply) purposes. The Hydrogen Hub has already participated in many EU projects, the most relevant of which was “HOST”, co-financed by the 6th Framework Programme, whose aim was the development of a modular vehicle prototype to be used for multiple purposes (as a shared car, taxi, garbage collector, freight delivery vehicle) by simply changing its cabin.
Lastly, the Hub premises host 2 masters courses organised by “La Sapienza” University on Energy Efficiency and Energy Management.

The Regional Hub for Sustainable Mobility (POMOS) was co-established in Cisterna di Latina (south of Rome) by the Regional Government of Latium and “La Sapienza” University. Its mission is to encourage

technology transfer from the academic community to industries as well as the cooperation between SMEs specialising in Ultra-Low Emission Vehicles (ULEVs) and Zero Emission Vehicles (ZEVs).

POMOS has developed many research projects at different levels. At a local level, the Hub and the Regional Government of Latium co-designed a project called "Ventotene: a zero-emission island", whose mission was to investigate solutions for an overall sustainable energy system serving the entire island. At a national level, the Hub focused on the development of a high-performance sports vehicle powered by a fully electric or hybrid motor.

The Regional Hub for Hybrid and Organic Solar Energy – mainly based at the campus of "Tor Vergata" University of Rome – is one of the 3 world excellence centres (the other 2 being located in Japan and Germany) of research on new generation organic photovoltaic cells. Cheap materials and extremely simple methods were used to manufacture these cells, thus allowing for considerable cost reduction. Moreover, cells can be either transparent or coloured to perfectly fit into various architectural settings.
Lastly, the Regional Hub For Biomasses and Energy Efficiency is located in Colleferro, in the abovementioned Latini Valley, at the BIC Lazio Centre for Business Promotion.
Its aim is to support business creation and development in the agro-energy sector.
In order to promote the use of alternative energy sources, a pilot plant was installed at the Hub: it is powered by a cogeneration microturbine, which supplies both electric and thermal power at high (90%) efficiency rates and with high multi-fuel flexibility (it can use biomasses, wood, vines from pruning, waste, biogas, and bio oils).

1.4 Conclusions

As stated above, the workshop on the Catch-MR project – held in Rome from the 19th to the 21st September 2011 – aimed to discuss mobility management policies and strategies to spread the use of renewable energy in transportation. It was organised in two sessions focusing on the two main topics and comprised a set of presentations followed by four discussion groups. The main overall conclusions emerged from presentations and discussion groups are reported below.

Long-term planning is crucial for both mobility and energy and should be agreed upon with:

- the different government levels
- the neighbouring local government
- the opposition parties that will have governing roles in the future
- Modal shift is "the" solution to reduce energy consumption in transportation, but very different approaches are needed to introduce this shift in down-town trips and commuting .

Technology is often necessary for this modal shift, especially in areas where transport demand is less significant and conventional public transport is less effective.
A reduction in energy consumption is essential to shift to renewable energy, because the renewable energy available in most cities is not enough to maintain our current consumption standards. Therefore, mobility management strategies to encourage a modal shift have to be combined with energy strategies.

The renewable energy sources chosen for use in transportation can vary considerably from one location to another. Winning technological strategies are not immediately transferable but need to be tailored to local needs and resources.

2 Sustainability in Province of Rome

2.1 European mobility Week

As written at the beginning of this newsletter, the Rome workshop was held during the European Mobility Week, an annual awareness raising campaign (from 16 to 22 September) that aims to make citizens aware about the use of public transport, cycling, and sustainable mobility in general.

We think that it is important to spend more words about this matter.

The European Mobility Week Award rewards local authorities' activities in the framework of the European Mobility Week 2011. The Award aims to promote best practices in organising the Week and to raise awareness of the need for local and individual action in the field of sustainable urban mobility.

The Province of Rome has presented the initiatives planned for the European Mobility Week, to be held in September. The provincial government has joined the event sponsored by the European Commission and co-organized by the Eurocities network of major European cities, Energie-Cités, and Climate Alliance.

Events

First Forum on cycling:
organised by Coordinamento Roma Ciclabile.

GoodBike:
the first eco-concert on a stage entirely powered by energy from bicycles. This is a brainchild of Têtes de Bois, a music band, and will be held in Rome, in Piazza dei Sanniti.

A car-free day:
organised by Province of Rome, and joined by the following 40 municipalities:
Ciampino - Mentana - Lanuvio - Mazzano Romano - Montecompatri - Monteporzio Catone - Genazzano - Montelanico - Albano Laziale - Anzio - Ariccia - Campagnano di Roma - Canale Monterano - Cineto Romano - Civitella san Paolo - Monterotondo - Frascati - Bracciano - Ladispoli - Morlupo - Nazzano - Palombara Sabina - Municipio XVII - Municipio XV - Montelibretti - Genzano di Roma - Poli - Percile - Zagarolo - Rocca Priora - Saracinesco - S. Vito Romano - Subiaco - I municipio - Capranica - Prenestina - Valmontone - Velletri - Riano - Rocca di Papa - Fontenuova - Pomezia.

Catch MR – Fifth Workshop:

As reported we have offered the following alternative transport modes:
In September and October, we have offered a shuttle service to the bus and train stations of the following towns: Albano Laziale, Castel Gandolfo, Genazzano, Bracciano, Anguillara, and Trevignano.

We have implemented the following permanent measures on the occasion of the European Mobility Week 2011:

1. Launch of a grant for the purchase and set up of electric bicycles with pedal assistance and installation of charging stations using alternative energy sources and bike parking to be used to improve cycling – second edition;
2. Launch of a shuttle service – using either hybrid or electric buses –, financed by the Provincial Government, in order to foster the decongestion of city centers ;
3. Delivery of bike parking to 40 high schools in Rome, to support citizens who go to work or school by bike, and training for those who are approaching the sustainable world of cycling;
4. Mobility Manager shuttle transport for employees. The Province of Rome – following the initiatives promoted by the Municipality of Rome and Atac spa – has decided to join the fund for subsidies and incentives allocated to public transport services for work commuters and the plans undertaken in response to the request for sustainable mobility promoted by mobility managers – provided in an innovative way - that could either supplement or complement local public transport.

The Mobility Manager shuttle transport for Province of Rome employees

European mobility Week leaflet

2.2 The Province of Kyoto: Province of Rome action plan on environmental sustainability policies

The Province of Rome has focused its government action on environmental sustainability policies within the framework of an action plan called “Province of Kyoto”: the Provincial Government has therefore committed all of its efforts to helping fight climate change.

Seven sustainability challenges have been singled out in the “Province of Kyoto” plan:- development of alternative energy;

- waste reduction and separate collection;
- land use planning;
- sustainable mobility;
- biodiversity and forest resources;
- provincial Government sustainability.

The strategic plan undertaken has identified the opportunities that may result from it by focusing on innovation, sustainable development, and green economy, thereby triggering a virtuous circle of public and private investment.

The most substantial action component regards energy efficiency in public and private building as well as the spread of renewable energy sources.

Sustainable mobility is one of the strategic sectors covered by the actions undertaken in the Covenant of Mayors, considering the impact of transportation on the overall amount of CO2 emissions. These are some of the actions deployed: mobility corridors, removal of level crossings, a provincial commodity monitoring centre, a sustainable mobility desk for municipal governments, subsidies for bike sharing, mobility managers.
In 2009, the Province of Rome entered into the Covenant of Mayors, an initiative promoted by the European Commission to provide local governments with an opportunity to actually commit themselves to fighting climate change, by implementing actions that innovate administrative management and directly af-

An example of solar panel on the roof of a high school

Province of Kyoto leaflet

fect citizens' quality of life.
The Province of Rome, in its capacity as a local co-ordinating body, supports Municipal Governments in drawing their CO2 Emission Reports, which is an obligation to fulfill in order to define the Sustainable Energy Action Plan (SEAP) required by the European Commission.
The SEAP established by the Province of Rome was approved by the Provincial Council in its meeting of 1st April, 2011. On 20th January, 2012, the number of Municipal Governments having joined the Covenant of Mayors was 31.

By the actions it has planned, the Provincial Government means to help attain the sustainable energy policy targets set by the European Union in the so-called "20-20-20 Package", namely a 20% reduction in energy use, a 20% increase in renewable energy sources, and a 20%, reduction in CO2 emissions by 2020.

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3 Site visits

3.1 Malagrotta

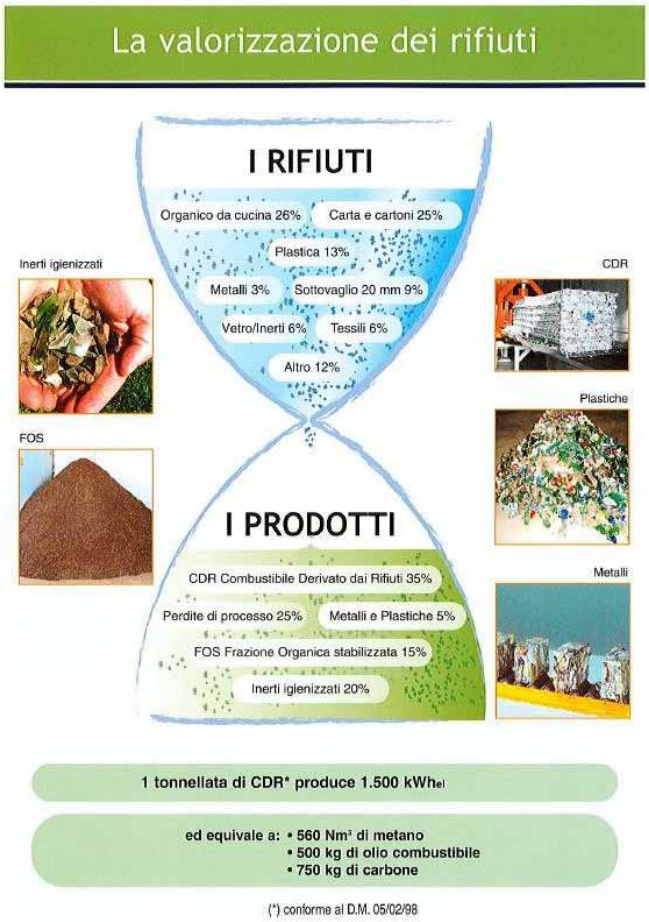
Malagrotta Landfill
Extending on more than 200 ha of surface, the Malagrotta landfill is the largest one in Italy and certainly one of the largest waste dumps in the European Union. It started operation in the second half of the '70s. For more than 15 years, the Malagrotta landfill site has been disposing waste from Rome, the "Vatican City" and the adjoining municipalities of Fiumicino and Ciampino international airports, accounting for a global yearly amount of some 1.5 million tons. In addition, a special unit treats about 150,000 tons of sludge from domestic waste water treatment plants.
The engineering, construction, and operation of the Malagrotta landfill have meant – and still entail – such a significant amount of investment, research, testing, human resources, and technology that the site has been appropriately nicknamed "the city of environmental industries".
Since the early 90s, particular focus has been placed on the use of biogas as an alternative energy source. The first attempt in this field was a system co-designed by S.I.C.E.S. S.r.l. and Eniplan Ltda. to produce fuel similar to oil products for road transport use: in addition to responding more than adequately to this purpose, biomethane releases significantly lower emissions into the environment than conventional fuels.

Malagrotta Model

The Process
The treatment process consists in purifying biogas derived from controlled MSW (municipal solid waste) landfills. The purification process can be applied to biogas of different origins, like biogas produced from the anaerobic fermentation of industrial organic waste, biogas from fermentation in sewage treatment plants, and so on.

General Information on Landfill Biogas
The production of biogas from MSW is a spontaneous process that demands no energy input from outside thanks to the anaerobic digestion of MSW itself. The production of biogas from MSW landfills results from the anaerobic digestion of organic materials in landfill sites, performed by highly-specialised bacterial populations contained in MSW.
These micro-organisms degrade organic matter through a number of phases leading to the production of intermediate products, which are gradually metabolised and eventually converted to methane and carbon dioxide.
Biogas production processes are spontaneous. The pace at which these processes occur depends on waste composition and landfill management.
There are three main phases in biogas production:

a) Hydrolysis and acidogenic fermentation
This phase consists in the hy-



drolysis of organic compounds – such as carbohydrates, fats, proteins –, which are transformed into smaller molecules. Compounds like starch and cellulose are hydrolysed into oligosaccharides and monosaccharides; fats are hydrolysed into long-chain fatty acids; proteins are hydrolysed into amino acids.

b) Acetogenesis
The organic compounds produced in phase a) are transformed into acetate (CH3C00-+H+) through oxidative metabolism and dehydrogenation processes, which demand low concentrations of hydrogen.
The hydrogen produced in the first phase can be removed by bacteria that produce acetic acid from carbon dioxide and hydrogen.

c) Decarboxylation of acetic acid and CO2 reduction
At low concentrations of hydrogen, methane is mainly generated through acetate decarboxylation by methanogenic bacteria (Methanotrix, Methasarcina) that produce methane and carbon dioxide in a 1:1 ratio. About 70% of the methane produced will normally result from this reaction.

The hourly production rate of biogas that can be captured is defined on the basis of the average output assumed in a 15-year time frame. Considering the actual biogas output trends and that MSW dumped over an average period of 3 years is gathered on the same lot, the actual production rate is expected to be higher than assumed at design stage for the first 7-8 years of biogas capture.

Energy recovery from biogas and environmental safeguard
BIOGAS derived from the anaerobic fermentation of organic waste (MSW) has a significant energy content.
As a matter of fact, its 50-60% methane content provides it with a heating value (HV) of 4000-5000 kCal/Nm3 and corresponding energy content.
Alongside methane, the so-called raw biogas contains inert compounds and, most of all, polluting and corrosive compounds such as hydrogen sulphide (H2S), hydrochloric acid (HCl), hydrofluoric acid (HF), silicon compounds, and other compounds such as acetic acid, butyric acid, aldehydes, etc. Moreover, it is saturated with humidity, which increases corrosiveness even in relatively inert gases like carbon dioxide (CO2).

The direct utilization of raw biogas, especially in internal combustion engines for automotive applications or electric power generation, will imply:

- low efficiency owing to the relevant amounts (30-50%) of inert gases
- adjustment difficulties owing to the variable behaviour of non-combustible compounds and most of all
- low operational life time of vehicles owing to the high corrosiveness of this gas
- high maintenance costs owing to the need to frequently replace parts and, above all, lubricating oil that is easily degraded and contaminated by the gas pollutants.
- higher operational costs owing to greater difficulties in maintaining engines adjusted.

On top of these economic issues, there are ENVIRONMENTAL IMPACT problems related to the air pollution caused by the use (burning) of raw biogas.
As a matter of fact:

- The massive content (about 40%) of CO2 (carbon dioxide) in raw biogas results in an increase of NOx and toxic CO in engine combustion chambers

- Although hydrogen sulphide (H2S) can be found in small amounts [50-200 ppm (vol.)], when it is burnt, it converts into SO2 (sulphur dioxide) and SO3 (sulphur trioxide). If there is humidity, SO2 and SO3 convert into sulphurous acid and sulphuric acid, which are the main causes of ACID RAIN. Moreover, H2S is a highly poisonous gas.
- Despite their negligible concentrations in biogas, hydrochloric acid (HCl) and hydrofluoric acid (HF) are, in engine exhaust gases, major causes of ACID RAIN owing to their high reactivity.

Raw Biogas Purification
Recovering energy from biogas requires a purification plant that reduces the pollutants released into the atmosphere by conveying them to the leachate treatment plant, from where they are then disposed of in special units, thereby obtaining purified biogas that allows to optimise the operation of endothermic engines and keep air pollutant emissions largely within standard limits.
Hydrogen sulphide results from the anaerobic fermentation of products containing sulphur compounds. It is almost completely washed out in scrubbers and then conveyed to the treatment plant, thus preventing if from being both released into the atmosphere and carried to endothermic generators.
Also hydrochloric acid and hydrofluoric acid are fully removed by converting them to sodium and calcium chlorides and fluorides, which are then forwarded to the treatment plant.

Origin of the Technology
This technology has been developed since 1983, starting from existing technologies, with the purpose of offsetting the drawbacks of traditional processes, such as the poor purity of the gas obtained and its humidity content that is particularly harmful in case of use in vehicles.
Starting from the existing gas scrubber, which operated by washing the gas with water (or aqueous washing liquids), the technology has been upgraded by adding molecular sieve SELECTIVE ABSORPTION. After building a pilot installation (50 Nm3/h of pure gas) that has made it possible to fine tune the technology, industrial installations have been engineered (500 - 1000 Nm3/h of biogas).

As a consequence, the current biogas treatment technology can be said to be the result of well-established lasting experience from more than 10 years of operating industrial installations.

3.2 Tiburtina Railway Terminal: a new city centre

Designing the New Tiburtina Railway Station – as suggested by the call for projects – offers an opportunity to build a new city centre, which may be spatially and physically reconnecting two districts that have been historically separated by the railway tracks. Starting from the provisions of the Urban Development Plan, the project design enhances some existing local layouts and axes that have become the reconnecting points of the New Railway Station to the physical context of the two districts it extends on.

The large pedestrian arcade built on the railroad bridge may thus create a bridge terminal as well as a city monumental indoor boulevard capable of joining the Nomentana and Pietralata city districts through a complex and sophisticated system of squares and pathways that establish continuous urban space by connecting the big station building to the smallest areas of those local contexts. The overall design aims to combine the inevitable „atopia“ of any major international passenger transport terminal with the inescapable needs of city physical settings as well as with the innermost and most fragile meaning of local contexts and the historically accomplished identity of individual places and the city. The big borderless railway terminal will be connected to the urban fabric by redeploying it to the city scale, by means of its structural axes and the design of its public spaces.

The New Railway Station as a Chance for Environmental Redevelopment
This project design aims to consider the New Tiburtina Railway Station as a chance for the city

environmental redevelopment and infrastructure endowment. This mission is pursued by means of a strategy that is globally aimed at identifying the environment as a major framework of infrastructure endowment to be systematised by the project design. The pedestrian arcade is meant to be a large city boulevard that will make it possible to reconnect the Nomentana district and the Pietralata park, by having the latter incorporate the environmental fragments of the former. The big city boulevard will link the park natural landscape to the city urban landscape by forming the initial sequence in the park new design setting. This goal is achieved by dedicated pathways both on the Pietralata district side – which directly join the park from the bridge arcade through pedestrian walkways – and on the Nomentano district side (where the southern square and its steps reconnect the arcade level to that of the large environmental fragment where two farmhouses subject to restriction are to be found). Moreover, the boulevard arcade is designed as a large environmentally friendly structure also from an architectural and technological perspective, thanks to the use of experimental technologies in the fields of bioclimatic architecture and overall environmental sustainability control.

The New Railway Station

General Architectural and Integrated Engineering Concepts. The Bridge Railway Terminal is herein designed as a large elevated arcade that serves the dual purpose of an international railway station and a major city boulevard. These two purposes are made mutually compatible by the concept of extremely high indoor space that is fully adaptable to the most varied layout needs. The spatial concept of a big container of floating suspended spaces is of course consistent with the structural requirements that suggest a „suspended“ organisation of space capable of optimising the structural bays of upper floors and solving any criticality resulting from the vibrations transmitted to the current platform-based structures by the passing and stopping of high-speed trains. The idea of freely floating spaces in a container that can interact with the outdoor environment from a climatic standpoint is also consistent with the general bioclimatic approach of the design.

The concept of an arcade without structural constraints at an elevation of +9.00 allows for true flexibility in using space by means of free layouts where shopping areas and waiting rooms can be actually integrated like in big airport terminals. The bridge arcade is built over the existing floor, which the new design has fully utilised across its length and width. Volumetrically speaking, it is a big parallelepipedal glass structure of 50 x 240 ml and a constant height of 9.80 ml. The parallelepipedal glass structure is supported by an upper net-like external structure, to which both the side windows and the flat roof (which is also partly in glass) are hooked. This big net-like external structure is built over and outside the glass building. Along its southern and northern sides, it rests on two rows of circular pillars of 2.00 ml across, which are in line with the side reinforced concrete

walls that support the existing floor, thus forming a mesh of about 50 ml clear span. The side windows are made up of a stretched supporting structure and special plate glass windows linked to stay wires by means of a steel hook. The glass used is a Thermal Insulating Material (TIM) in order to ensure proper insulation from sun rays and noise. The big arcade will be covered by a suspended flat roof made up of alternating transparent and opaque plate glass. On top of transparent plate glass windows, laminar shading devices are mounted on the external net-like structure in order to shield the parallelepipedal glass structure from the sun reaching the zenith in summer while letting winter sun through.

Catch_MR group at Tiburtina Station

The big suspended areas host facilities and amenities (VIP lounges, internet access points in catering areas, a restaurant, offices to rent, a small conference centre, an electronic traffic control room, and so on), which are usually to be found on the upper levels of airport terminals. These are eight separate suspended areas, each one having its own direct entrance by staircase and lift on the arcade floor at an elevation of +9.00. These separate areas are connected at a higher level by the suspended maintenance gangway that runs centrally across the glass station building lengthwise, at an elevation of +15.00.

The Bridge Terminal as a Smart Building

Following the obligations undertaken by parties to the Kyoto Protocol, the recent White Paper (7th April, 2000) of the European Commission outlined an integrated and coordinated action plan aimed at significantly reducing greenhouse gas emissions. Moreover, the increasingly considerable role devolved to local governments in resource management demands a new comprehensive strategy for energy conservation and proactive environmental protection. In this regard, Law No. 10/91 – which was passed to implement the National Energy Plan – is presently becoming a reference framework in promoting with greater emphasis the rational use of energy (RUE) by practitioners on the one hand, and energy saving habits among consumers on the other hand. With regard to the former, Law No. 10/91 compels designers to meet the energy demand of public buildings by using renewable energy sources or similar options, barring technical and/or economic obstacles. The term „similar options“ is understood in a broad sense and also includes energy saving achieved by acting on the building envelope (bioclimatic architecture) and on technological equipment.

Bioclimatic Architecture

The design of the New Bridge Railway Terminal – namely the arcade – stems from the use of effective bioclimatic strategies. In particular, the following systems have been adopted:

- solar radiation active control systems;
- passive control systems to obtain natural cooling in summer time and heating in winter.

All the systems used are easy to manage and maintain, and do not require any specific human intervention. The big parallelepipedal glass arcade is an engine that constantly produces hot air by greenhouse effect. The hot air produced is used directly in winter time, while in summer time, the thermal lift properties of hot air are used to trigger off convective air re-

circulation that provides the arcade with continuous fresh air delivery. In summer time, in particular, solar radiation is shielded by active control systems. Being set back from the flush of the upper structure, at the passage of emergency vehicles , the southern side of the arcade is self-shielded. As explained above, protection from sunlight at zenith is ensured by systems of laminar grids mounted on the outdoor net-like structure. The slope of the laminar systems will ensure complete shading from summer sunlight at zenith, while allowing the solar heat radiation to go through when the sun is low in winter time. Owing to its thermal properties, the hot air produced in summer time will flow upwards out of the roof-top ventilation stacks anchored to the outdoor net-like structure. These ventilation stacks are designed to pull indoor air out of the building thereby creating a depression that is fuelled by the controlled intake of outside air. Outdoor air delivery exclusively relies on the bioclimatic system installed all along the edge of side windows, at the base of the plate glass. Through this system, the outdoor air that is pulled into the building is made to flow through a cooling radiative system. This radiative air cooler utilises the cooling power of sprinklers that spray water onto the internal surface of a radiative plate, whilst incoming air flows on the external surface of the plate. Without coming in contact with the water circuit, outdoor air is gradually cooled and pulled into the building by the continuous flow of hot air escaping from ventilation stacks, thus forming a continued convective cooling loop. In winter time, instead, hot air is produced by the greenhouse effect of solar radiation not being shielded by the outdoor horizontal laminar shading devices. Like in summer time, hot air flows out of ventilation stacks by thermal lift, thereby creating depression in the arcade building. This depression is balanced by the outside air pulled in: in winter time, cool air comes into the bioclimatic system at the base of the arcade side windows. During the winter season, the cooling radiative system will be off, while the heating coil installed in the last chamber of the unit will be on, thus letting pre-heated air in and triggering a continued convective heating loop.

Rational Use of Energy (RUE): Informative Criteria for the Integrated Design of Technological Equipment.
The New Tiburtina Terminal design has been elaborated using renewable energy sources and state-of-the art energy saving technology, the aim being to optimise and balance design options according to an integration approach. Below are some informative criteria on the use and features of renewable energy sources as envisaged in the preliminary design.

Low-Temperature Solar Thermal Energy
This technology consists of a very advanced compound parabolic concentrator that offers a great potential for integrated and multipurpose use. In the New Tiburtina Railway Terminal, solar energy will be used to produce hot water as well as to supply refrigerating energy by means of absorbers and/or to provide geothermal heat pumps with additional energy.

Cogeneration
The combined – rather than separate – production of heat, power and cooling is becoming more and more widespread owing to the thermodynamic efficiency of cogeneration units. In particular, in such a complex scenario as a railway station that is constantly under strain in terms of energy supply and consumption, cogeneration makes it possible to reverse the consumer/producer relationship, by only resorting to the national transfer network for complementary and/or emergency supply in critical situations. The results of the technical-economic analysis can be found in the Technical Report.

Photovoltaic Energy
The use of specially designed photovoltaic panels installed on the large flat roof on top of the external net-like structure – which will make it possible to benefit from regional subsidies covering up to 75% of the total incurred cost – will supply energy to some of the electric engines of technological equipment, such as motor pumps and fans.

Geothermal Heat Pumps
Geothermal heat pumps use the ground as a natural heat source that is available at a relatively constant tem-

perature: as compared to outdoor air, it is higher in winter and lower in the summer. In particular, this technology is supposed to be used to provide alternative and/or supplementary energy supply for low-temperature installations (radiant panels, heating appliances, and air treatment systems).

Building Management System (BMS)
A BMS is a computer-based control system that manages the integration of traditional and alternative energy sources by interacting in real time with the building and its equipment through a neural control and information network. It should be considered, for all practical purposes, as a „virtual energy saving system“ in that it monitors, handles, and optimises all the energy management systems in a building throughout their life cycle around the clock. Specifically, the system envisaged should:

- ensure continued environmental safety control of all the areas in the building 24 hours a day;
- automate equipment operation by means of automatic adjustments, optimised start and stop, time and event sequences, and so on;
- allow for the remote control of technological equipment and scheduled maintenance management;
- integrate several autonomous sub-systems such as fire detection, access control, intrusion detection, and so on.

In conclusion, BMS is the system intelligence of the sophisticated New Railway Terminal, where the combination of system engineering and architecture makes it possible to draw, convey, modify, manage, and return alternative and supplementary energy so as to strike a balance between the building and its environmentally friendliness.
The project design presented herein won the “Tiburtina Railway Terminal” international contest.
In 2002, the design was awarded the „EUROSOLAR Italia“ prize and is the Italian nominee for the European corresponding award.

4 Experts contribution

4.1 Land use and mobility in the Province of Rome. Francesco Filippi Professor at the Faculty of Engineering, University of Rome “La Sapienza”

The countryside surrounding Rome has been increasingly urbanized. The first wave reached the villages around the urban area of Rome, followed by few planned new developments and a vast illegal built-up areas. Since the 1980s this “developments” have increased with a series of new settlements beyond Rome’s ring road (GRA) and in the territory of the neighbouring towns, favoured by the enormous increase in car ownership.

Gradually, a large number of new towns and villages grew up around Rome, of different sizes and with different urban layouts, with an overall population that now exceeds 1 million. These towns are arranged like the spokes of a wheel with the hub in Rome, which tends to absorb them and subordinate their development to its own, engulfing them in its vast metropolitan periphery.

The monocentric metropolis core has a downward population trend, with increases in the car rate and jobs. The first peripheral ring features a strong population growth, with lower motorization and job rates. The outer ring on the border of the Rome Province features a lower population growth, a high motorization rate and lower job growth rate.

The progressive expansion of the metropolitan area of Rome was in the absence of a political vision and an integrated governance, and ended up generating enormous problems of settlement and mobility:

- A big sprawl with low density and with few public transport services.
- A strong increase in mobility, mainly with private vehicles, which gives negative impacts on the environment, road safety and the quality of life, each citizen spends on average 260 hours per year queuing sitting in his car.
- The inadequacy of infrastructures and technologies to meet the increasing mobility demand.

In order to improve the accessibility of the area to services, retailers, jobs and rail stations and to reduce a car centric transport system generated by the dispersion has been proposed by recent planning instruments a polycentric model of development of Rome and its Province. The Plans are based on a polycentric model of the metropolitan area. The new sites of developments are planned around the metro and railway stations with emphasis on pedestrian and bicycle accessibility. The main transport system priorities are:

- Improve the railways infrastructures and services to support the new developments with stronger accessibility.
- Interventions targeted on the worst problems and bottlenecks, such as surface access links and corridors close to Rome urban area, which are likely to offer some of the highest returns.
- Deployment of ITS (Intelligent Transport Systems) or better use of infrastructures and services.

4.2 Sustainable Mobility. Paolo Desideri, Tiburtina Station design architect

I think that present-day metropolises should address the challenge of sustainable mobility starting from a general review of the meaning of public space to be reset into the mobility network. Implementing sustainable mobility in a big metropolis – namely in Rome – does not merely imply focusing on actions aimed at increasing the capacity and frequency of public transport supply while reducing the use of private cars. These are, in my view, the prerequisites for undertaking systematic policies in the area of sustainable mobility.

In addition to adopting these necessary measures, my assumption is that actions are equally required to redefine the quality and continuity of the public space framework. In other words, we must be able to convert individual initiatives and the occasional actions required from time to time into a fully autonomous network providing an alternative to the use of private cars in our city. This would form a framework within which services and the environment are to be repositioned by improving supply in terms of better space quality and living standards than those made available so far by the culture of private car mobility.

We should be able to direct all the creative efforts of our architects, local government officials, and the most conscious fringes of private investors to this target. We should be able to provide our city with an alternative framework capable of seamlessly reconnecting currently separate and disjointed sub-systems by making the best use of pedestrian areas and public transport, restoration services and green areas, underground and railway stations, cycle lanes and public services, museums and

shops, thereby creating a truly „new city“, which is interconnected but autonomous and better than the one created by private car mobility: a more beautiful, more efficient and more enjoyable city.

This challenge is crucial in Europe, especially in Italy – and namely in Rome, with its marvellous old town centre –, where it should make a difference (above all in cultural terms) as compared to the metropolitan models of North American large-scale cities being addicted to private transport. This is a challenge that we must be able to meet from the quality side, by making our model more commendable and competitive than the private transport model: resorting to public transport and sustainable mobility should no longer be viewed as a measure to inevitably restrain citizens‘ personal freedom, but as an added quality of space, services, and the overall network efficiency. This is an ambitious but achievable goal that has already been attained in other industries (such as food or fashion), in which the key to success has been the quality improvement of the whole sector that has allowed quality rather than quantity to become the ultimate value.

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