



CIVITAS

Cleaner and better transport in cities

M O D E R N

CASE STUDY



CHOPPERS – A SUSTAINABLE SOLUTION FOR ENERGY SAVING ON TRAMS

CLEAN FUELS AND VEHICLES



The electric transport fleet in Craiova is composed of 34 tramways: nine of them were not used due to their high electrical consumption. Craiova upgraded the nine trams using the chopper system, an electronic driving system that facilitates lower power consumption. The new driving system is assisted by an on-board computer and a Windows application for data storing and processing of energy consumption. The trams are now able to reduce the energy consumption up to 40 percent and to provide a more comfortable transportation mode thanks to a smoother start-stop phase.

Municipal context

Craiova, the capital of the Oltenia region, is a commercial and cultural center located 200 kilometres from Bucharest. Its foundation dates back to 400-350 BC, from which it developed into an important market town with administrative responsibilities. Today, Craiova is known for its university and is a centre for gas and petroleum, petrochemical, thermo and hydro-power plants. The Craiova metropolitan area includes seven neighbouring localities and will be expanded in the future with another 17 localities.

After Romania's accession to the EU, Craiova recorded rapid economic growth that was accompanied by an increase in motorised vehicles. As a consequence the air and noise pollution in Craiova, as in many other urban areas, is getting worse year by year.

Under these conditions, public transport should play a leading role and have a substantial share in the urban transport system, meeting the greater part of the demand for mobility.

In Craiova, public transport consists of 250 vehicles – trams, buses and minibuses – carrying annually about 65 million passengers. The city

MUNICIPAL PROFILE

LOCATION

Craiova, Romania

POPULATION

298,000

LAND AREA

81.4 km²

CIVITAS BUDGET

EUR 2,591,585.61



CRAIOVA IN CIVITAS

Craiova (Romania) participated in CIVITAS MODERN. Under the motto “MObility, Development and Energy use ReducioN”, CIVITAS MODERN connects the cities of Craiova, Brescia (Italy), Coimbra (Portugal), and Vitoria-Gasteiz (Spain).

PROJECT INFORMATION

Representing cities across Europe, each with a desire to preserve their historic and cultural centres from damage caused by private vehicles, the CIVITAS MODERN project enacted 42 measures that led to cleaner and better urban transport. Besides promoting sustainable mobility measures and interaction among the participating cities, CIVITAS MODERN specifically focused on encouraging strong cooperation among scientists and technicians to learn from experience and best practice throughout Europe.

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administration is aware that older vehicles should be replaced with newer models: more efficient in terms of energy and fuel consumption, safer and more comfortable, environmentally friendly, and that public transport services should become faster and adjusted to current needs in order to encourage a modal shift from private cars to public transport.

Introduction

Both the electric system conception and tram infrastructure from Craiova belong to the 1980s. Considering Craiova’s aging tram fleet the Municipality had two main problems: the high electric power consumption and the discomfort for the passengers. Both of them have been tackled within CIVITAS, particularly through applying the innovative chopper system.

The outbreak of the global financial crisis in 2008 created more difficulties in attracting new investments. Several projects had to pass into a conservation status as they could not be implemented due to the tight budget. For this reason we tried to find new, innovative solutions for the old trams belonging to the public transport operator’s (RAT) fleet. The CIVITAS program has been extremely important in this context.

Taking a closer look

The driving system of the nine old trams was replaced during the MODERN project with an electronic driving system named “chopper”.

The chopper system is a new driving technology that aims to decrease electrical consumption between 35 and 40 percent for the nine upgraded trams. Additionally, the measure will lead to lower exploitation costs and more safety and comfort for passengers as a result of the smooth starting and stopping of the modernised trams.

The tasks planned for the implementation of the measure were clustered around research and development activities, demonstration applications, training, evaluation and dissemination

activities. The tasks were set in a logical structure, taking the project from the idea to the tangible results.

Starting from the technical conditions and requirements, optimal technologies for the chopper system implementation were analysed, taking into consideration the best balance between quality and price. At the same time, devices for the chopper system were designed and software programs required for the operation of the chopper were developed.

The chopper driving system allows the engine to pass continuous current into the generator regime, particularly when the tram brakes. The kinetic energy of the tramway is therefore transformed into electrical energy, which is recovered in the power line. This energy

BACKGROUND INFORMATION

Although technologies reliant on energy consumption have progressed at an astounding rate, each step has also brought a raft of negative consequences, which have only become visible for the majority of policy makers in the last two decades.

Public transport by trams is increasingly encouraged, meaning old systems are often revived, since tram transportation systems have a large passenger transport capacity. Furthermore, trams can bypass traffic and are not a direct source of environmental pollution in urban areas.

The City of Craiova, as with many other cities, is committed to reducing its transport emissions by cutting energy consumption levels on its tramlines.



is consumed by the other vehicles that are powered by the same line. In the case in which there are no other consumers, the braking energy will be dissipated on the line.

The chopper prototype was installed and tested first on one tram, after which the final equipment specifications were defined. Several tests on shape and size, installation, control and power connections, insulation resistance and endurance of both devices were made. The equipment has met all the requirements.

The choppers' electronic control system contains a special instrument for traffic lights control, which gives green light to trams when they are approaching an intersection.

In the last year of the project Craiova expanded the chopper system with two additional elements:

Design and development of devices for reading and storing energy consumption data on trams related to the drivers' behaviour.

This activity became necessary to more accurately monitor energy consumption on each upgraded tram taking into consideration the different consumption patterns due to each single driver's behaviour in traffic, and the different use of the ancillary services. This device will provide more realistic information about the trams' energy consumption.

Design and development of a pilot qualitative evaluation system concerning electricity in the trams distribution stations, in order to optimise energy distribution.

The main objective of this task was to develop a distributed system for the acquisition, monitoring, storage and processing of vital electrical parameters from power distribution stations of trams in order to assess and better manage energy within the trams' power system.

This system completes the electric system of the trams and will provide real time off-line information and statistics regarding the consumed electricity. This enables the identification of solutions for energy and costs saving.

The innovative aspects of the measure are:

Use of new technology/ITS – The monitoring software is a Windows application that works independently of equipment, and both stores and processes data from the entire working system.

Increasing safety – The chopper system allows the tram to brake in a safer manner, meaning that the start and stop of the tram is more secure and comfortable.

Online management – The software allows the online visualisation and management of four defined electric measures – line current, engine current, line voltage, and filter voltage.

Results

The main results obtained by this measure are: nine trams endowed with chopper system and devices for recording the energy consumption per driver, a pilot system for qualitative evaluation of power parameters in the trams distribution stations, reduction of electric power consumption by 40 percent (for the trams endowed with choppers), lower costs and increased quality of service (more safety and comfort for passengers).

The evaluation strategy focused on a couple of key elements, including the economy, environment, transport and society. The indicators for every key element were carefully chosen so that the evaluation of the measure could demonstrate the necessity of the chopper system in Craiova.

Energy consumption is the main indicator in the evaluation process and shows a reduction of about 34 percent in the first operating month (April 2011). The city's overall approach leads to lower costs, less pollution of the national power network, and lower report price / travel.

The evaluation results based on the ex-ante values and ex-post first assessment are presented below:

Indicator	Indicator variation	Indicator evolution
Average operating costs	34,30%	decrease
Energy Efficiency defined as energy consumption per unit of transport activity [kW/vKm]	34,82%	decrease of energy consumption



Lessons learned

Do not scrap the old trams, upgrade and use them! Public transport by trams offers great transport capacity, as well as a good mobility option for passengers. Given the growing demand for mobility in the city, this CIVITAS MODERN measure focused on increasing the sustainability of the public transport by trams, as a practical, safe and independent transport method, with high transport capacity and zero direct pollution.

However, the introduction of a tram transport system is very expensive, therefore the existing system must be preserved, maintained and upgraded. Tram networks have the benefit of being environmentally friendly, allowing for faster travel within the city, and reducing the risk of accidents both for passengers and pedestrians.

One of the most important lessons learnt is to not remove the trams, but rather modernise and use them. Besides the advantages that they represent, the trams also form an integral part of the identity of the city.

Create synergies. We learned that it is difficult and takes time to create cohesion in a partnership between politicians, technicians and scientists. However, the synergy among them can create a powerful mechanism, which is able to produce great changes in the city. By working together, we learned to understand each other, to accept different opinions and to transform them into benefit for the city.

Upscaling and transferability

The chopper system strengthens the overall transport system, and along with the reconstruction of trams and tramway infrastructure, is part of the Integrated Urban Development Plan of Craiova. Based on the CIVITAS Initiative experience and achievements in the investment plan for 2012, by 2013 all municipal tram infrastructure will be restored.

The solution described has been promoted in neighbouring countries: Bulgaria, Slovakia, Albania and Macedonia during different events, economic missions or as part of partnerships between cities. Following these actions, the public transport company from Pleven, Bulgaria and the Pleven municipality decided to apply this solution to the trolleys fleet to reduce energy consumption. Public transport companies from Pleven have already made an assessment of costs and developed a first draft of an implementation plan.

Budget and finances

The budget allocated to this measure was modified during the project implementation from EUR 574,240 to EUR 819,561 in the first three years and then to EUR 849,000 in the last year of the project. This was achieved through redistributing the budget between the local partners. The additional budget was used to develop other equipment for the acquisition of power consumption information devices for the nine upgraded trams and to develop a pilot system that monitors the energy parameters in the electric power distribution stations for trams in Craiova.



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References and sources

Documents developed within the MODERN project.

www.civitas.eu > Cities > Craiova



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