Optimising energy consumption in urban rail systems

The EU-funded Osiris research project has been looking for technical and operational innovations that can help to cut the energy consumption of urban railway operations by 10% between now and 2020, explains Project Co-ordinator Andrea Demadonna.

Adaption to climate change, energy efficiency and emissions reduction pose major challenges for the transport sector, and nowhere is this more critical than in urban areas.

Transport in Europe currently accounts for roughly 20% of all CO_2 emissions, and urban transport is a major contributor to this. The revised *World Urbanisation Prospects* study published by the UN Department of Economic & Social Affairs (Population Division) in 2008 suggests that the proportion of the European population living in urban areas will increase from 72% in 2007 to 84% in 2050, and the number of cars in cities will continue to grow.

The combination of these trends threatens to create serious sustainability problems unless Europe can find a way to move towards lower- and zero-emission vehicles, and a different concept of urban mobility.

To respond proactively to these rising environmental concerns, the European rail industry association Unife has put in place an organisational structure, including an Energy Efficiency Group. It is also co-ordinating several European research projects aimed at improving the sustainable growth of mobility.

Rail has a critical role to play in changing the way that people travel, yet there is still much that the rail mode can do to improve its own performance. What has been lacking is a systematic approach to address energy efficiency in the entire urban rail system, including vehicles, infrastructure and operation. This is the goal of the Osiris project.

Andrea Demadonna is Technical Affairs Manager at Unife and Osiris Project Co-ordinator. He has spent the last two years heading the Unife Energy Efficiency Group, working on sustainability and energy efficiency for rail. He also co-ordinates the association's freight activities and the recently-established Freight Committee.

A CAF tram fitted with an on-board energy storage system was tested in the Spanish city of Vitoria-Gasteiz.

Osiris (Optimal Strategy to Innovate and Reduce energy consumption In urban Rail Systems) is a three-year research and development project co-ordinated by Unife and co-financed by the EU under the European Commission's FP7 Programme. The project has brought together 17 partners from urban rail operators, the supply industry and research centres. Launched in January 2012, the project will end with a final conference in Brussels on March 31, where the results are to be presented.

System-level solutions

Rather than focusing on specific technologies, Osiris has worked to develop system-level solutions which offer significant opportunities for energy reduction in many different urban rail systems. We have adopted a global approach to benchmark, simulate, optimise and test a variety of energy-saving technologies, operational techniques and tools, in order to assess their individual benefits in real scenarios as well as the benefits of combining them. Our aim has been to find ways of reducing the overall energy consumption of European urban rail systems by 10%, compared to current levels, by 2020.

Within this global approach, Osiris considered the various segments of the urban transport market and came up with a range of proposals which could be adopted by different players.

Innovative technologies

The project has tested a number of Technical Demonstrators. An onboard energy storage system developed by CAF Power & Automation using lithium-ion batteries from SAFT was tested on a tram in Vitoria-Gasteiz. The aim was to capture and store energy during braking, in order to reduce overall

A new type of auxiliary energy converter developed by Alstom was installed on an ATM metro train in Milano.

The water-based heat exchanger, pumps, filters and regulation valves installed by Ansaldo STS in the well room at Roma's Barberini metro station.

energy consumption and cut the power losses from the catenary and substations.

In Milano, Alstom Transport installed a new type of auxiliary converter on an ATM metro train, combining lower weight with higher efficiency. This was intended to reduce the power consumption of onboard systems, including heating, air-conditioning, lighting and the battery charger.

Ansaldo STS developed and deployed a novel cooling and heating system for equipment rooms using underground water, which was installed at Roma's Barberini metro station with the collaboration of ATAC. This was designed to address the thermal behaviour of fixed installations and the cost of maintaining correct temperatures to ensure the proper operation of signalling and communications equipment.

In terms of Operations, RATP in Paris and Ulasim in Istanbul developed a variety of innovations covering escalators, tunnels and station ventilation, and station lighting which potentially offer substantial energy savings.

The third area concerned Energy Simulation & Optimisation. Siemens, the University of Chile and the Technical University of Wien have created an ad-hoc holistic tool for electrical and thermal calculation of the whole railway system, in order to understand better the interactions between different energy consumers in the urban transport environment. This tool has the ability to interface with dedicated tools from various urban railway operators, and although still experimental it will be used to analyse the project's results.

KPIs and benchmarking

As a fourth step, the partners have defined a number of energy and business-related Key Performance Indicators for urban rail systems, to allow direct performance comparisons and the benchmarking of technologies. The energy KPIs are intended to indicate the overall usage for rail operations and analyse the key contributing factors such as traction, onboard and station utilities. The economic and business-oriented KPIs provide a useful tool to calculate the positive or negative return on investment for both energy-saving technologies and operational changes.

Last but not least, OSIRIS has defined a series of standardised duty cycles for benchmarking purposes. This will enable urban rail operators to compare the energy consumption of their various systems and support them in decision-making as well as optimising their procurement processes. This work was led by Milano operator ATM, with the support of a user group of European operators co-ordinated by the International Association of Public Transport, UITP, which provided consistent data for the definition of the duty cycles and the validation of the results.

Further explanation of the results will be presented at the final conference on March 31 in Brussels, which all urban rail stakeholders are welcome to attend. ■

For more details of OSIRIS or to attend the Final Conference, please contact the author at **andrea.demadonna@unife.org** or visit **www.osirisrail.eu**