



Technological novelties in Gdynia trolleybus transport

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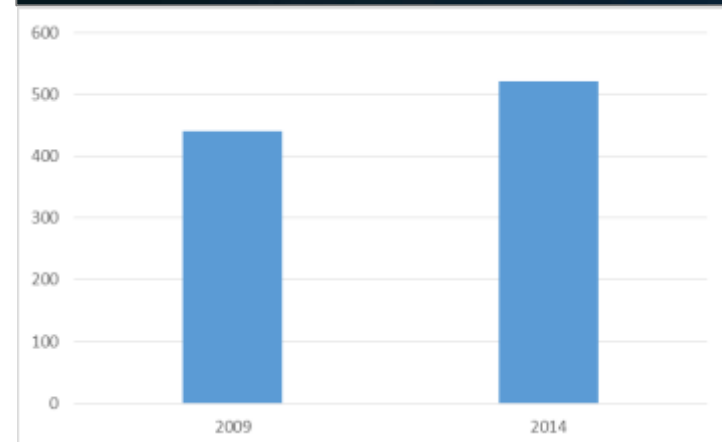
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Gdynia and its public transport system

- **250.000** inhabitants
- Part of metropolitan area with Gdansk, Sopot and other cities: ca. 1 mio. inh.;
- Length of public roads: **ca. 400 km**;
- Length of public transport routes: **ca. 250 km**;
- Motorization rate: **521 cars/1000 inhabitants**;
- Transport modes market share: **53%** individual transport, **47%** public transport (2013);
- **77%** of all Gdynia inhabitants live within a **5 min.** walk from a bus/trolleybus stop;
- **3** trolleybus cities in Poland (Gdynia, Lublin, Tychy).



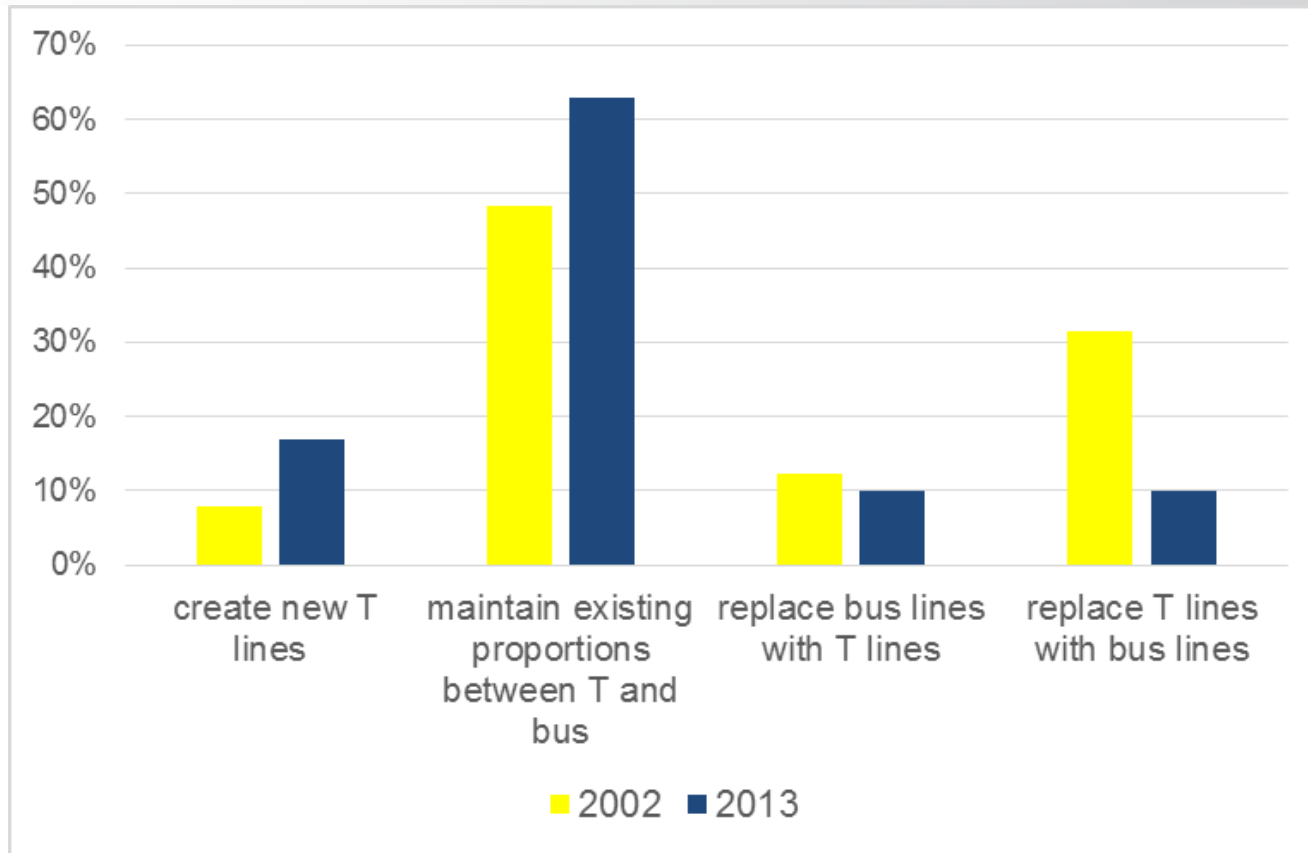
Ind. motorisation rate in Gdynia in 2009 and 2014

Trolleybus transport in Gdynia: combining TRADITION and MODERNITY

- 1943 - 1957 – introduction and initial development of trolleybus transport in Gdynia;
- 1958-1971 – peak of development (introduction of new vehicles, spatial expansion);
- 1972-1980 – the trolleybus decline, being replaced by diesel buses;
- 1981-1997 – the trolleybus revival (restoration of lines, trolleybuses again in Sopot)
- 1998 – 2004 – the transformation period (setting up PKT Gdynia – an autonomous trolleybus transport operator);
- 2005 – up to now – qualitative development of trolleybus transport (conversion, acquisition of new trolleybuses, upgrading the network, first regular operations without catenary).



Increasing public acceptance for trolleybus transport among citizens



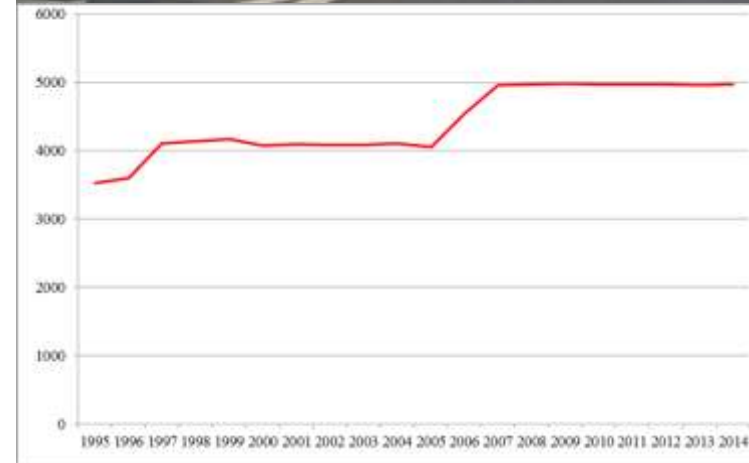
Self-made based on: Marketing research on transport behaviour and preferences of Gdynia's citizens in 2002 and 2013

Modern trolley depot and office building in Gdynia



Gdynia trolleybus transport operation in numbers

- 92 trolleybuses;
- 12 day trolleybus lines;
- ca. 90 km of trolleybus traction;
- ca. 5 million vehicle kilometres a year;
- 10 traction substations supplying power to the traction;
- Servicing cities of Gdynia and Sopot;
- Crucial for servicing Gdynia city centre;
- constitute ca. 30% of the whole public transport in Gdynia.



Annual supply of trolleybus transport
1995-2014 [thous. veh-kms]

FROM CIVITAS DYNAMO TO ELIPTIC:

CIVITAS DYN@MO TASK 1: Innovative hybrid trolleybuses with a new type of Li-ion battery running on a new line

PKT CIVITAS DYN@MO objectives realized:

- Purchase of 2 trolleybuses with an alternative power source – a Lithium-Ion battery in March 2015;
- Choice of a schedule trolleybus line 21 which since May 2015 has regularly been serviced by hybrid trolleybuses with a new battery on a 2 km unwired extension – 2 trolleybuses getting off the traction and going for **2 km in Gdynia central street – Skwer Kościuszki** solely on the battery;
- Planned further expansion of trolleybus transport operation into new areas where so far traditional trolleys were not able to run due to the lack of the traction network – CIVITAS DYN@MO set the ground for another EU Project – CIVITAS ELIPTIC (*Electrification of public transport in cities basing on existing infrastructure*);
- Enhancing the overall reliability of the trolleybus transport;
- Setting a national and European showcase of innovative technologies application in public electric transport.



TECHNOLOGICAL INNOVATIONS IN PKT PROJECTS

Modern equipment in purchased Polish Li-Ion Solaris Trollino 12M

Automatic pantographs enabling automatic raising and lowering the current collector

Asynchronic drive with energy recuperation system

Alternative power supply – lithium-ion battery enabling regular off-traction operation up to 15 km



External and internal monitoring system

Air conditioning of the whole trolleybus space

The battery location – at the back of the vehicle



CIVITAS DYN@MO TASK 2:

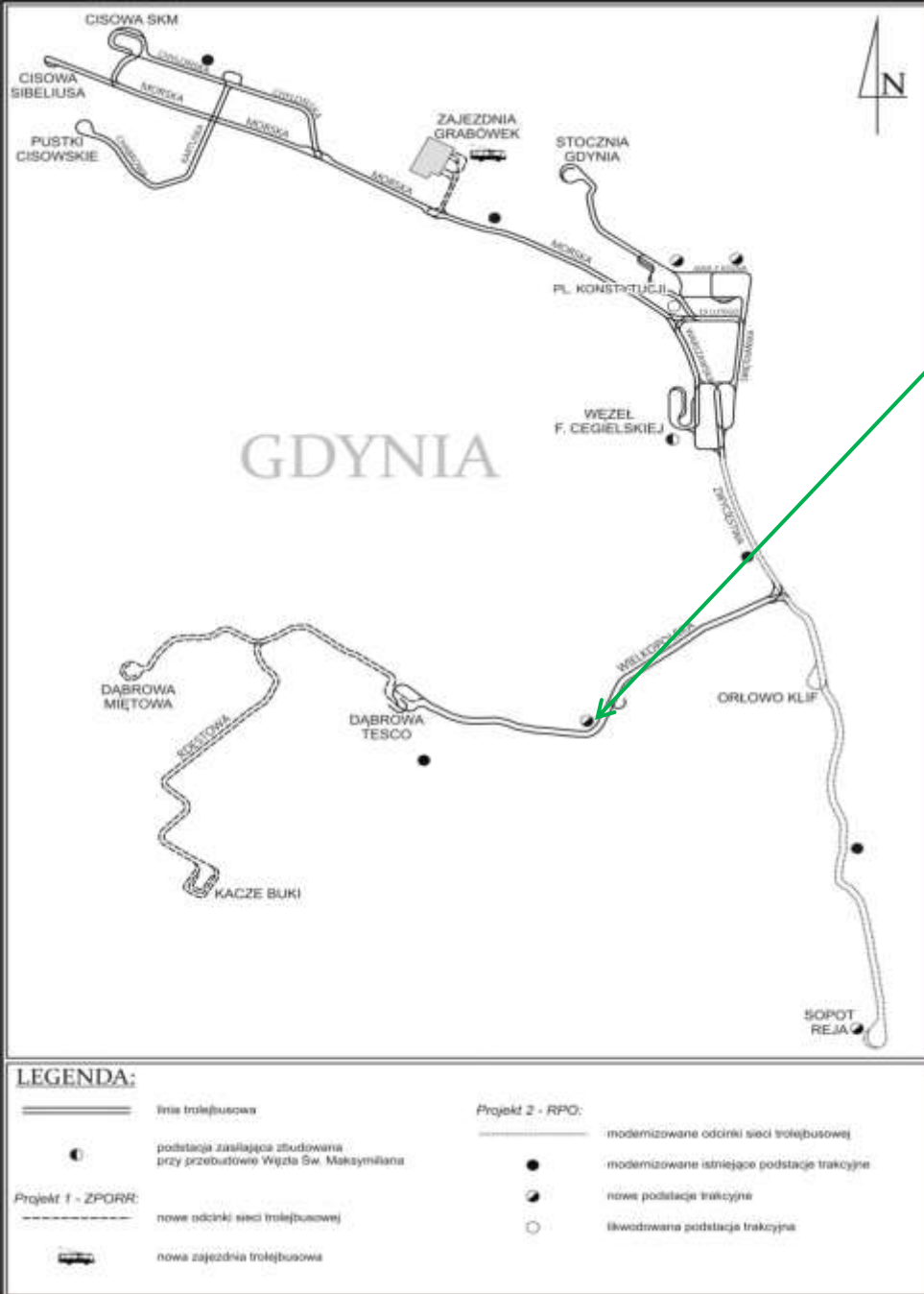
Supercapacitor for greater energy efficiency of trolleybus system in Gdynia

- July 2013 a contract for the supercapacitor was signed with the Polish company MEDCOM;
- installation took place in April 2014; supercapacitor fully working now and successfully saving energy;
- reduction of electric power demand on the network section where the supercap is installed by 12%; supercapacitor cooperates with the traction network and trolleybuses with recuperation braking system (over 50% of PKT's fleet is equipped with it).
- Enhancing energy efficiency of trolleybuses and existing infrastructure;
- Setting a national and European showcase of innovative technologies application in public electric transport.



Supercap modules and resistor

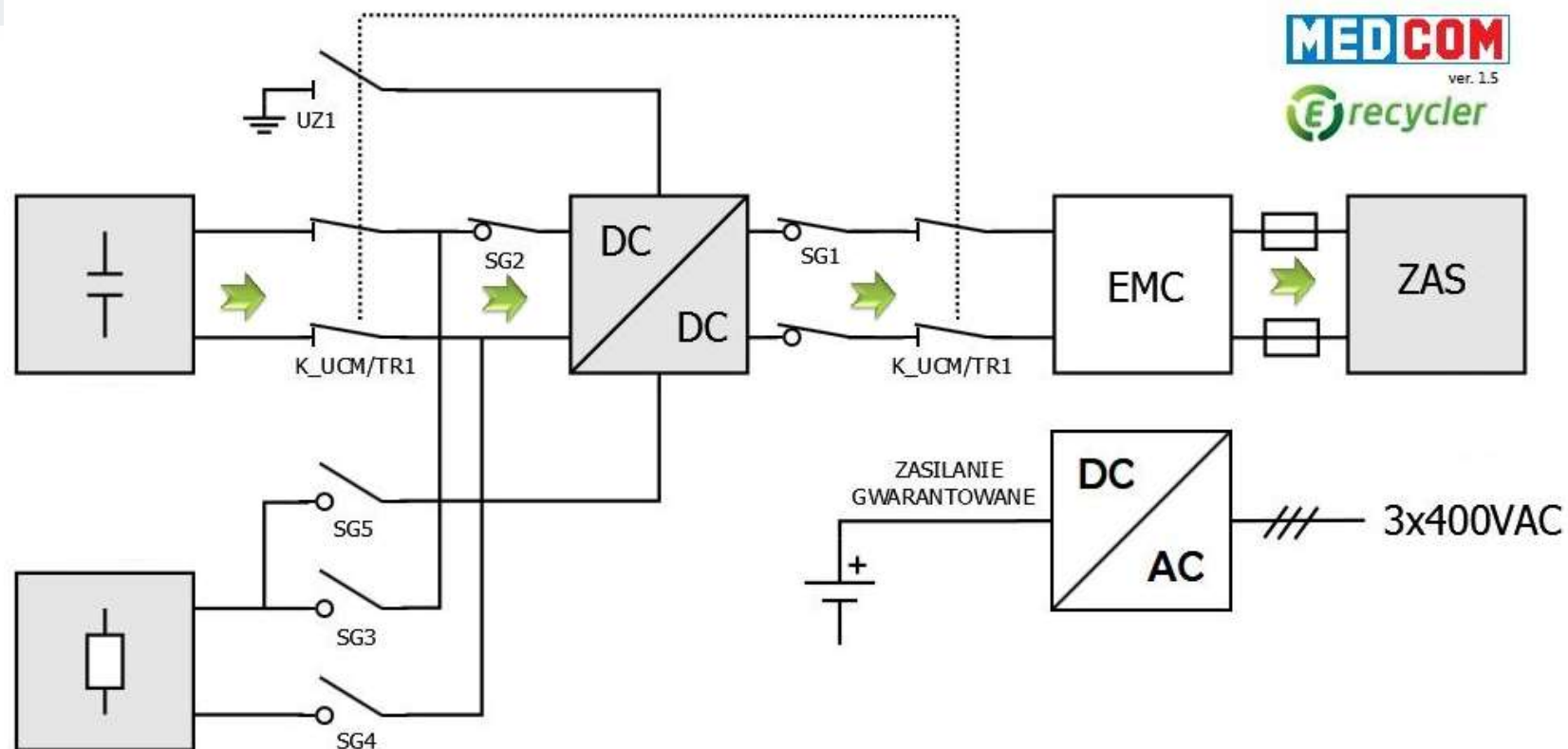




Wielkopolska Substation - Localization of new supercapacitor bank.

This substation was predisposed for supercapacitor installation due to the hilly character of the power supply area – there are more occurrences of trolleybuses braking and giving this recuperative energy back to the traction network. Supercapacitor ‘catches’ this energy and stores it for later use by other trolleybuses.

Basic scheme



Technical data

General data

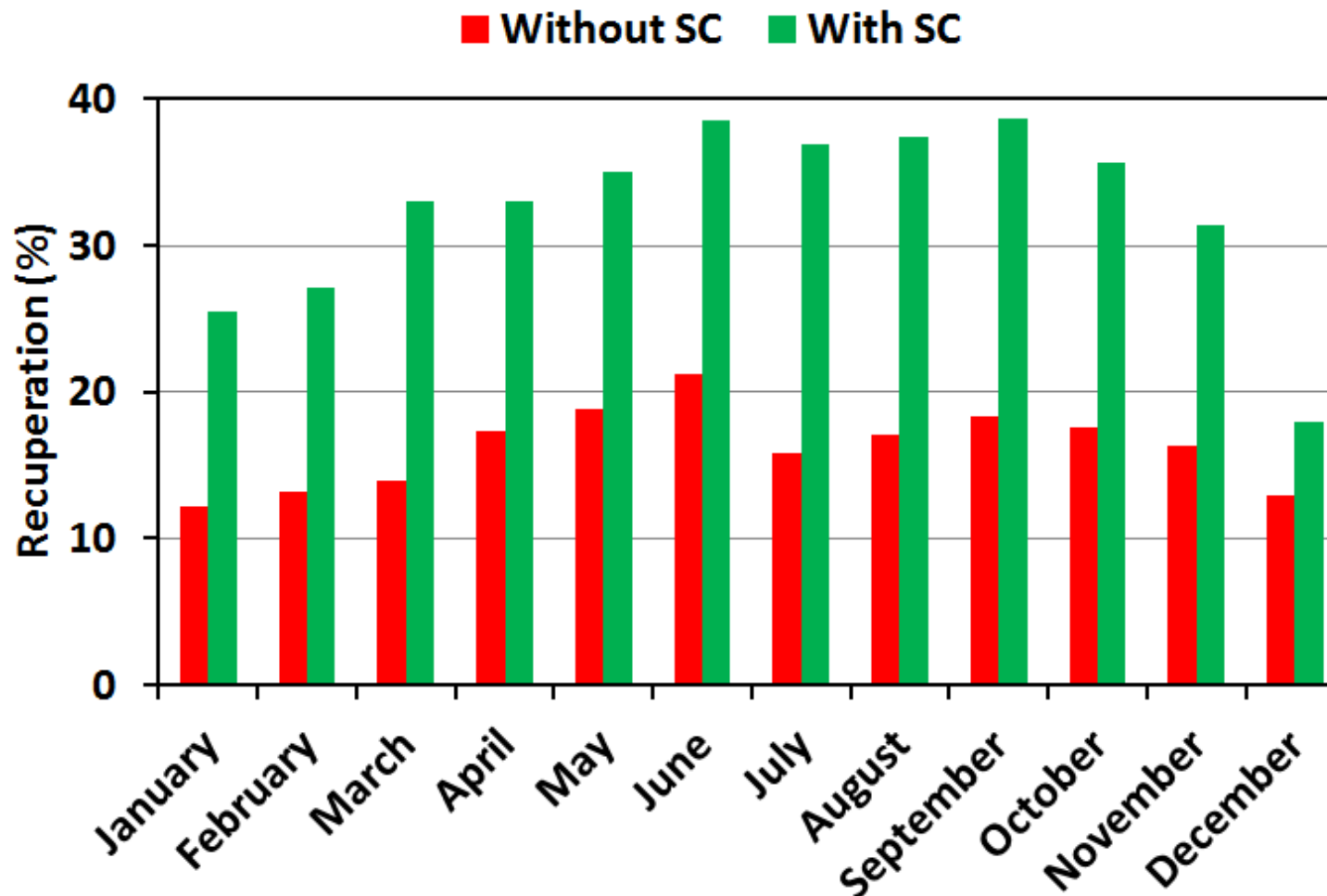
Nominal input voltage	600 V DC
Max. input current	500 A
Max. input power	400 kW/20 s.

Data of SC bank

The range of voltage during operation	187 - 375 V
Max. current	1000 A
Capacitance	104.15 F
Energy capacitance	1.56 kWh
Number of modules	15: 5 branches x 3 modules
The range of voltage during operation	187 - 375 V



Results – recuperation of energy in vehicles before and after SC installation



Direct presentation of the savings



Technological innovations - Plans for the future

- after acquisition of 2 Solaris trolleybuses with Li-Ion batteries in CIVITAS DYN@MO project, the operator purchased in 1 more with the same battery capacity (March 2016) and 3 more with a double battery capacity purchased with own funds and produced by Solaris Bus&Coach;
- from nationally governed EU funds PKT applied for more vehicles with Li-Ion batteries and exchange of the Ni-Cd batteries to Li-Ion batteries in all remaining trolleybus;
- realistic plans for further unwired extension of several trolleybus lines to some districts of Gdynia (incl. ELIPTIC studies);
- building several charging points for e-vehicles is now seriously considered (incl. ELIPTIC studies); the first one to be built this year in one of Gdynia districts – Fikakowo;
- photovoltaic cells energy production farm on the roof of the depot.

Thank you for your attention!

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<http://www.pktgdynia.pl>

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