

# Range Extended Trolley Buses in the city of Gdynia / PL

LowCVP UK E-bus Summit, 10th November 2016

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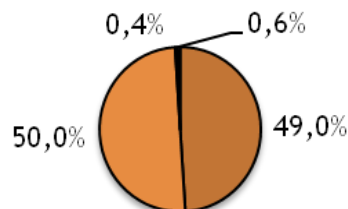
**CIVITAS DYN@MO and ELIPTIC Project Coordinators**



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# GDYNIA PUBLIC TRANSPORT FACTS

- **250.000** inhabitants
- Length of public roads: ca. **400 km**
- Length of public transport routes: ca. **250 km**
- Motorization rate: **450 cars/1000 inhabitants**
- Transport modes market share: **50/50** individual transport and public transport:



- 77% of all Gdynia inhabitants live within a **5 min.** walk from a bus/trolleybus stop
- Trolleybus transport operated by PKT constitutes **26 %** of the whole public transport in Gdynia
- **93** trolleybuses run ca. **5 million** vehicle kilometres a year on **12 day** lines on **90 km** of traction supplied by **10** traction substations (**75** trolleys in daily operation)
- only **3** trolleybus cities in Poland (Gdynia, Lublin, Tychy)



# Gdynia trolleybus depot





## Roofed parking spaces and inside of the depot



# CIVITAS DYN@MO in a nutshell



## CIVITAS DYN@MO

Miasta aktywnie dążące do  
dyn@micznego rozwoju  
zrównoważonej mobilności

- Włączanie mieszkańców w proces planowania zrównoważonego transportu
- Wdrażanie rozwiązań w zakresie czystych i energooszczędnych pojazdów transportu miejskiego
- Rozwój systemów i usług «Mobility 2.0»



## DYN@MO Project

- EU project realized within CIVITAS II PLUS initiative and co-financed from FP7
- Consortium of 28 partners from 2 leading cities: Aachen (Germany), Gdynia (Poland) and 2 learning cities: Koprivnica (Croatia) and Palma de Mallorca (Spain)

## Project objectives

- development of innovative transport systems and services
- introduction or reinforcement of ecological means of transport in the partner cities
- engaging citizens in sustainable mobility
- cooperation and experience exchange between the cities

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

- Purchase of **2 SOLARIS Trollino 12 M trolleybuses** with an **alternative power source – a Lithium-Ion battery** in March 2015; positive off grid tests
- Choice of a schedule trolleybus **line 21** which **since May 2015** has regularly been serviced by battery hybrid trolleybuses on an unwired extension – 2 trolleybuses gett off the traction and go for **2 km in Gdynia central Skwer Kościuszki street** solely on the battery
- Planned further expansion of trolleybus transport operation into new areas without 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 flexibility and reliability of the trolleybus transport / setting a showcase



**400.000 EUR**





# TECHNOLOGICAL INNOVATIONS IN NEW TROLLEYS

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

**Automatic pantographs enabling automatic raising and lowering the current collector**

**Asynchronous 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







<Ev> • <Date> • <Location> • <Speaker>

# Basic comparative data - traction batteries currently used in Gdynia

## Traction batteries used in new Solaris Trollino 12M trolleybuses

**Type of the battery cell: Li-ion**

**Manufacturer: WAMTECHNIK**

**Two parallel modules 638 V**

**Energy capacity of 38 kWh / 27 kWh approximately available**

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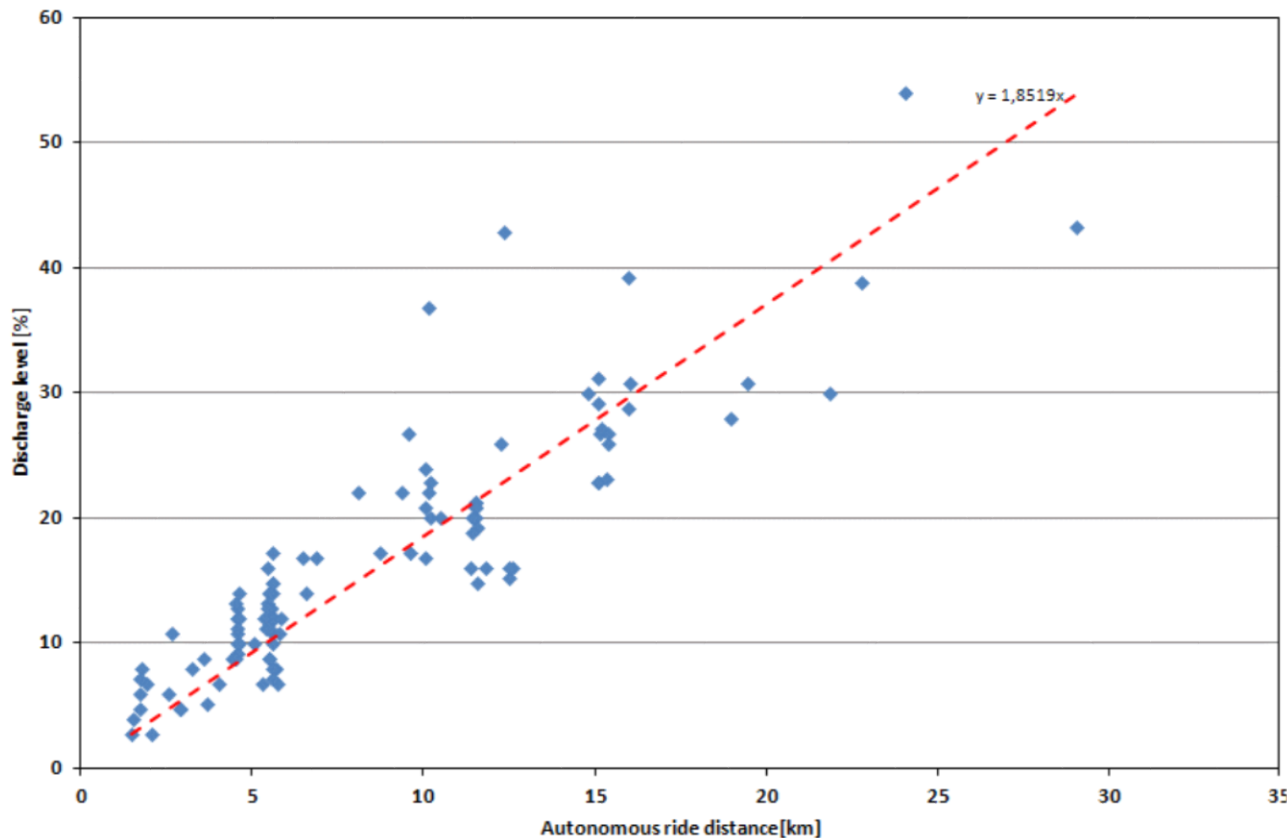
## Traction batteries used in older type of Solaris Trollino 12M trolleybuses

**Type of the battery cell: Ni-Cd**

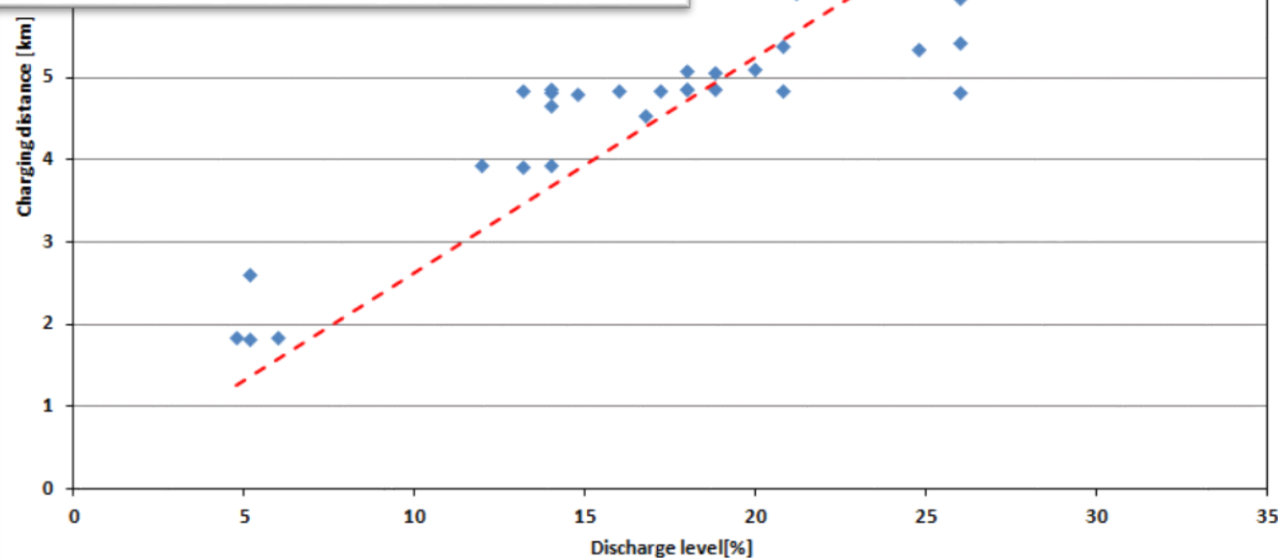
**Manufacturer: SAFT**

**2 paralel modules 100.6 V**

**Energy capacity of 16 kWh**



Only 30 % of total length of the line needs to be covered by overhead infrastructure to be operated battery trolleybuses





## An example of Landskrona (30.000 inhb.)/ Sweden







# 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 equipped with recuperation braking system (over **50% of PKT's fleet** is equipped with it)
- enhancing energy efficiency of trolleybuses and existing infrastructure / setting a showcase





# Supercap modules and resistor

75.000 EUR



# Technical data

## General data

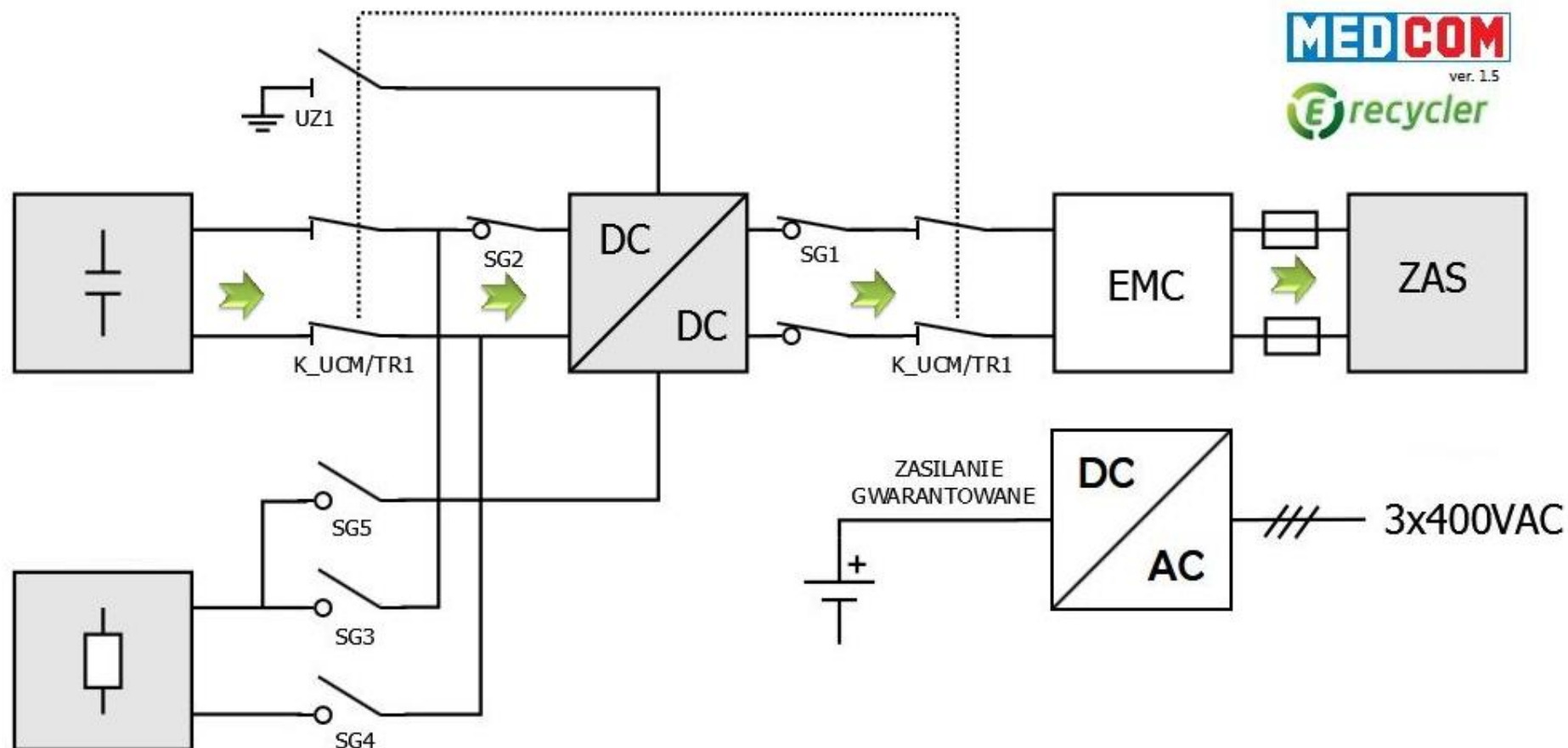
Nominal input voltage	600 V DC
Max. input current	500 A
Max. input power	400 kW/20 s.

## Data of SC bank

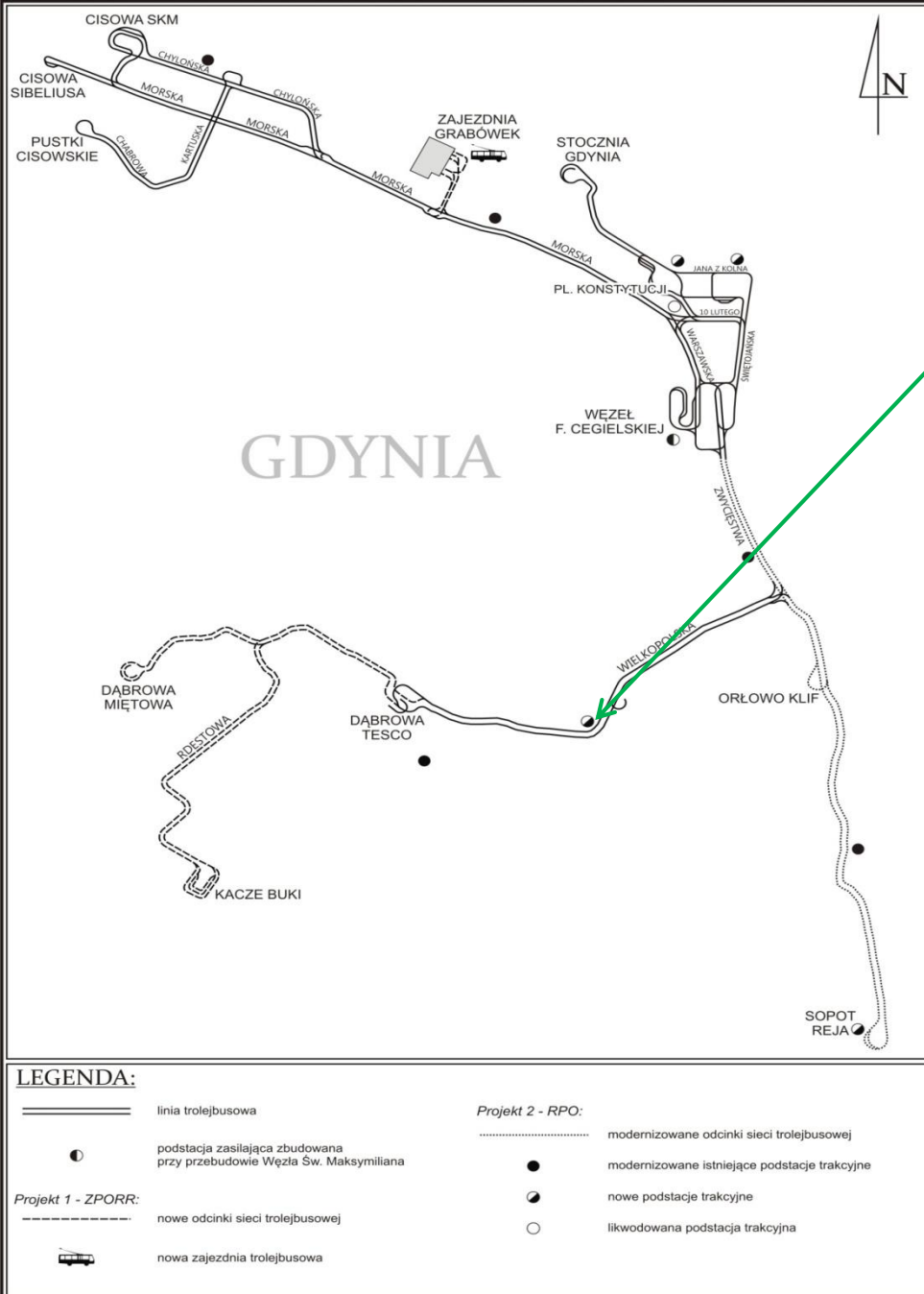
The range of voltage during operation	187 - 375 V
Max. current	1000 A
Capacitance	104.15 F
Energy capacitance	1.56 kWh
Number of modules	15: 5 branches x 3 modules
The range of voltage during operation	187 - 375 V



# Basic scheme



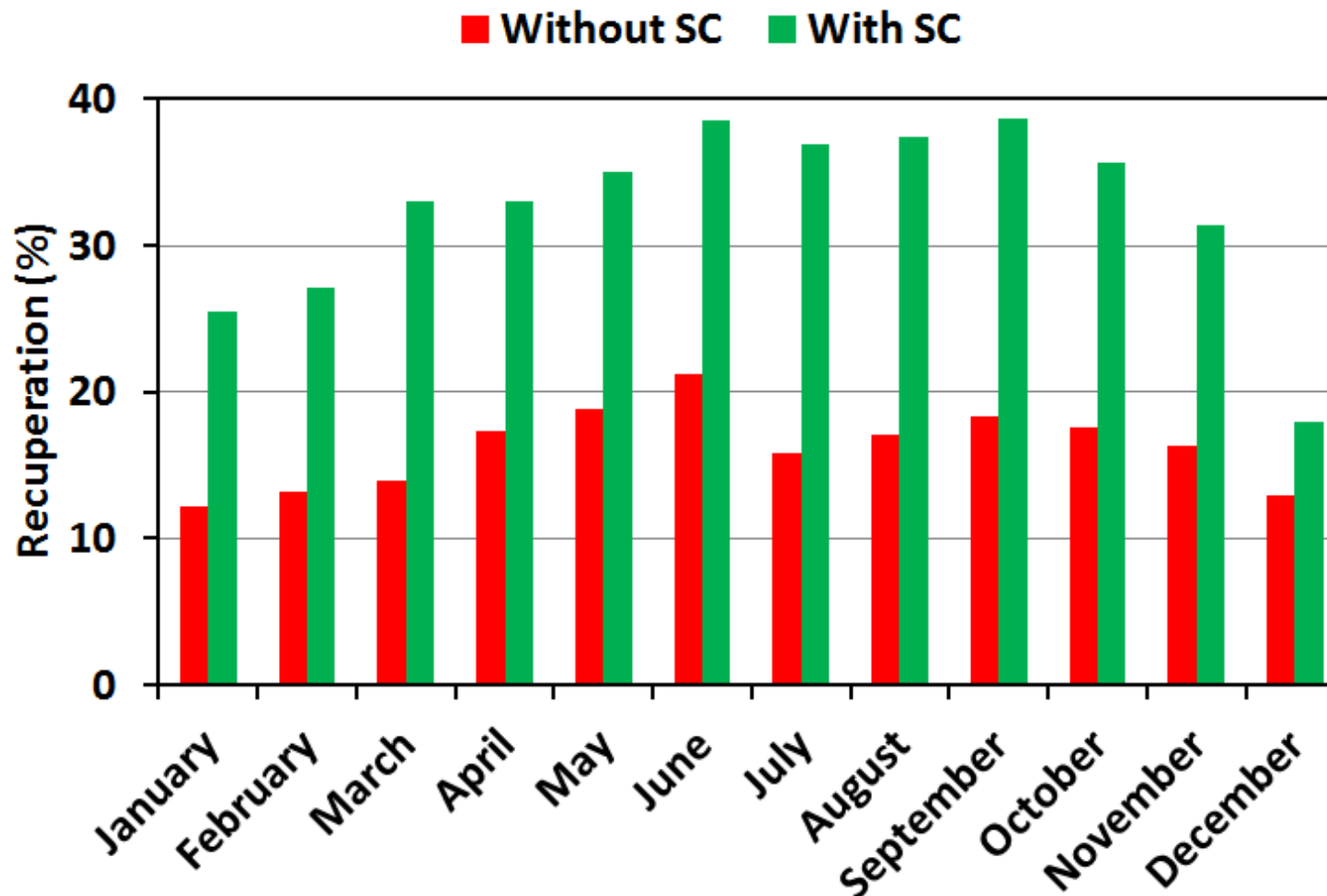




**Wielkopolska Substation -**  
**Location of supercapacitor bank.**  
 This substation was predisposed for supercapacitor installation due to the hilly terrain of the power supply area – there are more occurrences of trolleybuses braking and giving recuperative energy back to the traction network.

Supercapacitor ‘catches’ this energy and stores it for later use by other trolleybuses.

# Results – recuperation of energy in 2015 in vehicles before and after SC installation



# Direct presentation of the savings





# Development plans for the near future

- after acquisition of 2 Solaris trolleybuses with Li-Ion batteries in CIVITAS DYN@MO project, PKT purchased in **1** more Solaris with the same battery capacity and **3** more with a double battery capacity
- from nationally governed EU funds PKT has now applied for **30** vehicles with Li-Ion batteries (incl. **16** articulated 18 M trolleys) and exchange of the Ni-Cd batteries to Li-Ion batteries in **21** trolleys
- plans for further unwired extension of several trolleybus lines to some **new districts of Gdynia** (incl. ELIPTIC studies), eg. to one of Gdynia districts Fikakowo / **winter 2017**
- building **several charging points** for e-vehicles is now considered (incl. ELIPTIC studies); the first one to be built this year also in Fikakowo, next one in Sopot / Ergo Arena Stadium
- Photovoltaic panels power plant on the roof of the depot – **5000 m<sup>2</sup>**

# ***Thank you very much for your attention!***

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