



OPTIMISED BRAKING ENERGY RECOVERY IN TROLLEYBUS SYSTEM

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CONTENT OF THE PRESENTATION:

- 2011 – 2013: 1st Supercap Energy Storage System in Gdynia
- 2014 – now: 2nd Supercap Energy Storage System in Gdynia (Dyn@mo project)
- 2016 – now: Smart Grid technologies – bilaterall supply system (Eliptic project)



1ST SUPERCAP INSTALLATION FOR GDYNIA

IDEA OF PROJECT

- In 2009 Electrotechnical Institute in Warsaw (IEL) received ministerial research donation for design, developing and testing off-board energy storage system for electrical city transport
- ▶ In-door design
- ▶ Focused on energy recovery improvement
- ▶ Technical specification:
 - ▶ 4 supercap modules LS Mtron: 41 F 201,6 V
 - ▶ usable capacity: 0,7 kWh (possibility of increasing up to 1,5 kWh)
 - ▶ max. power: 300 kW



UNDER CONSTRUCTION...



**SUPERCAPS
MODULE
INSIDE**



**SUPERCAPS
MODULES**



ASSEMBLING...

FINALLY IN GDYNIA

SUPERCAPS



SOME DETAIL PHOTOS

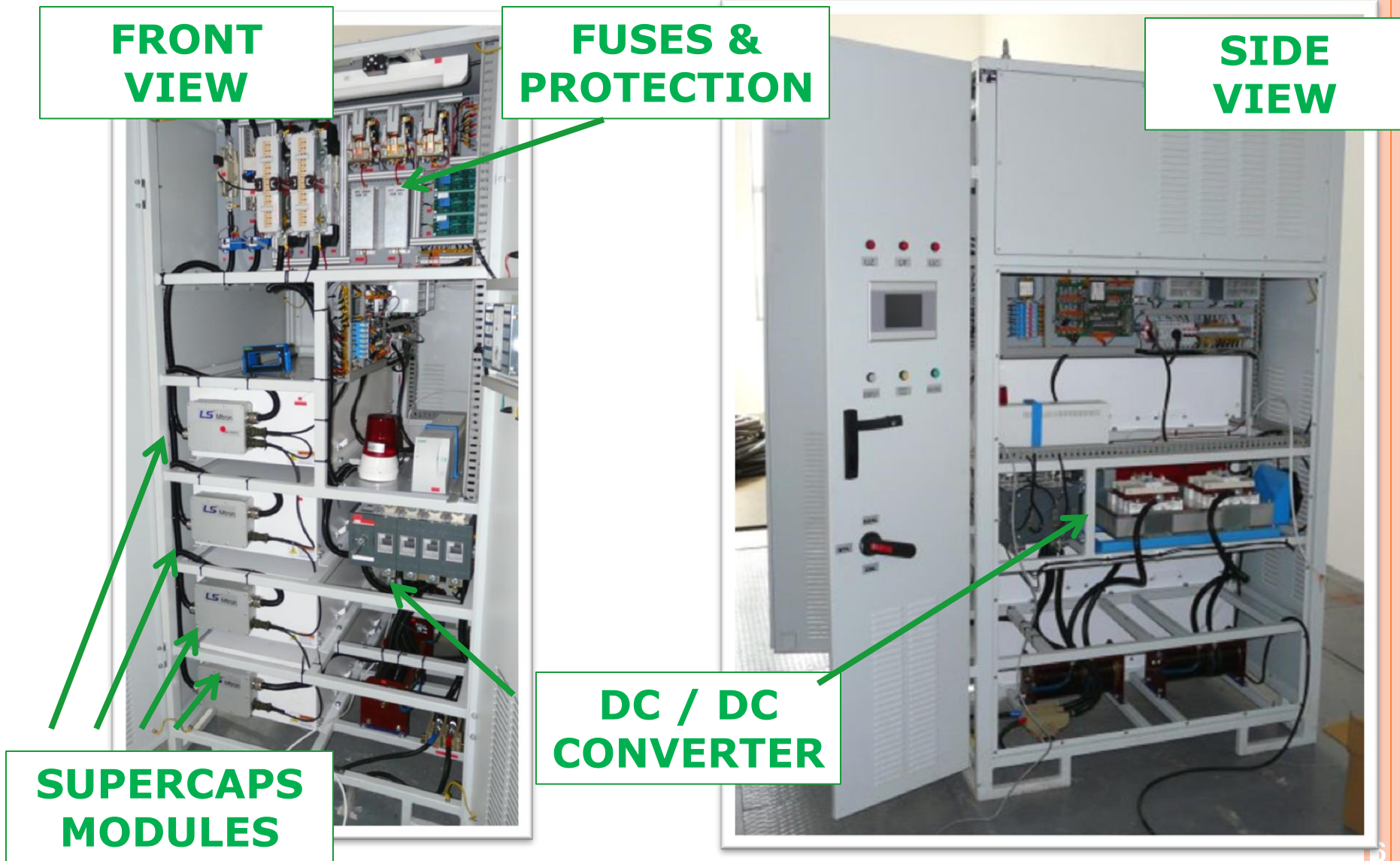
**FRONT
VIEW**

**FUSES &
PROTECTION**

**SIDE
VIEW**

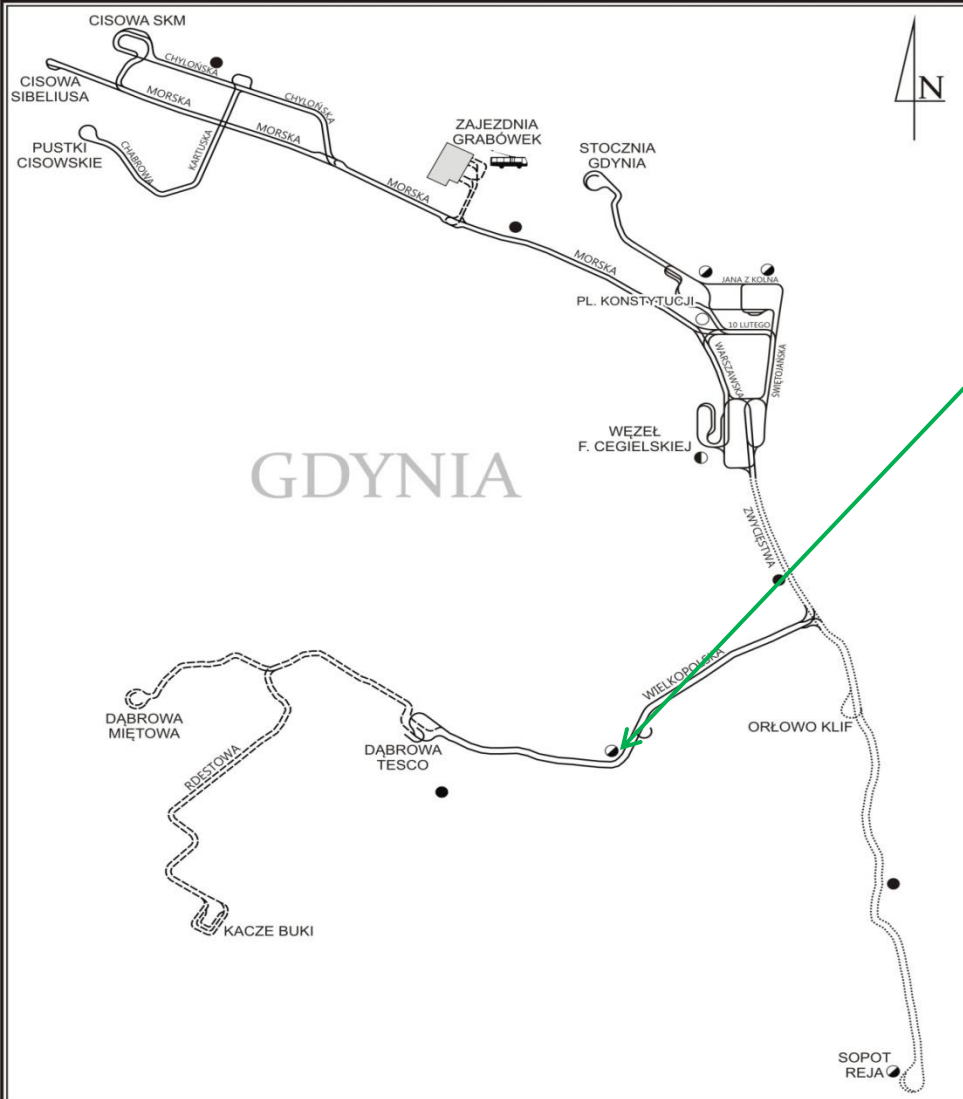
**SUPERCAPS
MODULES**

**DC / DC
CONVERTER**



2ND SUPERCAP: DYN@MO PROJECT

- Installation of supercap storage unit in Wielkopolska substation
- This substation is located in a hilly part of Gdynia
- Capacity: 1,5 kWh
- Max. power: 500 kWh
- Supercap was made and installed by Polish company Medcom
- Outdoor – indoor instalation:
 - Control system and DC/DC converter placed inside substation
 - Supercap modules and discharged resistor placed outside substation
- In May 2013 a tender for purchase of supercapacitor was published; in July a contract for its technical project, production, delivery, assembly and installation was signed; installation took place in April 2014; supercapacitor is fully working now

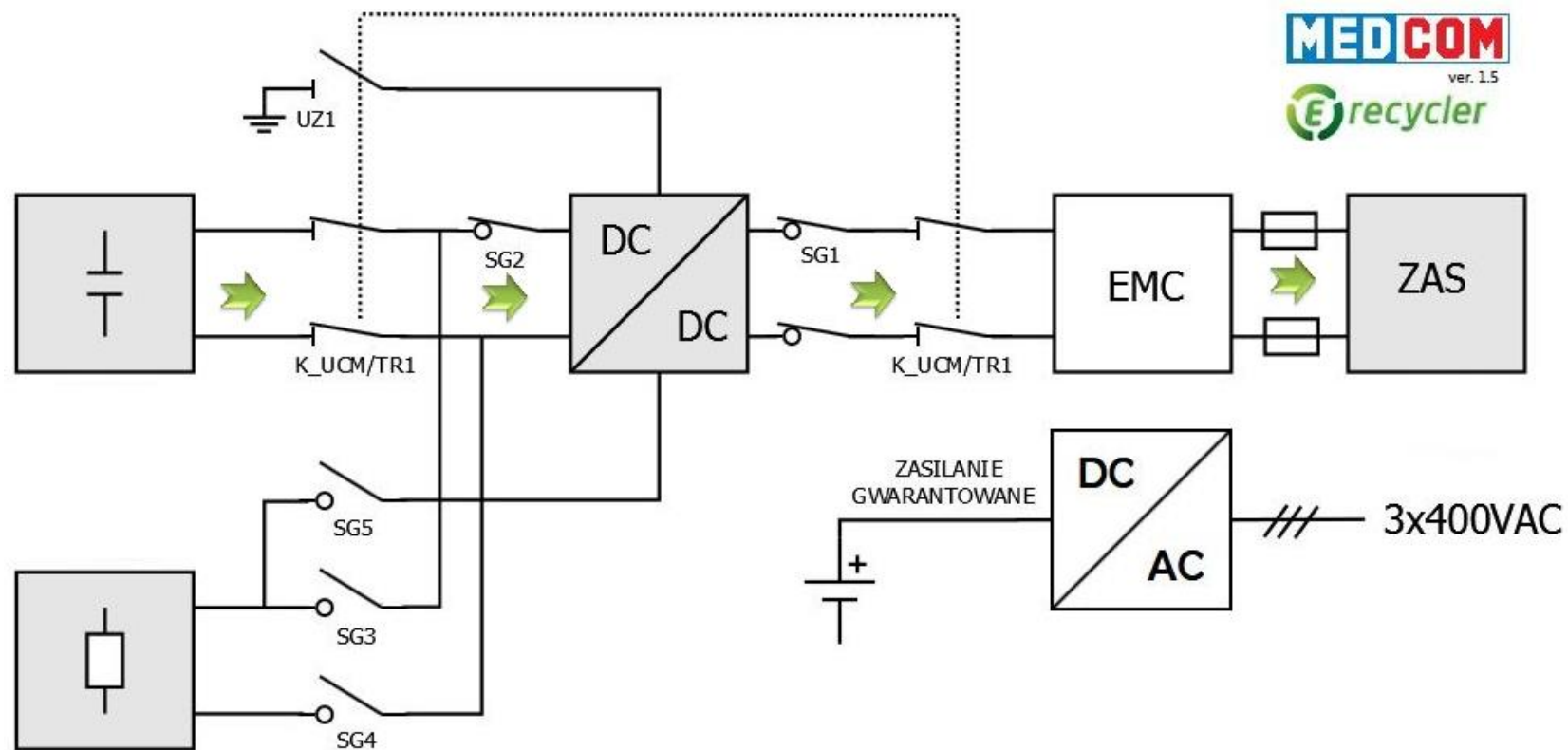


Wielkopolska Substation

LEGENDA:	
	linia trolejbusowa
	podstacja zasilająca zbudowana przy przebudowie Węzła Św. Maksymiliana
Projekt 1 - ZPORR:	
	nowe odcinki sieci trolejbusowej
	nowa zajezdnia trolejbusowa
Projekt 2 - RPO:	
	modernizowane odcinki sieci trolejbusowej
	modernizowane istniejące podstacje trakcyjne
	nowe podstacje trakcyjne
	likwowana podstacja trakcyjna



BASIC SCHEME



SUPERCAP MODULES AND RESISTOR



SUPERCAP MODULES INSIDE



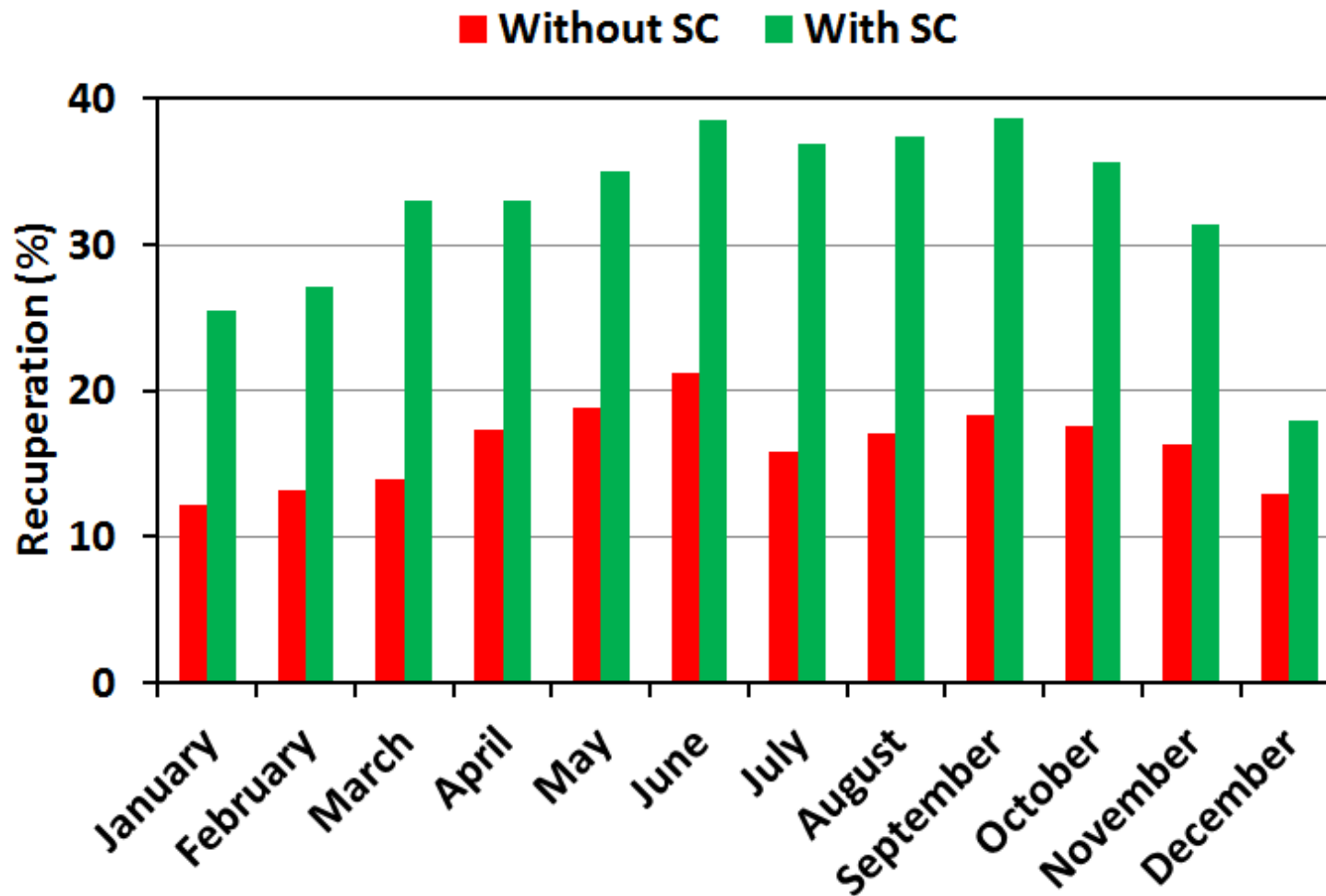
DC/DC CONVERTER AND CONTROL SYSTEM



DC/DC CONVERTER AND CONTROL SYSTEM



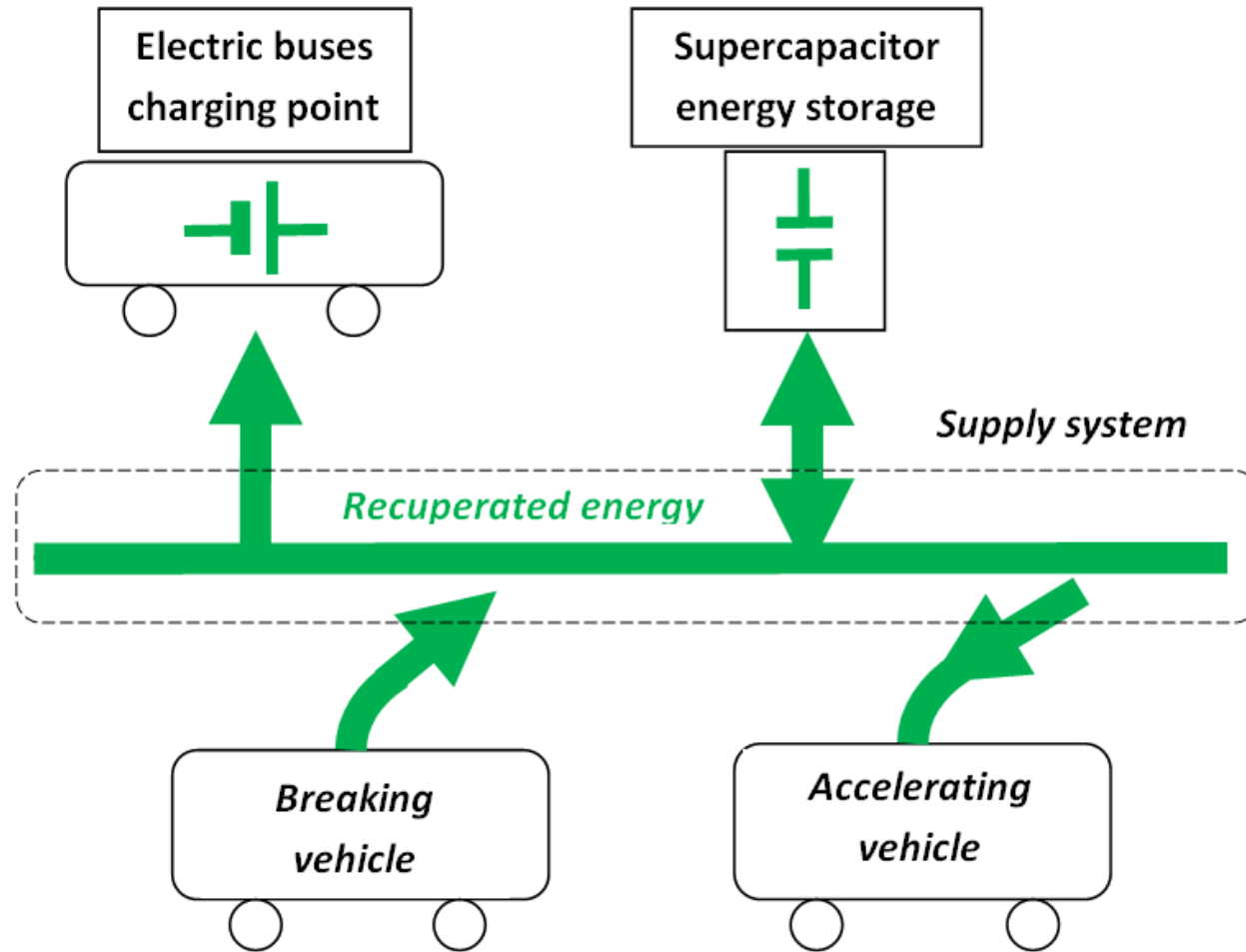
RESULTS – RECUPERATION OF ENERGY IN VEHICLES BEFORE AND AFTER SC INSTALLATION



DIRECT PRESENTATION OF THE SAVINGS



UTILIZATION OF RECUPERATED ENERGY – SMART GRID – GLOBAL SYSTEM APPROACH

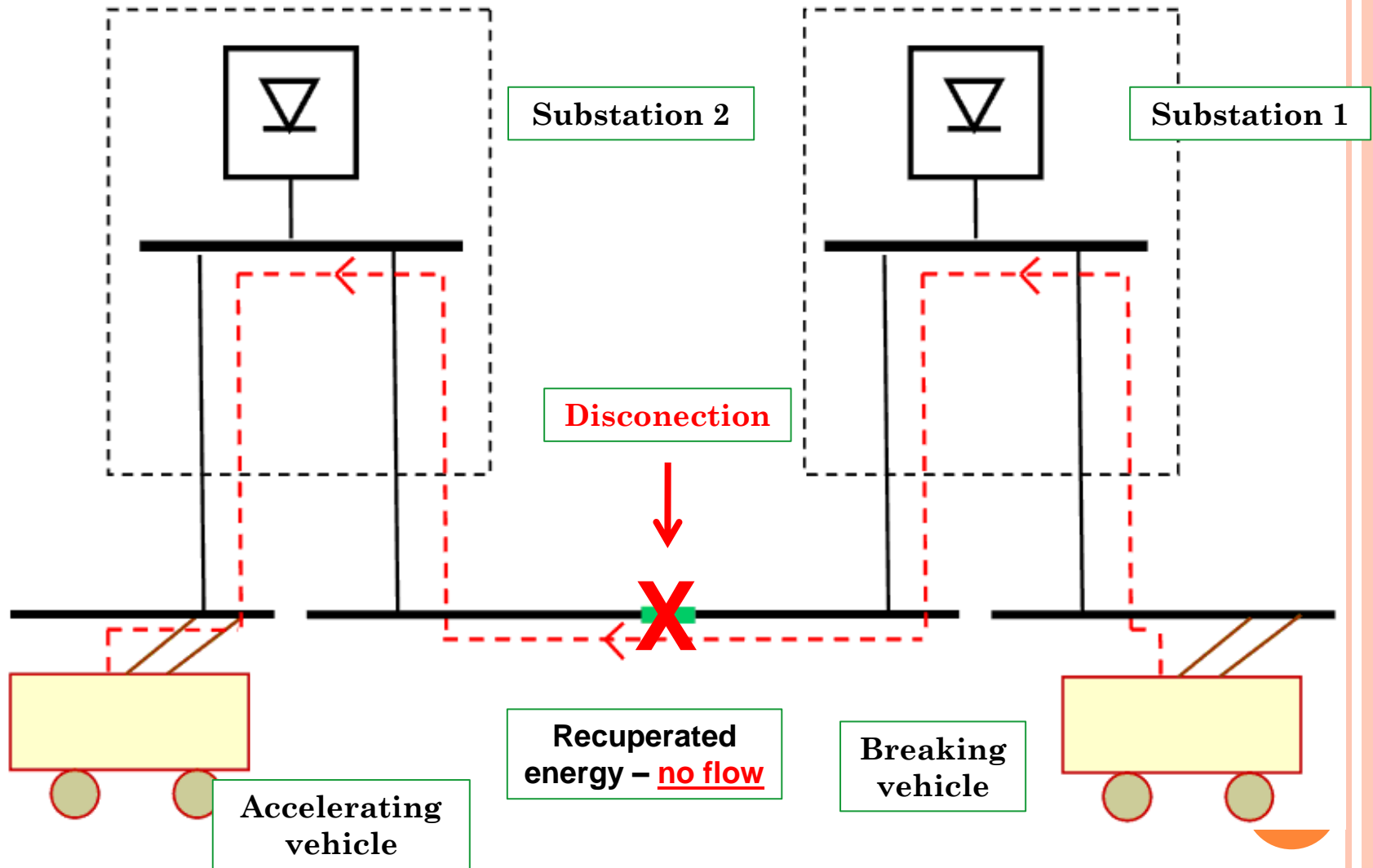


SMART GRID TECHNOLOGIES

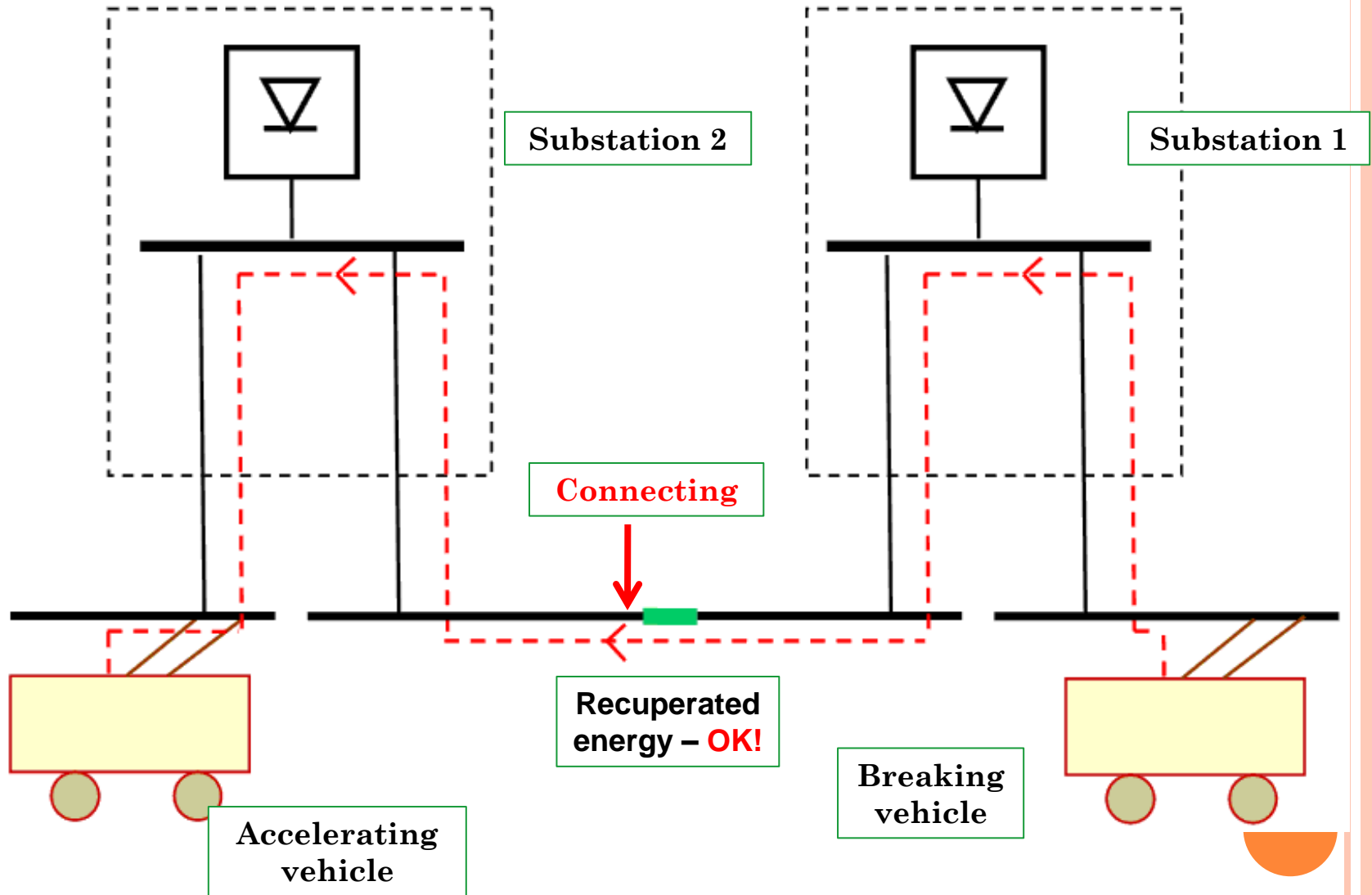
- 1) **charging stations for electrical buses and cars supplied from the overhead line, which may use the recuperation energy of vehicles,**
- 2) **remote control of the disconnectors system in the overhead line, enabling immediate reconfiguration of the power supply of the overhead line in the case of damage,**
- 3) **smart protection devices allowing for detection of damages in the overhead line from remote network systems,**
- 4) **bilaterral supply system**
- 5) **stationary and vehicle energy banks: supercapacitors, storage energy systems,**
- 6) **traction substation inverters to return recuperated energy to AC supply system.**

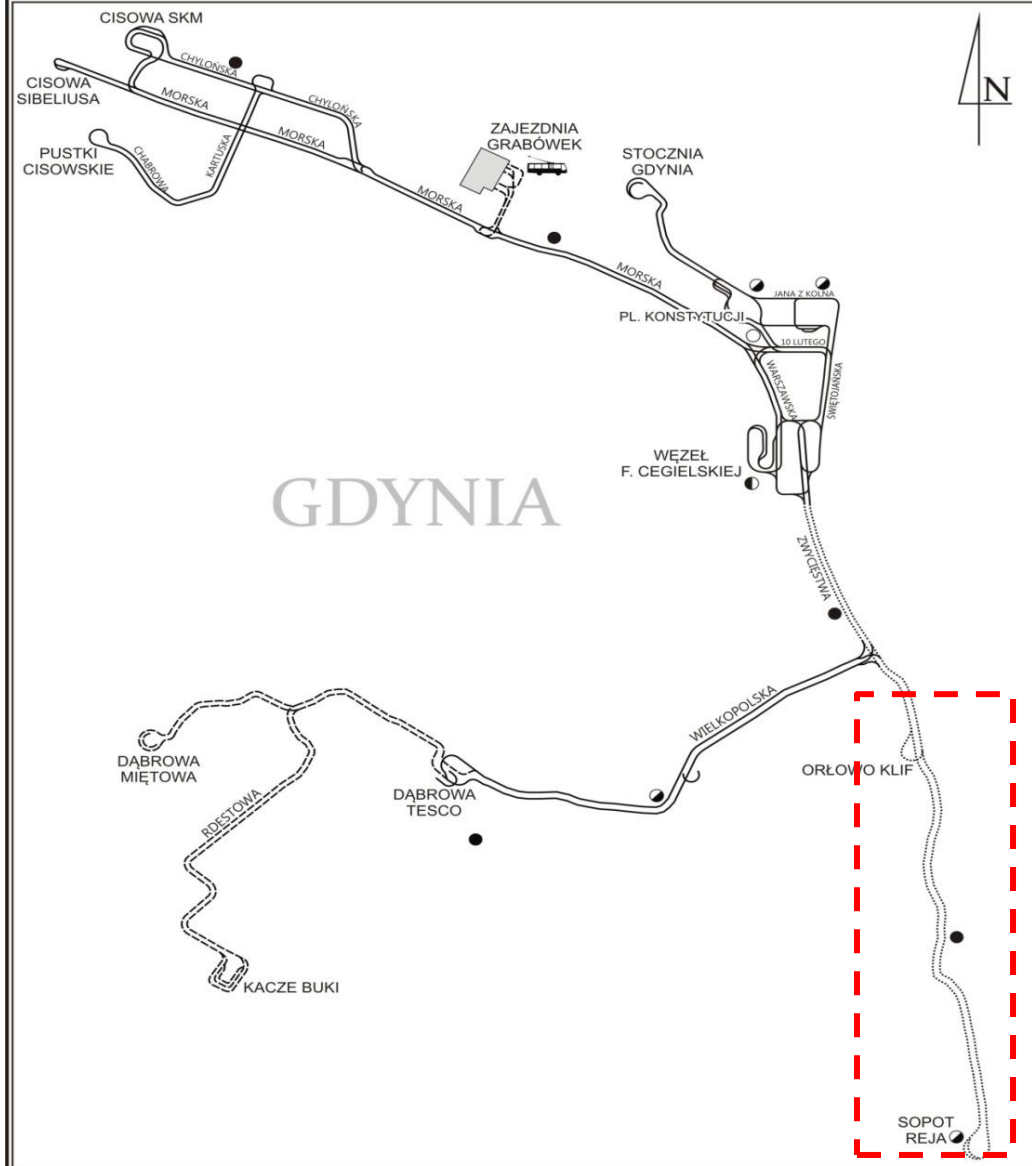


Classic supply system



Bilateral supply system





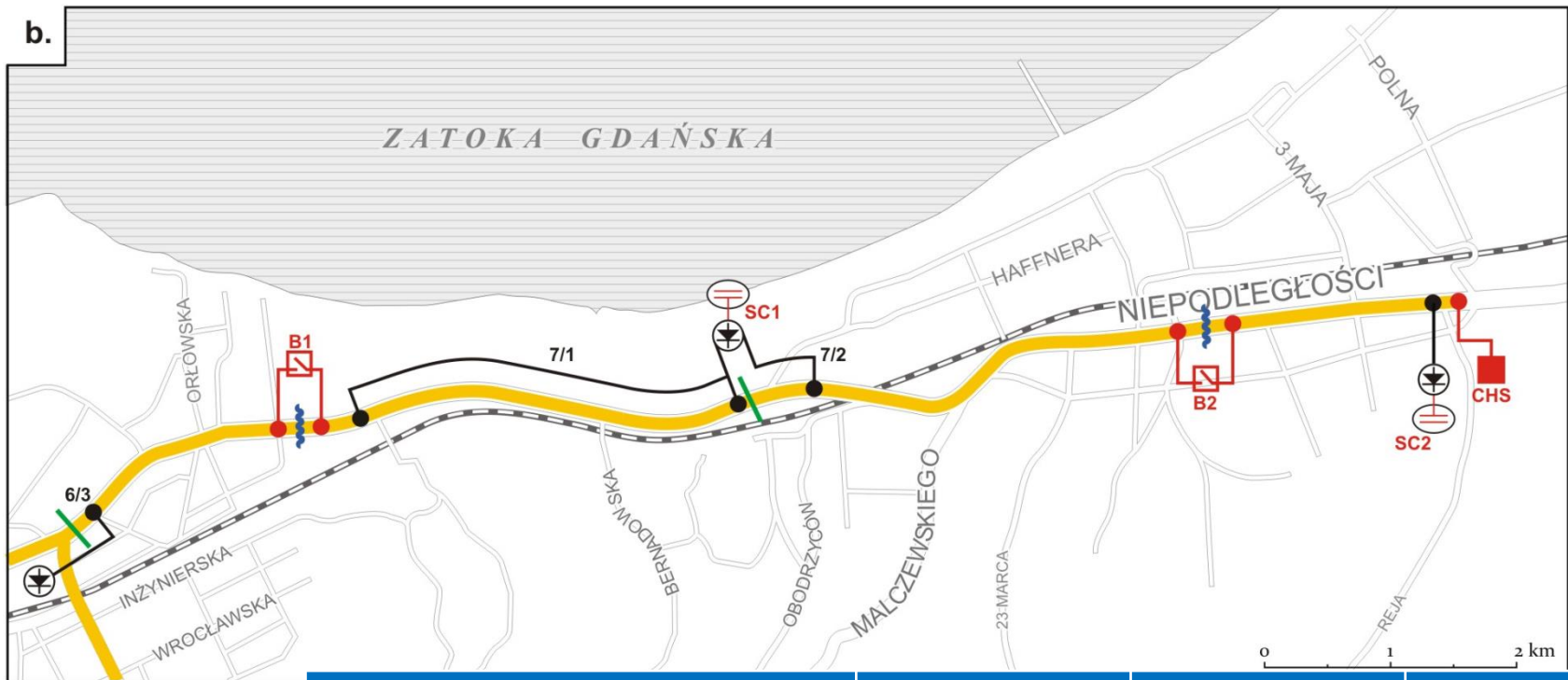
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	likwidowana podstacja trakcyjna



RESULTS OF MODIFICATION



	Now	Super cap	Smart
Power total	58 kW	48 kW	48 kW
Losses	7 %	6 %	5 %
Recuperation	8,4 %	23 %	23 %
Use of recuperation potential	34 %	92 %	92 %



SUMMARY

- Recuperation is working, even in case of a „flat“ city
- Topology of power supply system is a very important element -> bilateral supply of trolleybus network
- Energy recuperation allows to save up to 40% of total energy costs
- Energy saved is the cheapest form of energy

Thank you for attention!

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