trolley:2.0 for smart cities

Interreg CENTRAL EUROPE

EfficienCE

GDAŃSK UNIVERSITY OF TECHNOLOGY

PRZEDSIĘBIORSTWO KOMUNIKACJI TROLEJBUSOWEJ SP. Z O.O. PKT GDYNIA

Advanced trolleybus supply system with Stationary Energy Storage

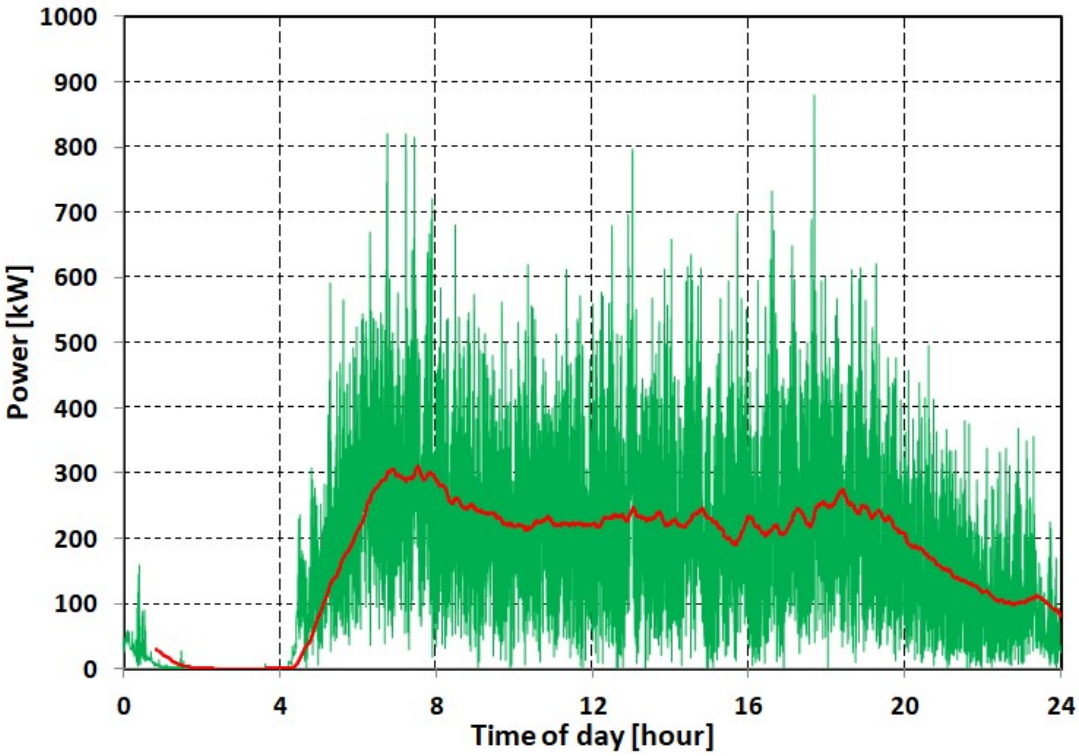
Mikołaj Bartłomiejczyk, Ph.D., D.Sc.
Leszek Jarzębowicz, Ph.D., D.Sc.

The article discusses two energy storage applications in power supply system of public electrified transport:

- the first application aims at reducing the peak power of the traction substation;
- the second application increases effectiveness of using solar power plant to cover partial power demand of traction supply system.

These two applications were discussed and analyzed based on trolleybus supply system in Gdynia, where most measurements were recorded.

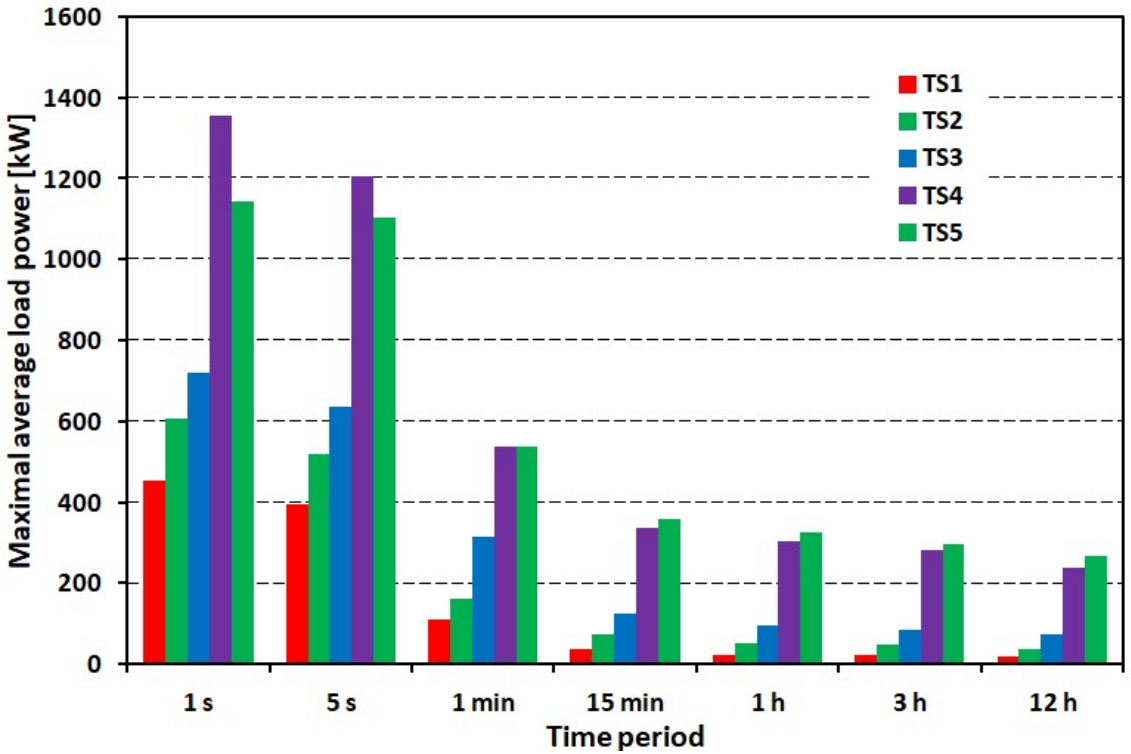
Variation of traction substation's load



Load variations:

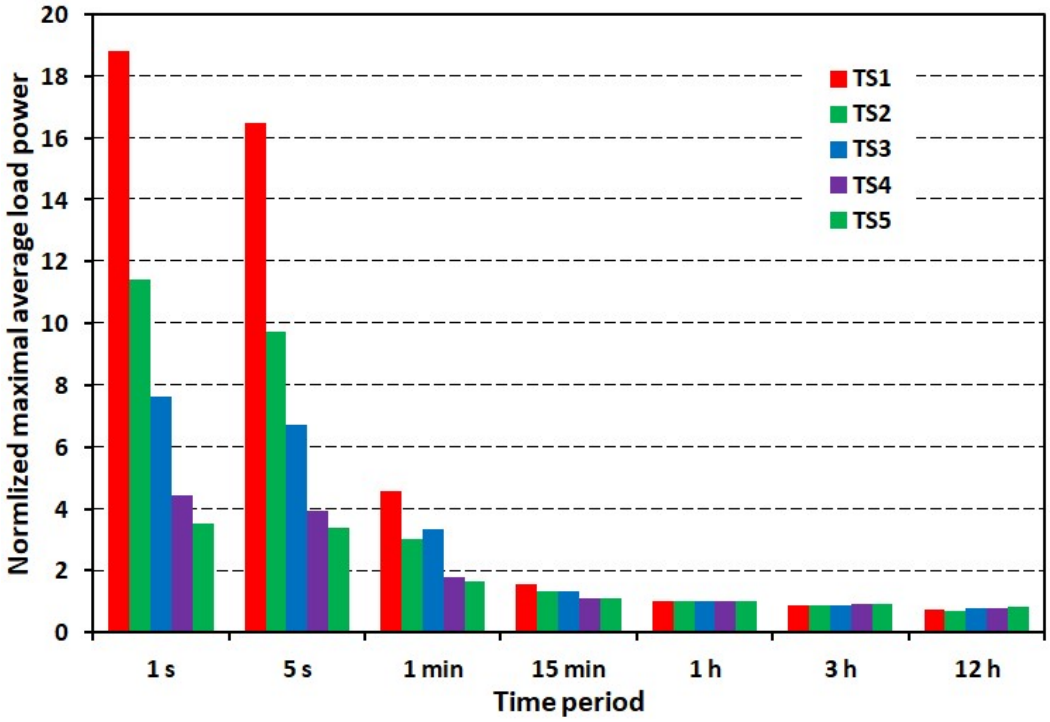
- weekly load cycle,
- daily load cycle,
- short-term load variations.

Indicators of traction substation's load



Maximal load in the short scale is bigger than that in the long scale.

Indicators of traction substation's load

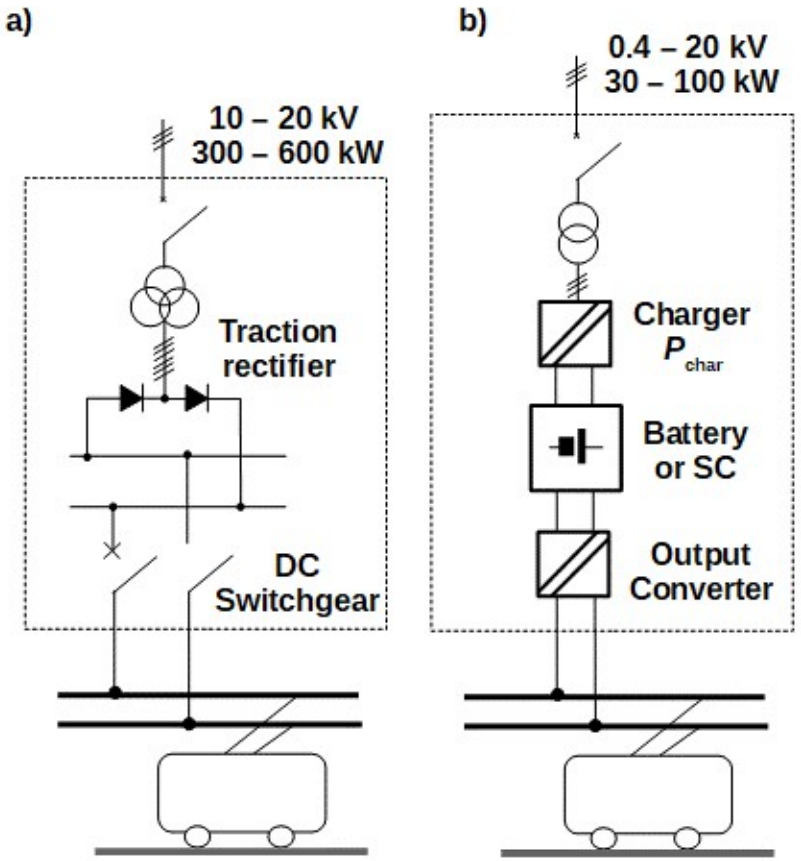


The non-uniformity of the load is evident in the case of small substation.

This brings higher connection fee and contracted power from the energy supplier.

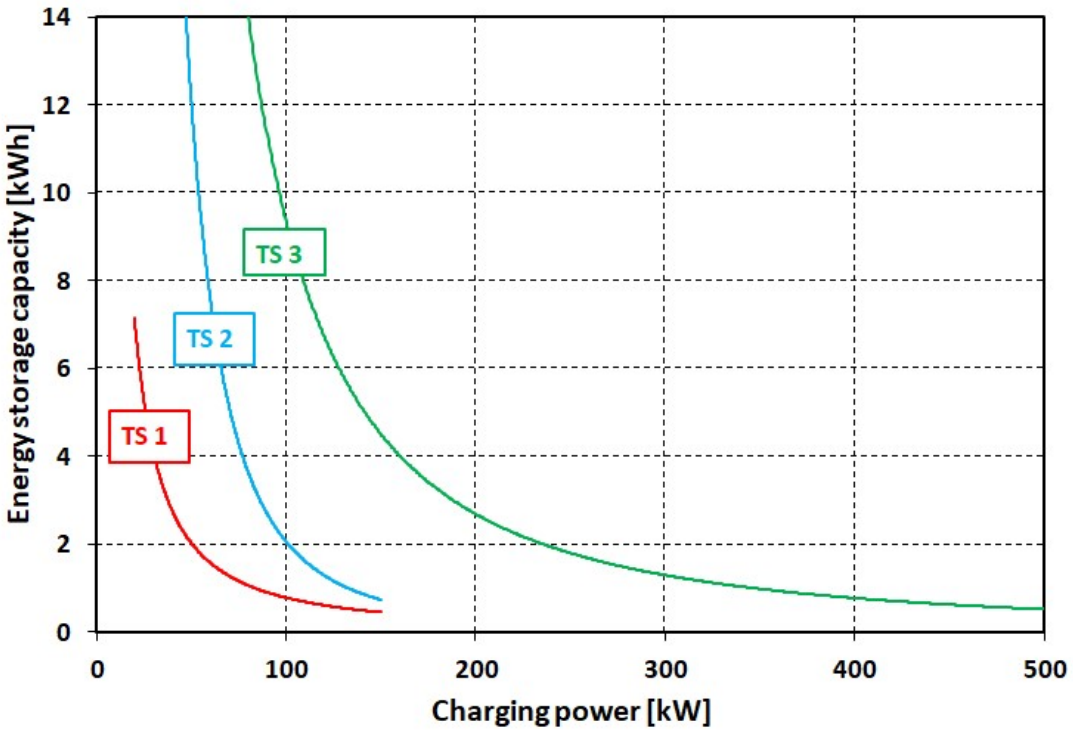
Traction substations' structures

Standard traction substation



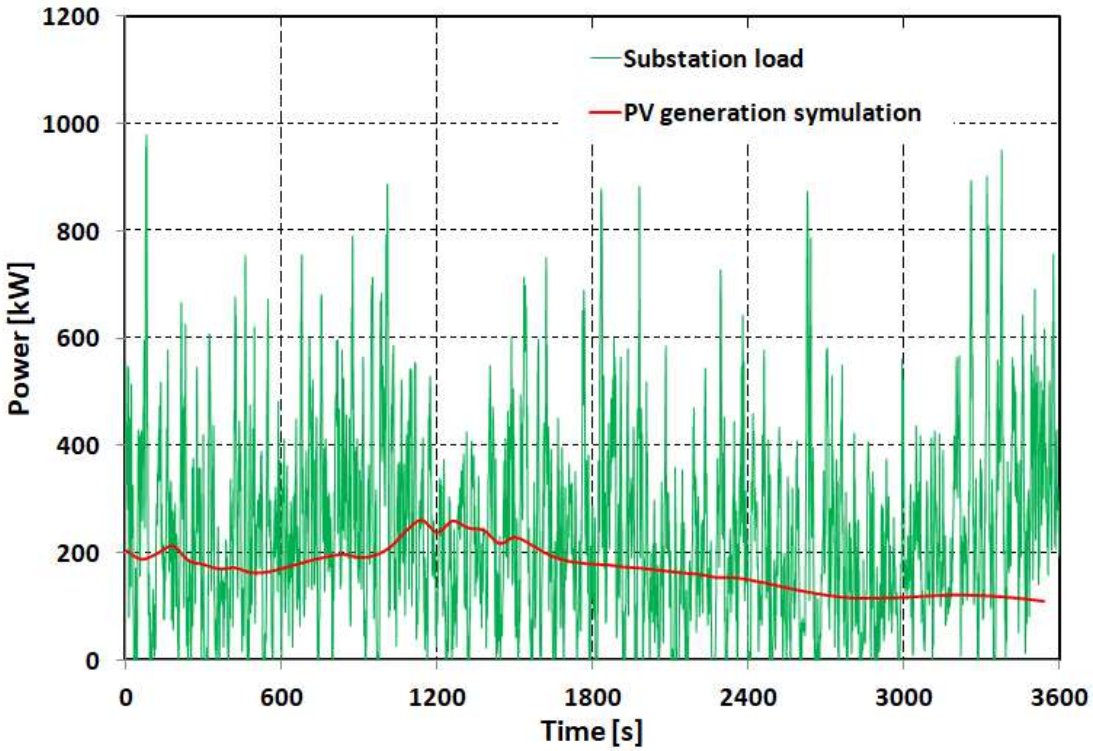
Traction substation with SES

Benefits of SES installation



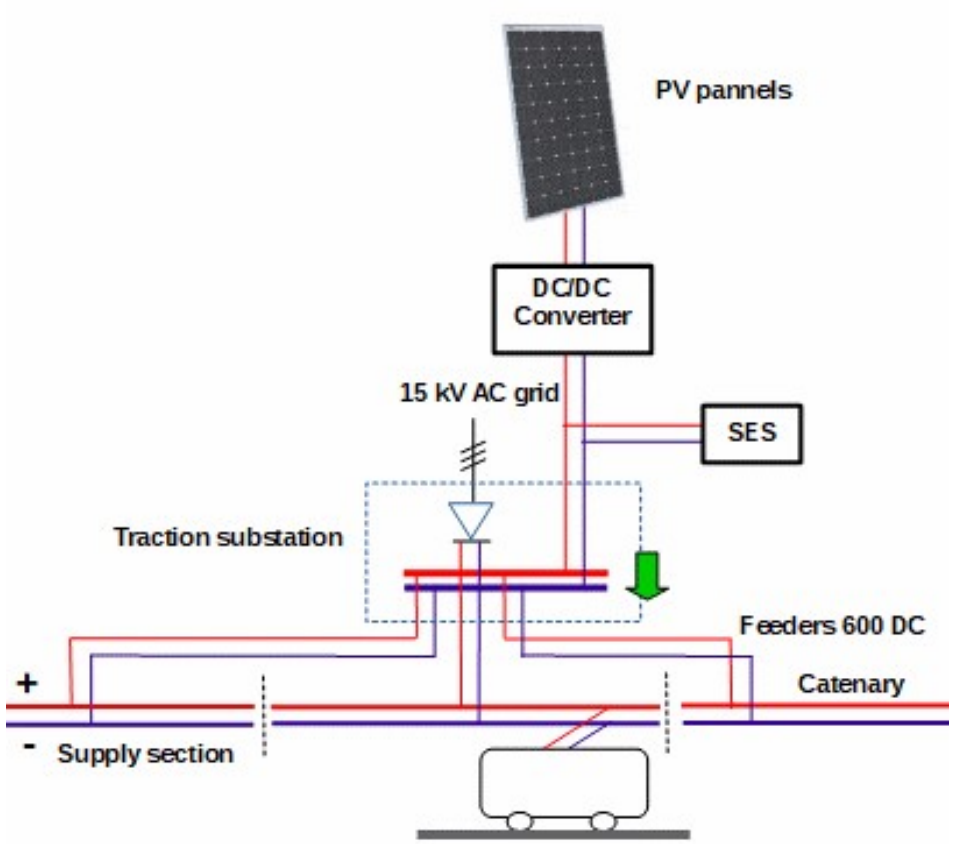
The use of an SES makes it possible to reduce the peak power consumption of the substation to the level of maximum load in the one-hour scale.

Traction load vs. PV generation



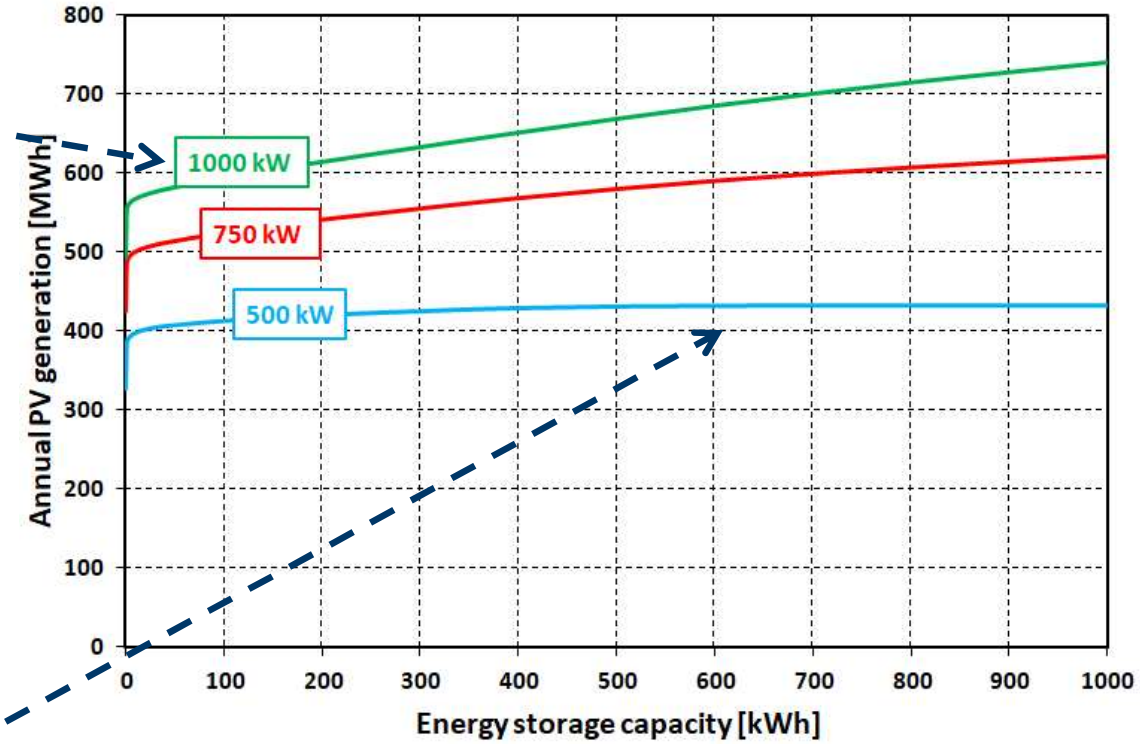
The challenge of using PV for traction system: matching the changing nature of PV power generation to the changing nature of the traction system load.

The scheme of PV and SES



Results of using SES

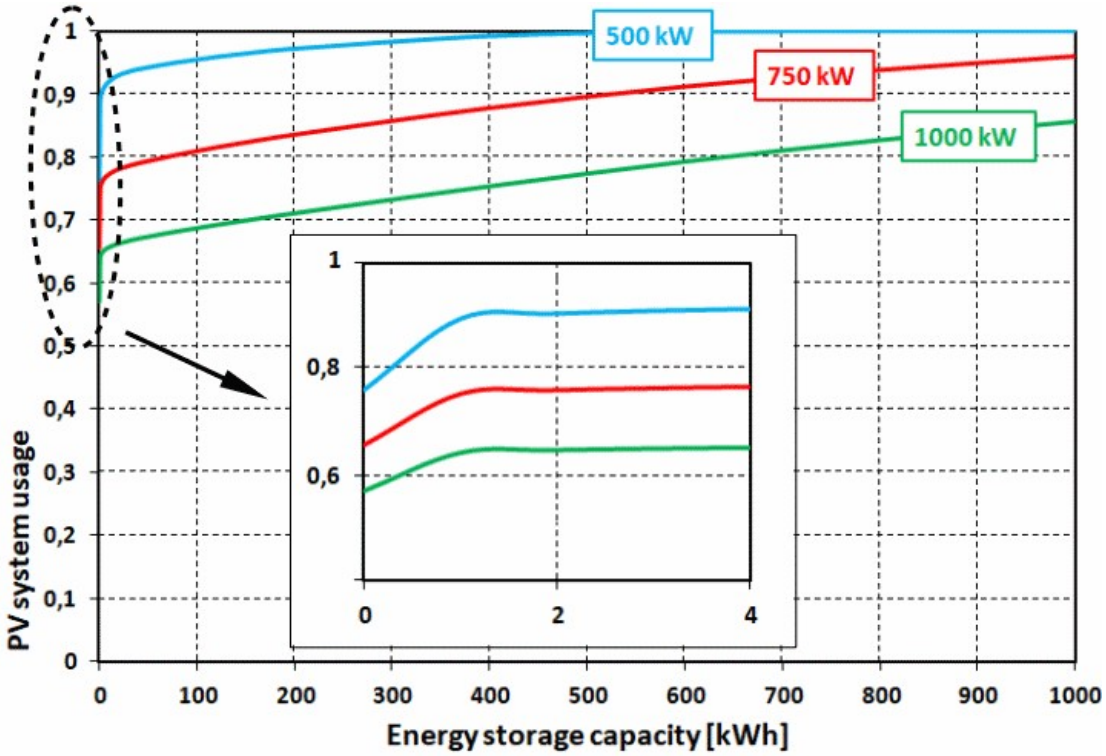
Peak power of PV system



Bigger SES capacity = better usage of PV system.

Costs–benefits analysis is required.

Results of using SES



Compensation of load irregularity in:

- long scale,
- short scale.

Even low-capacity SES helps to improve efficiency.

- The article discussed two innovative applications of energy storage system in power supply systems for electrified urban transport.
- The considered applications have different aims – reducing the peak power demand of a traction substation or optimizing the utilization of solar energy related to the mismatch between generated and load power. Both applications are expected to provide economic benefits. The second one increases the use of green energy, so it also brings the ecological gain.
- Algorithms for calculating the optimal capacity of SES in the considered applications were presented and used for exemplary cases. Using real measured data analysis have been done giving interesting results. The presented solutions can be elements of a smart grid DC traction supply system.

GDAŃSK UNIVERSITY
OF TECHNOLOGY

HISTORY IS WISDOM
FUTURE IS CHALLENGE