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Institute of Electrical Power Engineering

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# Optimization of energy storage operation at competitive market

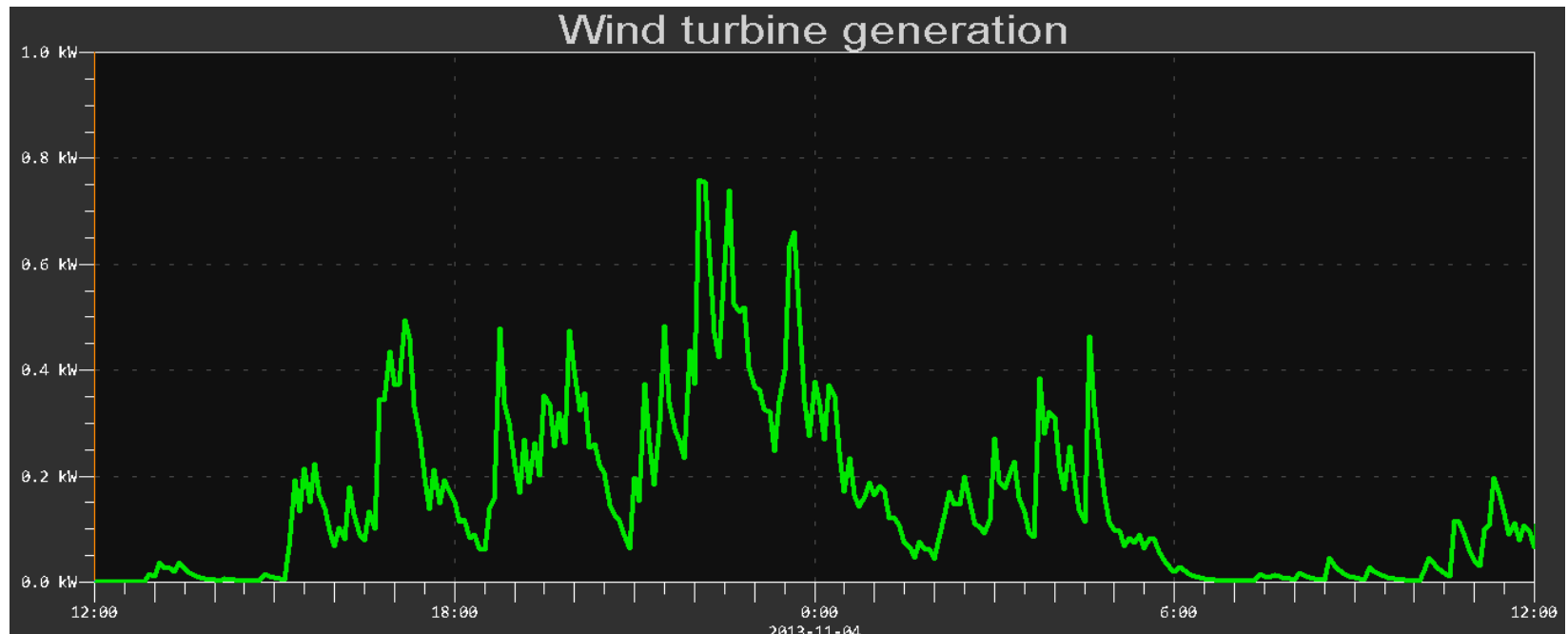
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Lodz University of Technology,  
Poland





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# Justification – Wind turbine generation

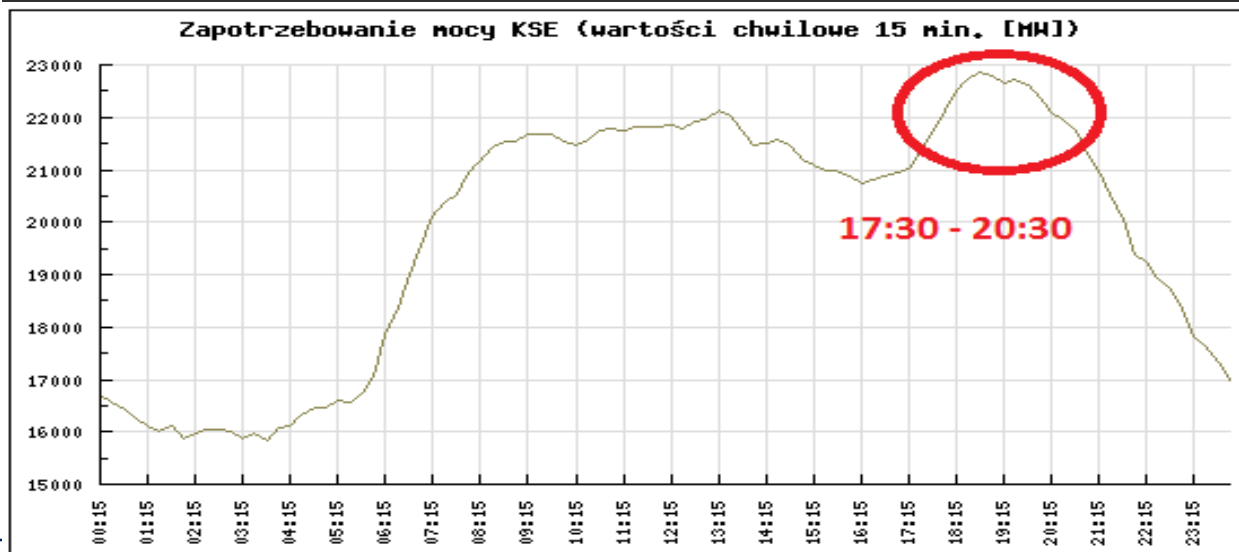
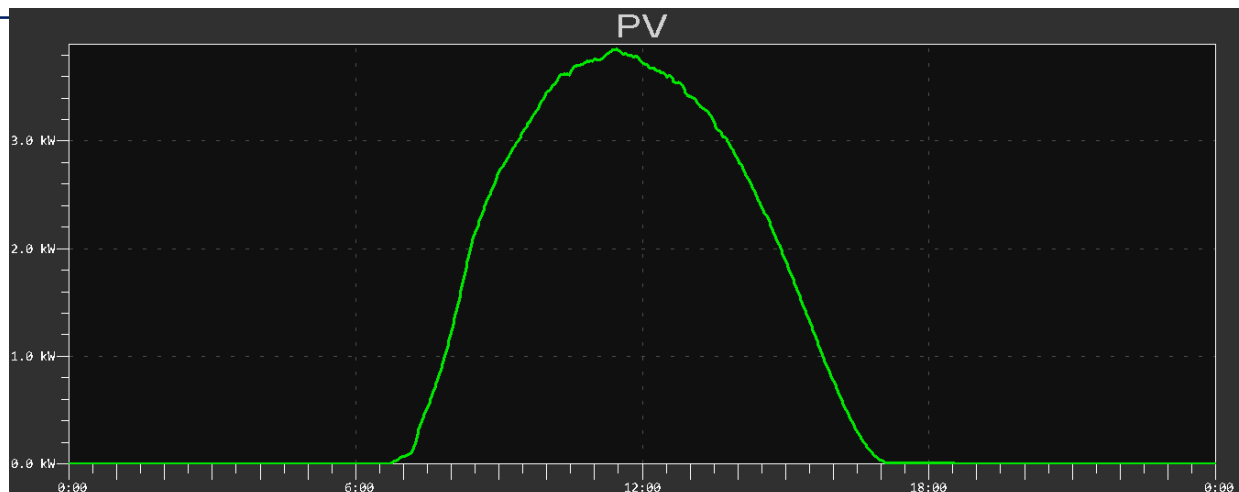




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# PV generation



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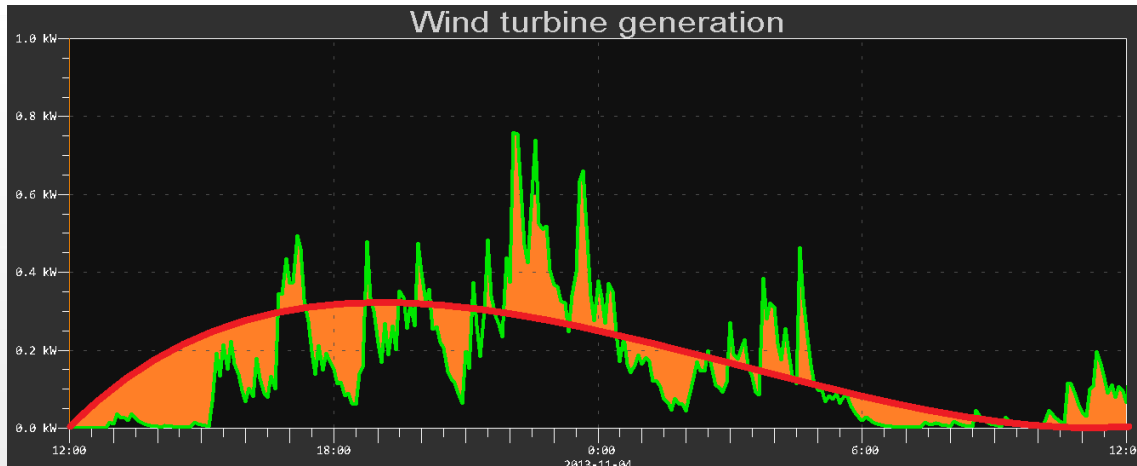
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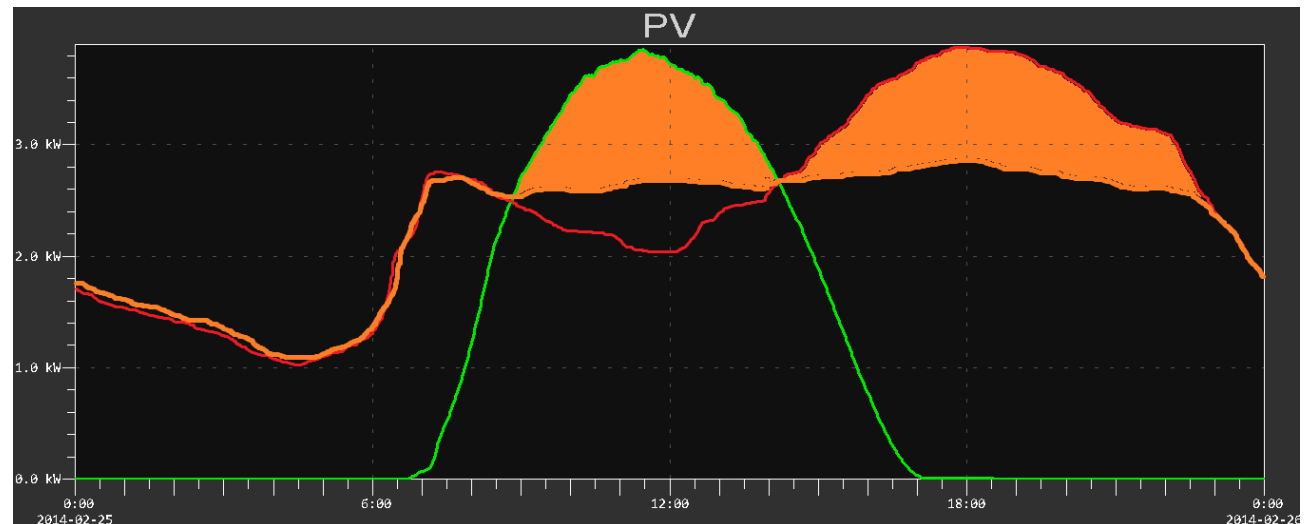
# Daily demand profile



**Subsidies for ES:**

**NFOŚiGW**

**40% for PV with  
ES**





eurelectric  
ELECTRICITY FOR EUROPE

WEB NEWS

EURELECTRIC Urges Commission To Adopt Strong State Aid Guidelines



In particular, EURELECTRIC believes that:

- Granting support when prices are negative is unacceptable;
- The review of the EEAG should be used as an opportunity to integrate small-scale renewables into the market;
- **Balancing should become the rule, with all power producers bearing balancing responsibility.**

## RES and DG should operate on the same rules as rest of the power industry participants





# Legal and market rules

Unbundling

Third Party Access

Energy = product, traded on an Energy Exchange

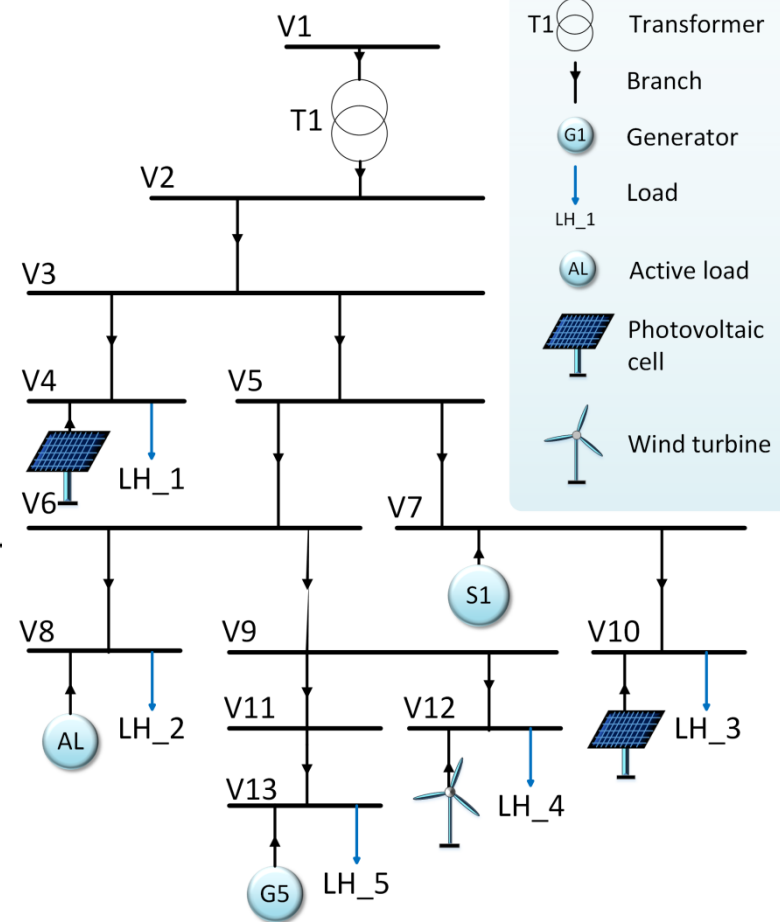
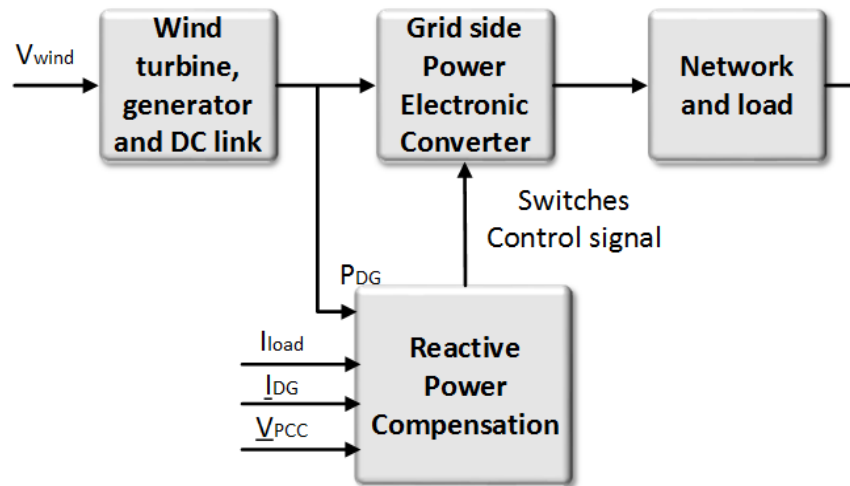
Balancing market





# Assumptions

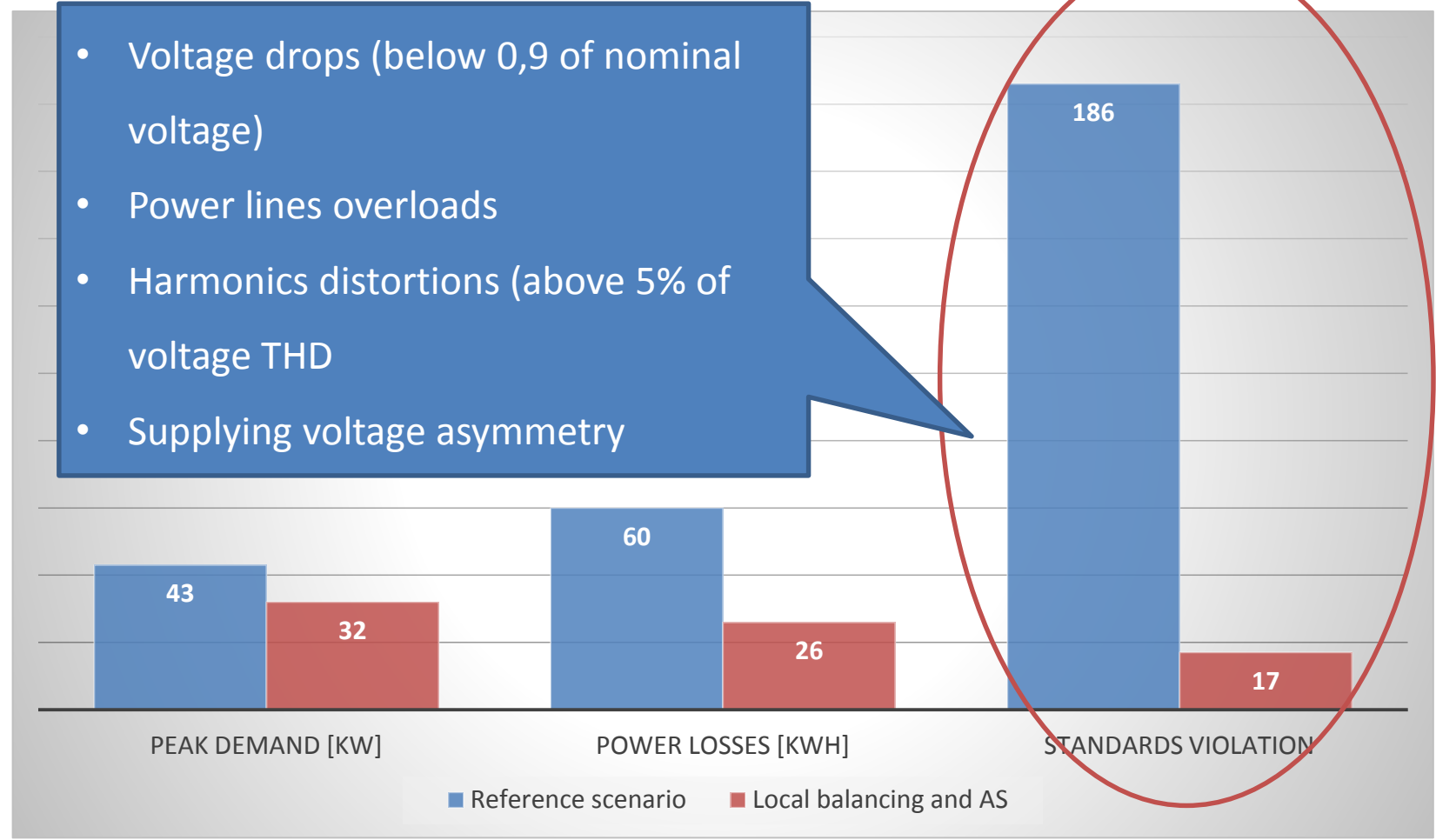
- Energy balancing
- Ancillary services
  - Reactive power compensation
  - Asymmetry reduction
  - Harmonics reduction



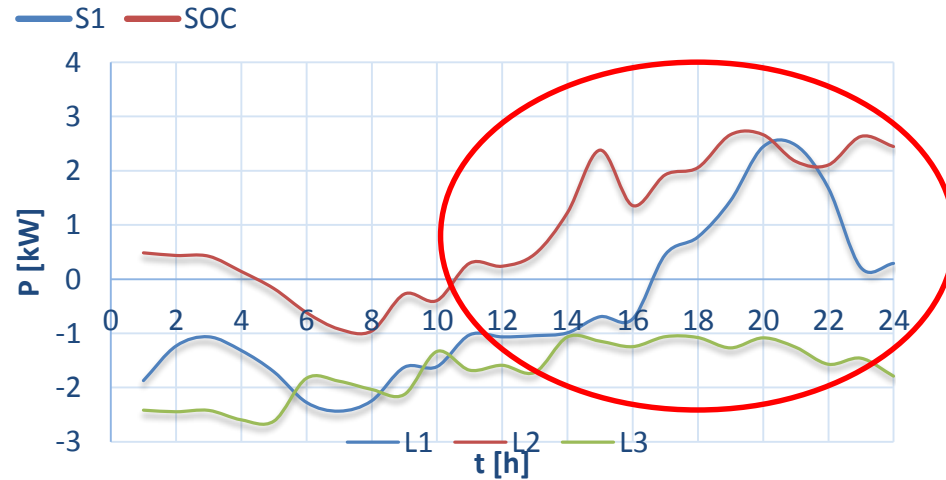
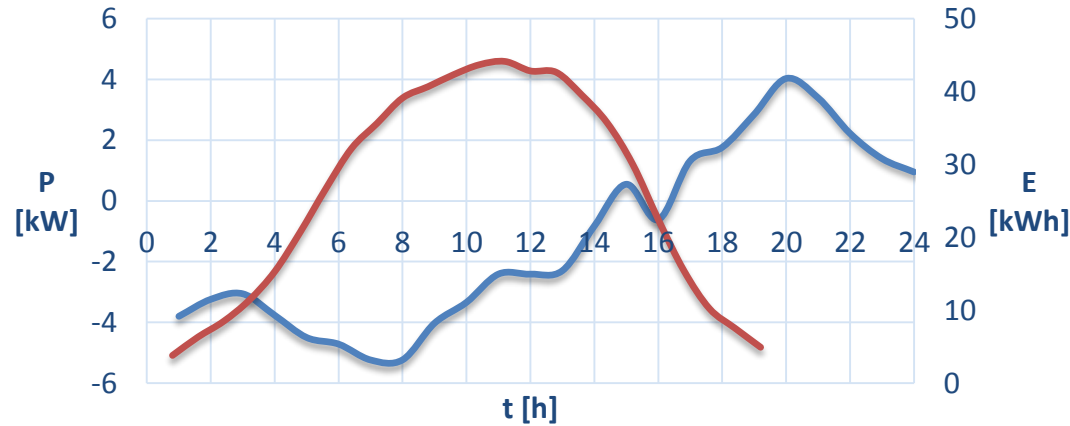


# Results

- Voltage drops (below 0,9 of nominal voltage)
- Power lines overloads
- Harmonics distortions (above 5% of voltage THD)
- Supplying voltage asymmetry









## **Coordinated operation of DG with ES and provision of AS can provide:**

- **Increase of local network reliability**
- **Better usage of local energy resources**
- **Avoid technical constraint violationa.**

## **Further research:**

- **Further investigation of the reactive power compensation, asymmetry and harmonics reduction;**
- **Analysis of the applicability of the existing definitions of harmonics distortion and asymmetry;**
- **Bidding strategies for energy storages which would be able to maximize the operating income of such installations;**





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Thank you for attention



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