Technical Task

Consider an energy system comprising a photovoltaic system and an electrical battery. The system is connected to the external electrical grid, enabling the buying and selling of electrical energy. Utilize the provided characteristics for each component, along with production predictions for the photovoltaic system over the next 48 hours and energy prices for buying and selling over the same period. Calculate optimal energy flows within the system for each hour within the prediction horizon. The objective is to meet predicted electrical energy demands while minimizing costs.

The connections within the system are presented in the scheme. Each arrow represents an energy flow. All energy flow and system characteristics are in kW or kWh units.

**System Components Description:**

* Photovoltaic system provides electrical energy in kWh, no output loss.
* Electrical Grid: max sell power 700 kW, max buy power 700 kW.
* Battery: Capacity 160 kWh, max charging/discharging rate 100 kW, efficiency 92% (loss during the charging process, no loss during the discharging process). Consider the levelized cost of storage (lcos) – each kWh stored in the battery becomes more expensive for usage. The initial battery charge is 0.
* Electrical Consumer consumes electrical energy in kWh.

A) Consider only linear constraints.

B) Optional. Consider that it is not possible to sell and buy energy type from the grid and to charge and discharge the battery simultaneously (during one timestep).

C) Optional. Additionally consider that it is possible to sell and to buy energy from/to the grid only by packages of 100 kWh. The battery capacity might be increased if it is necessary, but the charging and discharging rate is 100 kW.

The A task is obligatory to implement; the B, C task are optional. You can provide your thoughts regarding those problem: What additional constraints should be considered? What changes should be made in the A solution? What issues might occur?

A diagram of electrical grid

Description automatically generated