Economic optimization of microgrids

Due to the 2020 Strategy in the European Electrical Sector, there are different initiatives to lead the CO2 reduction, the renewable increment in the generation mix and the efficient energy management. A new component of this scenario will be microgrids, which can be defined as a power system composed of Distributed Energy Resources (DER) that can operate coordinately as an electrical or thermal generator, as a storage system or as a load, to provide maximum electrical efficiency with a minimum incidence to loads profile in the local power grid.

**Objective**

Design a control strategy to meet the management needs of the microgrid. This control strategy will be based on optimization tools in order to maximize the economic profit of the microgrid operation subject to security and environmental restrictions.

**Methodology**

From a general point of view, the optimization problem can be defined as follows:

**Objective Function:**
Minimize energy cost: \(\text{MIN} \sum P_i \cdot C_i\)

**Indices:**
- \(i = \text{Microgrid units}\)
- \(t = \text{Time period}\)

**Decision Variables:**
- \(P_i = \text{Power consigned to each microgrid unit [kW]}\)

**Constraints:**
- Production capacity of unit \(i [\text{kW}]: P_i \leq P_{\text{max}}\)
- Satisfy energy demand and deal with energy balance: \(\Sigma P_i = D_t\)
- Lower boundaries: \(P_i \geq P_{\text{min}}\)
- Storage capacity: \(0 \leq E_t \leq E_{\text{max}}\)

**Given Data:**
- \(D_f = \text{energy demand forecast within the microgrid in period t [kWh]}\)
- \(D = \text{energy demand within the microgrid in period t [kWh]}\)
- \(C_i = \text{cost per generation unit [€/kWh]}\)

**Expected results**

- Theoretical development of a microgrid control strategy using advanced optimization tools.
- Implementation of the control strategy in IREC’s microgrid test facilities.

**Requirements**

- Capacity to work in a team, flexible, with initiative and ability to innovate. High level of analysis and synthesis skills.
- Knowledge on operations research, mathematical modeling and optimization techniques are required.

**Contact**

Miguel Cruz (mcruz@irec.cat)  Tel: +34 93 356 26 15
Electrical Engineering Research Area
Location: C/Josep Pla 2, B2. PB 08019 BARCELONA (SPAIN)
UPC Advisor: F. Javier Heredia (GNOM-UPC)