Optimal Bidding Strategies for Thermal and Combined Cycle Units in the Day-ahead Electricity Market with Bilateral Contracts

F. Javier Heredia
f.javier.heredia@upc.edu

Marcos J. Rider
marcos.rider@upc.edu

Cristina Corchero
cristina.corchero@upc.edu

Group on Numerical Optimization and Modeling
Departament d'Estadística i Investigació Operativa
Universitat Politècnica de Catalunya

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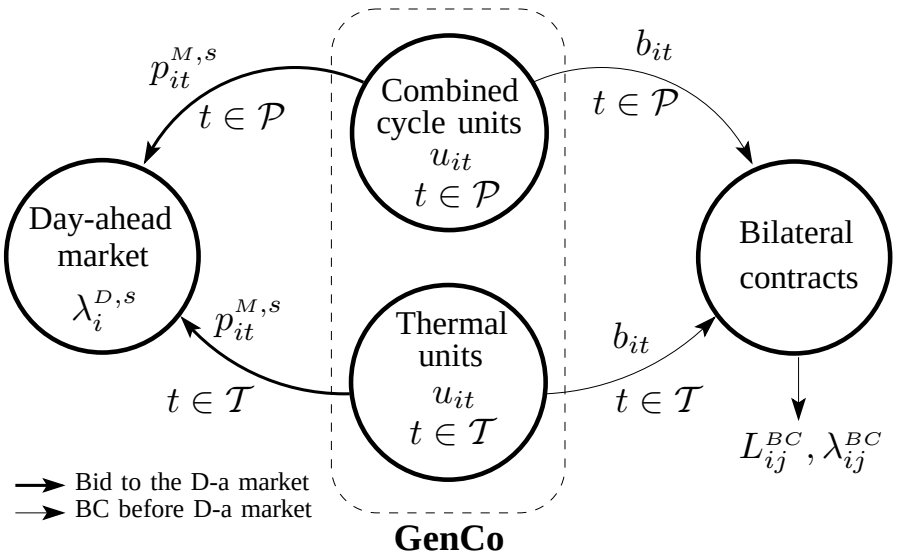
Objectives of the study

- The objective of this study was to develop an stochastic programming model that allows a price-taker producer to decide:
  1. The economic dispatch of the bilateral contracts among the thermal and combined cycle programming units.
  2. The optimal bidding for both thermal and combined cycle programming units, observing the MIBEL regulation.
  3. The unit commitment of its thermal and combined cycle programming units;

  that maximizes the expected profit from its involvement in the spot market and bilateral contracts.
- The model was solved using real data of a typical generation company and a set of scenarios for the Spanish market price.

Modellization: assumptions



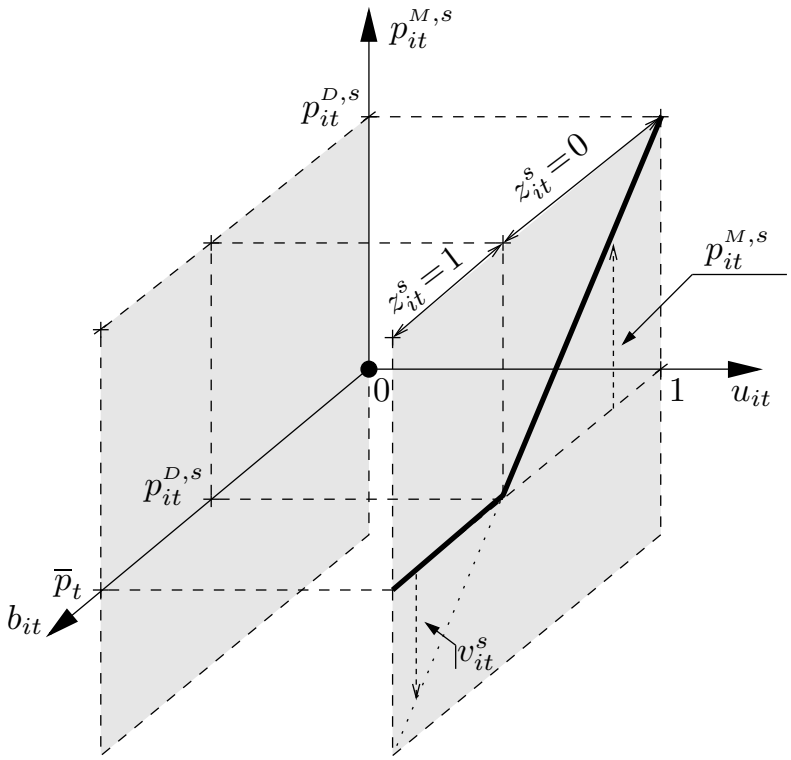
- Price-taker GenCo.
- $\mathcal{T}$ thermal units: convex gen. costs; start-up/shut-downs costs; min up/down time.
- $\mathcal{P}$ combined cycle units: convex gen. costs; start-up/shut-downs costs; min up/down time.

- Both thermal and combined cycle units bid to the day-ahead market and provide energy to bilateral contracts.
- $\mathcal{B}$ bilateral contracts: L_{ij}^{BC} MWh, λ_{ij}^{BC}€/MWh $\forall j \in \mathcal{B}$.
- The stochasticity of the spot price is represented by a set of scenarios.

Modellization: bidding model

A new model for the optimal bidding function and matched energy who takes into account the presence of bilateral contracts.

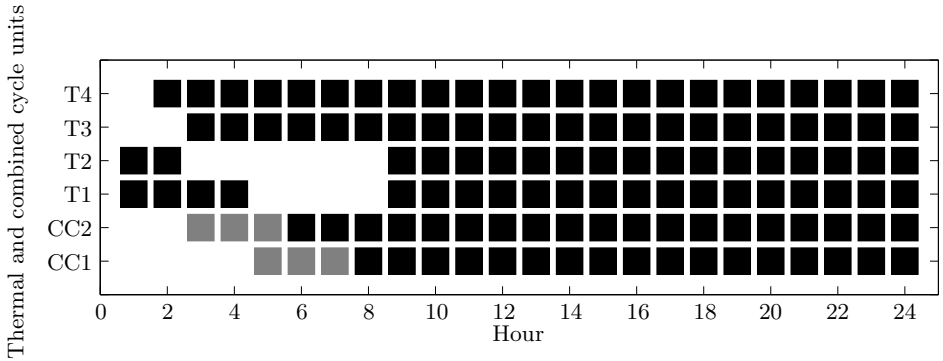
- the function is non-differentiable, but;
- can be transformed into the an equivalent mixed-integer linear system



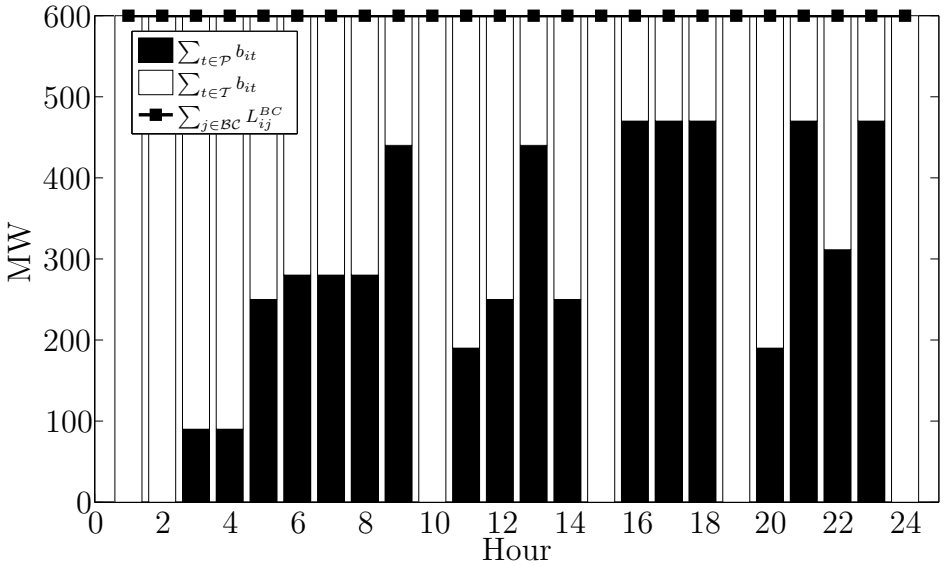
$$
\left.
\begin{aligned}
& p_{it}^{M,s} = p_{it}^{D,s} u_{it} + v_{it}^s - b_{it} && (a)\\
& p_{it}^{D,s}(z_{it}^s + u_{it} - 1) \le b_{it} && (b)\\
& b_{it} \le p_{it}^{D,s}(1 - z_{it}^s) + \overline{p}_t(z_{it}^s + u_{it} - 1) && (c)\\
& p_{it}^{D,s}(1 - z_{it}^s) \ge p_{it}^{M,s} && (d)\\
& p_{it}^{D,s}(1 - z_{it}^s) \le p_{it}^{D,s} u_{it} && (e)\\
& v_{it}^s \le (\overline{p}_t - p_{it}^{D,s})(z_{it}^s + u_{it} - 1) && (f)\\
& p_{it}^{M,s} \in [0, p_{it}^{D,s}] && (g)\\
& v_{it}^s \in [0, \overline{p}_t - p_{it}^{D,s}] && (h)\\
& z_{it}^s \in \{0, 1\} && (i)
\end{aligned}
\right\}
\begin{aligned}
& \forall i \in \mathcal{I}\\
& \forall t \in \mathcal{U}\\
& \forall s \in \mathcal{S}
\end{aligned}
$$

Case study: analysis of the solution

Unit commitment of thermal and combined cycle units

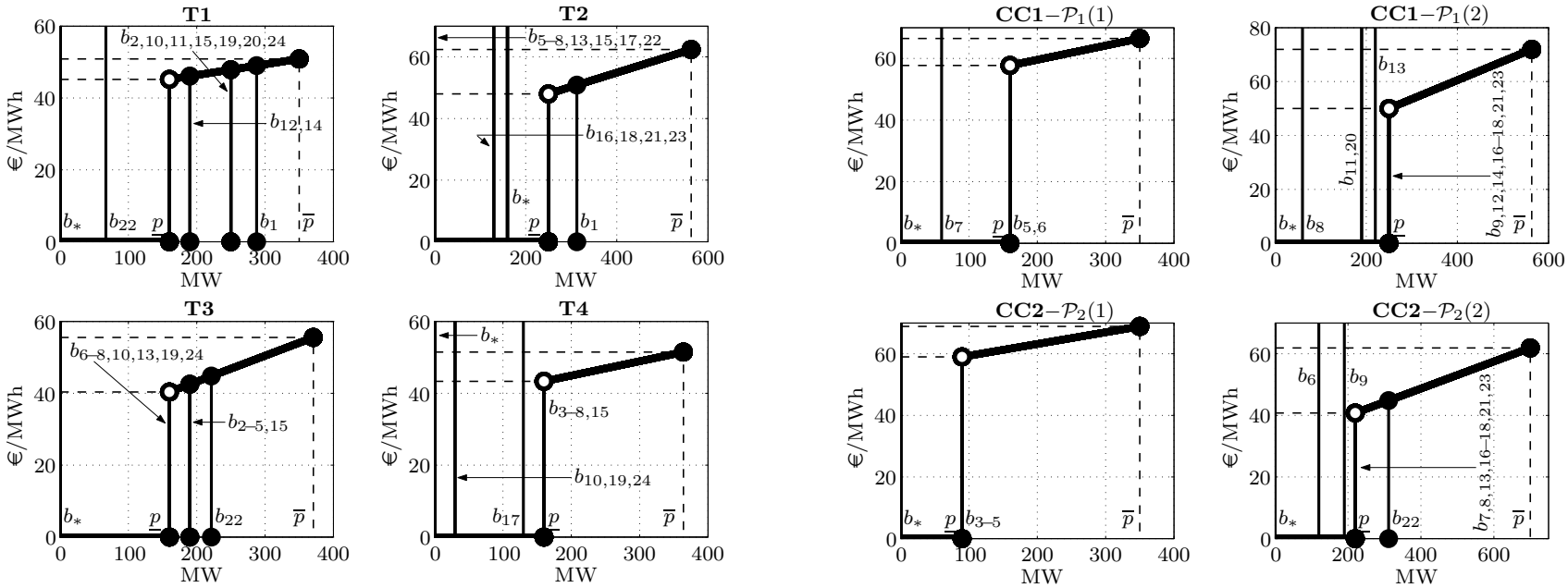


Management of the bilateral contracts.



Case study: analysis of the solution

Optimal bidding curves.



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