# Medium-Term Unit Commitment

In the medium term UC optimization models are applied to define tentative scheduling of the power plants over typically one to three months horizon. More specifically, there are 3 main objectives:

- strategies for water
- moving starting/stopping of plants
- making risk analyses

There are some differences from the long term UC (one-plus year horizon) approach. In the medium term the main goal is to assess the tentative reservoirs management for hydro in a more effective manner since some more accurate forecast are available, especially in the one month ahead horizon. The problem is still coupled with the producibility of a fossil fuel power plant and with the (non programmable) uncertain production of renewable power plants. While for short time horizons, typically of one day or of one week, the pure short term UC problem (but not max profit UC in market related) can also be considered deterministic, for medium management horizons, a special emphasis must be put on the uncertain nature of data. In particular, on a yearly or more scale, reservoir inflows, demand, as well as availability of the plants cannot be considered deterministic. For instance in winter time customer demand can vary up to one GW per degree Celsius for big countries such as Italy, UK, France or Germany. On the other hand a rainy season can fill reservoirs and let the hydro production plants produce much more w.r.t. a dry season. Another crucial factor is related to renewables (wind and solar) power plant whose productivity fluctuations can be high. In the following we give insight to the different goals and constraints of the long term UC:

- **Main goals**: Main goal of the medium term UC is to decide the production levels of the plants comprising the mix in such a way that the demand is satisfied at each time step and the production cost is minimized. The physical model typically considered is a stochastic or robust dynamical system for which the uncertain parameters are a) the electricity consumption, b) the availability rates of the thermal plants (either due to optimized scheduled mantinance or faults) and c) the quantity of inflows received by the different reservoirs of the hydroelectric power stations. An additional goal of a long term UC could be a definition for a GenCo (or for the monopolist) of the gas long term (ToP) contract to be signed. As a reversed engineered problem also an optimized schedule for mantinance can be deduced.

- **Thermal units:** Thermal (including nuclear) power plant are modeled in a simplified manner w.r.t short term UC, main constraints include only min and maximum stable production and sometimes simplified (e.g. linearized) cost curves. However Start Up Cost are normally taken for middle merit units (i.e. those that are not always running) into account also because they affect the medium term maintenance costs.

- **Hydro Units:** Hydro units are modeled in a simplified fashion w.r.t. short term UC, for small basin power plant, production minimum is relaxed to 0 and very often cascade are aggregated to single production units.

- **Renewable non programmable (i.e. wind and solar):** These power plants do not actually have operational constraints but due to their intermittency the UC modeler should try to have a tentative forecast of their production profile perhaps by geographical aggregation. More importantly than in the short term cases the inherent uncertainty in their forecasted schedule in turns calls for stochastic-like approaches.

- **Electricity Demand:** Uncertainty in demand global values and profile shape are the most important data to deal with. Both the global demand level and, separately, the demand profile are important to the solution of a long term UC. On the other hand this electricity demand uncertainty couples with the uncertainty of the Renewable non programmable units production.

In medium term UC, the strategies for the big Hydro reservoirs are defined. Hydro power is a renewable source of energy that plays a key role in electric power systems, especially due to its flexibility and to its ability to allow the integration of other intermittent renewable sources. The medium-term hydro-scheduling is a very complex task that involves a great variety of processes and variables,some of which are considered stochastic, because of their uncertainty in the medium term. Two combined methods are used by Iberdrola in medium-term hydro-scheduling: stochastic optimization and simulation. The objective is to schedule, on the short term, the hydoreservoir. Secondly, a risk analysis and decision about the start/stop of the powerplants are defined. For the hydro what is done is the strategy for using the water, mainly done by calculating Bellman values.

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