

# Which unit-commitment formulation is best? A comparison framework

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## Abstract-

The Unit Commitment (UC) problem, which determines the day-ahead dispatch of generation units, is one of the key problems in power systems operation. A long list of formulations that claim to solve this problem more efficiently have been proposed. However, comparing them is not easy due to the different interpretations of constraints (e.g., ramps, reserves, startup/shutdown) and the heuristic component of the solution process of most solvers. This paper proposes a general framework to establish a systematic procedure for comparing different formulations. We apply the procedure to the three current state-of-the-art formulations in this context: tight and compact (TC), state transition (ST), and projected two-binary-variable (2bin). We carry out an exhaustive analysis over 54 problem instances of very different sizes (10 to 1888 generators) and time scopes (24 and 168h), for four alternative definitions of additional constraints. Our results favor the TC formulation in general in terms of integrality gap and CPU time. Stronger ramp constraints improve CPU time in general, and depending on the case study and size the fastest formulation changes and sometimes the differences among the formulations are almost negligible.

**Index Terms-** Mixed-Integer Linear Programming (MIP), unit commitment (UC), tightness, compactness, reformulations.

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