

A Model to long-term, multiarea, multistage, and integrated expansion planning of electricity and natural gas systems

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Abstract— A long-term, multiarea, and multistage model for the supply/interconnections expansion planning of integrated electricity and natural gas (NG) is presented in this paper. The proposed Gas Electricity Planning (GEP) model considers the NG value chain, i.e., from the supply to end-consumers through NG pipelines and the electrical systems value chain, i.e., power generation and transmission, in an integrated way. The sources of NG can be represented by NG wells, liquefied natural gas (LNG) terminals and storages of NG and LNG. The electricity generation may be composed by hydro plants, wind farms, or thermal plants where the latter represent the link between the gas and the electricity chain. The proposed model is formulated as a mixed-integer linear optimization problem which minimizes the investment and operation costs to determine the optimal location, technologies, and installation times of any new facilities for power generation, power interconnections, and the complete natural gas chain value (supply/transmission/storage) as well as the optimal dispatch of existing and new facilities over a long range planning horizon. A didactic case study as well as the Brazilian integrated gas/electricity system are presented to illustrate the proposed framework.

Index Terms— Electricity systems, natural gas systems, operation and expansion planning of electricity systems, operation and expansion planning of natural gas systems.

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