TECHNO-ECONOMIC MODELLING AND ANALYSIS OF CO-GENERATION UNITS IN FRANCE

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Overview

At the end of 90s, following high fossil fuel prices and environmental concerns, the world energy context had considerably changed. Hence, governments and regulatory authorities engaged in the promotion of renewable and less emitting technologies. It is in this context that co-generation power plants have been promoted by the French government.

In this study, we analyse the current situation of co-generation power plants in France. We go through different support schemes dedicated to CHPs (combined heat & power) introduced by the government following the 20×20×20 energy policy for the year 2020. Then, through a modelling approach, we analyse various alternatives that the co-generators will be faced with after the expiration of these support-schemes and the liberalised market for power.

Methods

In the context of market liberalization, our model takes to help co-generators to maximize their profits and to know when it is profitable to run their cogeneration units and vice versa shutting them down according to the electricity prices. Modelling was performed in General Algebraic Modelling System (GAMS) interface.

The objective function in our case is a profit maximization one. The model allows us to switch between two modes based on the imposed constraints: <u>Normal mode</u> (conventional power units) and the <u>CHP mode</u> (cogeneration) according to energy prices. The objective function consists of the sum of the two modes and because we can only run one of the two modes for each period, we have introduced a binary variable (X_i) which allows maximizing only one of the two modes at each time step.

This optimization model helps the CHP producers with their decision-making process. It gives them the right signals so as to know when it is profitable to start producing from their cogeneration units. The model's main variables are the amount of gas (fuel) used in the power plant and the quantity of electricity and heat produced.

Initially, we begin by running a static model in which binary variables are fixed and are not time-dependent. Thereafter, they vary according to the time periods (already defined in the model) and different working days from Monday to Friday. We have imposed constraints which allow switching between production modes up to two times per day. Finally, market prices of electricity based on the marginal cost of power generation (modelled in parallel) are integrated into the model as a decision making parameter.

Results

The result illustrates that in the short-term, cogeneration units must continue to produce under the existing support scheme structure. In medium-term and under the liberalized market conditions, running cogeneration units (based on energy price signals) can still remain profitable for the power producers. However, toggling between two production modes (more than once a day) entails significant costs due to the O&M and energy losses.

Conclusion

The structure of electricity production in France has not necessitated a remarkable use of cogeneration units, since France has mainly nuclear power as a source of electricity with its low greenhouse gas emissions and low generation costs per MWh of electricity. This prevents France to promote efficiently the cogeneration units and has obliged policy makers to support its development through the feed-in tariffs and many other sorts of support schemes.

Co-generators' decision-making process has evolved since the release of feed-in tariff contracts and market liberalization. This change leads to a new form of contract for electricity generation from cogeneration units whose price reflects the evolution of wholesale electricity market.

From now on, the main question for cogeneration sector is the fact that on one hand, the government wants to increase the CSPE public tax (*contribution to public service electricity*) in the coming years for avoiding heavy

financial weight of cogeneration benefiting from feed-in tariffs. And on the other hand, this policy will challenge the co-generators who wish to not only preserve the profitability conditions of the existing fleet but also to obtain suitable conditions for creating new sites and investing.

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