MODEL FOR EFFICIENT USE OF EXISTING POWER GENERATION CAPACITIES IN AZERBAIJAN

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Overview

Having 7.9 GW of installed generation capacity, Azerbaijan's power system possesses thermal (85%) and hydro (15) power plants. The total electricity generation in 2016 reached about 25 billion kilowatts-hours (kWh), of which 92% was generated from thermal power plants (TPPs) and 8% from hydro power plants (HPPs). Natural gas is used as the main fuel (99% of consumption) in thermal power plants. The hydropower plants are solely used for regulation of daily peaks. The electricity consumption pattern by household and non-household consumers has sharply changed since the country's independence in early 1990s. While the household consumers had in average 60% share in the countrywide consumption by early 2000s, it dropped to 40% in average, associated with significant industrial growth, improved metering and tariff increase.
As to the structure of costs at power plants, the fixed costs constituted 43% in average per annum in the last 7 years. Conversely, the variable costs (mainly attributive to TPPs) had 57% share in average in the same period. Since the HPPs are mainly used for daily peaks and for regulating water flow rates on rivers in Azerbaijan, the power sector institutions need for a comprehensive capacity utilization and planning tool methodology for more efficient use of generation units in electricity production and optimization of fuel consumption associated with the variable costs at TPPs. The government defines separate single generation tariffs for TPPs and HPPs irrespective of day or night generation periods, lacking with such methodological tool. In other words, the lack of price discrimination in electricity generation doesn't enable the efficient use of capacity at power plants, given the notable share of fixed costs (almost 100% of all costs) at HPPs. On the other hand, the potential application of differentiated day and night generation prices would provide incentives for efficient electricity consumption as well. Considering the above matters, relevant economic day and night prices for household and non-household consumers are calculated in this paper. These prices are in such level that ensures required return for power plants and the maximum beneficial utilization by all categories of consumers, while enabling the efficient use of capacities.
The paper has the following structure: (i) Introduction (covering an overview of electricity generation in Azerbaijan and the objective of paper); (ii) The economic concept on price discrimination in electricity generation (iii) Applied methodological approach; (iv) Data used in the paper; (v) Results; (vi) Conclusions and policy recommendations.

Methods

Azerbaijan doesn't have any statistical records on differentiated day and night consumption by household and non-household consumers, and this requires indirect estimation of such data. To this regard, the authors collected the data of the State Statistical Committee of Azerbaijan Republic on the number of households' electric appliances on annual basis and used it for the estimation of the households' day and night electricity consumption. Furthermore, the authors used the Input-Output Tables of Azerbaijan Republic for the year 2001 and 2011 for the estimation of day and night consumption of non-household consumers. An Equilibrium Model was built based on Cobb-Douglas functions of electricity generation and consumption with due consideration of day and night electricity generation and consumption. Then, optimal calculations were made using Lagrange multipliers. Finally, the statistic parameters of model were econometrically evaluated using EViews program.

Results

As the first step, relevant behavioral production functions of day and night production were built based on the data on day and night production costs of power plants, assuming the equilibrium condition of electricity generation and consumption. In the second step, the behavioral functions of household and non-household consumers on generated electricity were built again assuming the equilibrium condition. Finally, considering the equilibrium condition, the equation system, which has the variables of day and night generation prices, was solved to find relevant values.

Conclusions

The key result of the paper is the calculation of discriminated prices for day and night generation in accordance with the paper objective. In this context, this has the following policy implications for the Azerbaijan, where the Government sets a single tariff for electricity generation at power plants:

- With the application of discriminated day and night generation prices, the Government might provide an incentive for the consumption of electricity during night time, when electricity generation is cheaper, particularly by industrial consumers. This would ultimately decrease the current high variation between day and night consumption;
- Optimization of fuel consumption at TPPs due to decreased variation between day and night generation and subsequent reduction of variable costs;
- Enhanced use of HPPs' generation capacities with the decreased variation between day and night generation.

The built econometric models can be used by the Tariff Council of Azerbaijan Republic and the State Agency for Regulation of Energy Issues under the Ministry of Energy that are involved in market and tariff regulation in the power sector, in order to optimize the costs of the state-owned electricity generation & wholesale company Azerenerji OJSC and the state-owned electricity distribution company Azerishiq OJSC.

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