# Cost Efficiency Evaluation of Thermal Power Plants in Bangladesh Using a Two-Stage DEA Model

*Shahriar Ahmed Chowdhury*[a], *Shakila Aziz*[b], *and Muhammad Bellal Hossan*[c]

## 1. Motivations underlying the research

Electricity production in Bangladesh is based primarily on fossil fuels, which leads to one of the highest levels of subsidies in the world. These subsidies arise from the supply of subsidized fuels to the plants, but also to support plants which operate at a loss from selling electricity at a tariff lower than the cost of production. The cost of production depends on the fuel cost, the fixed costs and the variable O&M costs. The loss occurs more frequently in peaking power plants, which do not operate at high plant factors, but must be given capacity payments in order to compensate the plant owners for their capital investments. This inefficiency became particularly evident during the Covid 19 pandemic, where subsidy payments to the power sector broke all records, while electricity demand plummeted. Capacity payments for idle plants take up a third of the budget allocated to the entire power and energy sector.

Bangladesh is planning to implement an energy transition plan, by cutting down inefficiency in the power sector, while increasing the share of renewable energy in electricity production. However, the cost of renewable electricity is not perceived to be competitive with the average cost of fossil fuel electricity, and this point is highlighted by the traditional fossil fuel industry to downplay the potential of renewable electricity solutions. In this research we aim to highlight how the average cost of fossil fuel electricity does not represent the wide variation in the profitability of individual fossil fuel plants, and that many such plants have generation costs that far exceed the current cost of solar PV even combined with storage.

We take the annual generation and cost data of the thermal power plant fleet of Bangladesh, including 30 baseload plants and 91 peaking plants, for the financial year 2019-2020. Using a two stage approach of Data Envelopment Analysis and Tobit regression, the study aims to investigate and compare the pattern of cost efficiencies among the thermal power plants of Bangladesh, and identify the main causes of loss, which make subsidization necessary. It takes into account the three main cost components of plants, and analyzes which costs are responsible for the cost inefficincies.

## 2. A short account of the research performed

In the input oriented data envelopment analysis model, the input variables are fuel cost, variable O&M costs, fixed costs and installed capacity, and the output is electricity generation. In addition to the BCC and CCR efficiencies, a slack analysis is also conducted. In the Tobit regression analysis, the effects of uncontrollable variables such as the age of the plant in years, the technology of the plant, the fuel used, the location in the country, the installed capacity, and the type of ownership are analyzed. Base load plants and peaking plants are analyzed separately.

The analysis of base load plants reveals that most of the plants are operating at increasing returns to scale. Few of them have fuel cost, variable cost and fixed cost slacks, but none have installed capacity slacks. The biggest predictor of cost inefficiency among these plants is the type of fuel used. Higher capacity plants have greater efficiency, but ownership or technology has no impact on efficiency. The cost of fuel often determines the merit order of plants. The cost of fuel leads to inefficiency in high speed

a Centre for Energy Research, United International University, United City, Madani Avenue, Dhaka 1212, Bangladesh. Email: shahriar.ac@gmail.com.

b School of Business and Economics, United International University, United City, Madani Avenue, Dhaka 1212, Bangladesh. Email: shakila@bus.uiu.ac.bd.

c Bangladesh Power Development Board (BPDB), Directorate of System planning, WAPDA Building, Motijheel C/A, Dhaka-1000. Email: bellal_duet@yahoo.com.

diesel based plants, which then have low plant factors and high capacity payments. Low supply of coal can lead to the poor performance of even coal plants, which then have low plant factors.

Among peaking plants, the overall efficiency levels are low, and many have fuel cost and fixed cost slacks. Plants operate on an economic merit order, where low cost fuel plants are used before the high cost fuel plants. Therefore, heavy fuel oil and diesel plants have higher cost fuels, and lower priority in dispact and lower plant factors. Capacity slacks occur mostly among privately owned plants, but of all fuels. Fixed cost slacks occur in low plant factor plants. Fuel type again is the greatest predictor of inefficiency. Even though gas is a low cost fuel, the shortage in the supply of gas leads to low plant factors in large gas plants.

## 3. Main conclusions and policy implications of the work

The findings point to the importance of the choice of fuels, which affect not only the cost of operations of power plants, but the frequency and priority of use, and therefore their long run operational efficiency. The high cost of fuels in many thermal power plants of Bangladesh can make modern renewable electricity competitive in comparison. Our analysis points to the possibility of replacing the most inefficient plants from among especially the peaking groups, with cheaper renewable energy technologies, as these plants become due for retirement. Some of the expensive liquid fuel based plants which run during the daytime may be replaced with solar plants, combined with limited storage. As a small number of liquid fuel plants are disproportionately responsible for a large portion of subsidy payments, replacing them will also reduce the subsidy burden to the electricity sector.