SYNOPSIS

Forecasting System Thermal Efficiencies in Technology Importing Countries*

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The system thermal efficiency (STE) refers to a set of fossil-burning power-plants with a common characteristic – belonging to the same company, area, country and so on – and it is a measure of the proportion of the input heat energy that is converted into usable electricity. It is determined as the weighed average of the thermal efficiencies of the individual plants which contribute to the electricity output during a defined time-period. The weight for each plant is determined as the ratio of the electricity produced by the individual plant to the total electricity produced by the whole system. The STE is an often quoted indicator of the technical performance of the electricity systems.

Forecasting system thermal efficiencies is of importance for energy, water and environmental planning, because the STE provides the link between demanded output and required input. The energy authorities, for example, can use the STE to derive future fuel requirements from projections for electricity demand. Similarly, the water authorities can use the STE to determine cooling water requirements for power plants (which are of the most voracious users of water), and the environmental authorities to estimate the degree of future thermal pollution.

Previous research [1 to 5] on the subject concentrated on predicting the efficiencies of the "best plants", especially in technologically leading countries, as an exercise in technological forecasting. When forecasts of the STE are required, naïve extrapolations of past performance [6] or subjective estimations of the degree that the STE will approach the "best plant's" efficiency [7] are used.

In this paper, a model for forecasting system thermal efficiencies of technology importing countries is developed and as an application the STE of the electricity supply utility of South Africa (ESCOM) is forecast. It is recognised that the STE is not an independent variable and the intertemporal change of the system thermal efficiency is viewed as a dynamic process with the demand for additional capacity, the speed of technology adoption and the age profile of the plants constituting the system, the determinant variables.

The application of the calculation to the South African utility shows that the STE in the year 2015 will be 20 to 25 per cent higher than that in the year 1983.

The structure of the paper is as follows: Firstly, the way with which the STE changes, is analysed. Secondly, the time scale involved in technology transfer and adoption is discussed and the gap in power producing technology between the USA and South Africa is empirically examined. Thirdly, a mathematical description of the change in the STE is given. Lastly, a forecast of the STE for the Electricity Supply Commission (ESCOM) of South Africa is provided and the main points of the paper are summarised.

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