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A Comprehensive Environmental Life Cycle Assessment of Kelanitissa Combined Cycle Power Plant (KCCP): Gate-to-Gate Approach

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Abstract

Even though the electric power industry has made significant strides in lowering pollution, fossil fuel-fired power plants continue to be a major source of pollution that impacts communities across the country in the air, water, and land. This study evaluates the Kelanitissa Combined Cycle Power Plant (KCCP) in Sri Lanka through an Environmental Life Cycle Assessment (LCA). The main goal of this study is to assess the environmental effects of its activities via a gate-to-gate approach and identification of environmental hotspots of electricity generation at KCCP through the LCA framework. This study covers the electricity generation process, starting from procurement of Naphtha and diesel and ends upon the production of electricity. The method of data collection included several approaches such as site observation, referring to daily and annual reports, emission reports, discussions with field level personnel and a literature survey on secondary data sources. Life Cycle Inventory stage involved conversion of input/output information and presenting them per 1 MWh of Electricity generated which is the functional unit. To assess the environmental impacts, the ReCiPe 2016 technique in SimaPro was used, concentrating on midpoint impacts and endpoint indicators. Finally, in the data interpretation step, the impacts were normalized, and a consistency check was performed to validate the findings. The results indicate that when 1 MWh is generated, it results in 523 kg CO_2 eq Global warming potential, 6.28 kg NO_x eq Ozone formation affecting human health and 0.547 kg NOx eq Ozone formation affecting terrestrial ecosystems, 0.38 kg PM2.5 eq Particulate Matter Formation and terrestrial acidification potential of 0.314 kg SO_2 eq. After normalizing impacts in E-LCA, the highest impact was recorded under the category of ozone formation affecting human health, followed by global warming and ozone formation affecting terrestrial ecosystems. A comprehensive strategy is necessary to mitigate the public health damage, perhaps imposing a carbon tax on the KCCP. Such revenues can also be allocated to energy efficiency initiatives, renewable energy projects etc.

Keywords: *Thermal power, Environmental Life cycle analysis, Human health, Greenhouse gas emission*