GREENHOUSE GAS (CO_2) EMISSION AND MITIGATION FROM COAL BASED THERMAL POWER GENERATION

By

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to

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Environment pollution - Coal
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CERTIFICATE

This is to certify that the thesis entitled "*Greenhouse Gas (CO_2) Emission and Mitigation from Coal Based Thermal Power Generation*", being submitted by *Mr. Shiv Pratap Raghuvanshi* to the *Indian Institute of Technology, Delhi* for the award of the Degree of Doctor of philosophy is a record of bonafide research work carried out by him. *Mr. Shiv Pratap Raghuvanshi* has worked under our supervision and guidance and has fulfilled the requirements for the submission of this thesis, which to our knowledge has reached the requisite standard for the Doctor of Philosophy Degree. The results contained in this thesis has not been submitted in part or full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Fossil fuels based power generation is considered as the major source of greenhouse gases, in India. More than 85% of the total CO_2 emissions has been estimated to be emitted from the energy related activities, since 1990. The CO_2 equivalent emissions contribution in total GHGs emissions in India has raised from 52% to 71% since year 2000. Coal based thermal power generation is expected to continue to dominate in the power generation scenario and power plants capacity is expected to increase by 81,000 MW by 2010. Serious climate change mitigation measures aimed at stabilizing atmospheric concentrations of CO_2 will require a radical shift to a decarbonized and efficient energy supply. Thermal power generation being the major contributor of the most potential, greenhouse gas, carbon dioxide, needs to be a primary target for deep reductions in CO_2 emissions. CO_2 emissions are between 0.3 to 0.6 tons carbon per capita per year in India. Specific CO_2 emission from burning coal is 1.6 times that from natural gas and 1.2 times that from oil. The average CO_2 emission from coal combustion in India has been analyzed and is 0.949 kg/kWh. In the present research, energy and environmental policy of India is studied for policy analysis using different empirical and computer based models, under various emission scenarios with comparison to Business as Usual (BAU). The main purpose of the study is to understand the power generation based emissions and associated economics trends so as to predict the trends for future for planning CO_2 emissions' mitigation strategies. It is believed that the projection that would be achieved by using these models along with policy analysis studies may be useful for the energy experts in planning and framing of policies for future energy scenarios. Computers model like MAGICC, SCANGEN, MARKAL and LEAP, has found to be convenient tools to be used for the study. A quadratic equation suggesting the carbon dioxide emissions from fossil fuels consumption, for projection has been obtained. Version 2.4 of MAGICC (Model for Assessment of Greenhouse gas-Induced Climate Change) has been employed for emission analysis in different policy scenarios. Mathematical equation based models in Excel has been developed, with incorporation of default factors as well as literature

reviewed emission coefficients used by various researchers, for generation of CO_2 emission inventory from Fossil fuels and Bio-based Fuels. Emission inventory from power generation in India has been analyzed and has been plotted on Indian map using GIS ArcView technique. CO_2 Mitigation studies on various parameters like efficiency, emission coefficients, replacement with advanced technologies, renewable energy resources (Solar, Biomass, Wind, Ocean) are carried out. Carbon Sequestration studies using forestry in India and Delhi has been computed. CDM studies for computing CERs has also been pursued by replacement of coal with natural gas, FO and efficiency improvement. Among, renewable energy resources solar, wind power and ocean power have vast potential to achieve and their utilization as well as may help to curb CO_2 emissions drastically. Further efficient technologies installation may have a significant role to play in a carbon constrained world. This thesis fills a critical gap in the literature by taking a closer look at the emission and mitigation of CO_2 emissions.

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