Economic and Environmental Impacts of Carbon & Energy Taxes in the Power Sector

Thesis Presented
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DECLARATION

The work in this thesis is the results of my own investigation, except where otherwise stated.

It has not already been accepted in substance for any degree, and also is not being concurrently submitted for any other degrees.

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Executive Summary

This report presents the results and analysis of a study conducted with the objective of investigating the impact on economy wide emissions due to a carbon and energy taxes levied within the electricity generation sector of Sri Lanka.

An Input-Output decomposition technique is used to analyze four types of effects that contribute to the overall reduction in equivalent Carbon, NOx and SO_2 emissions. These four effects are; fuel mix effect (i.e. the change in emissions due to variation in fuel mix), structural effect (i.e. change in emissions due to changes in technological coefficients), final demand effect (i.e. the change in emissions associated with changes in final demand) and joint effect (i.e. the interactive effect between or among the fuel mix, structural & final demand effects). The polluting fuel sources (e.g. coal) are less preferred under these tax regimes. Of the four effects change in fuel mix in thermal electricity generation and change final demand for electricity were found to be the main contributors in achieving economy wide emission reductions.

It was found that a minimum of $50/tC of carbon tax or $1.0/MBtu of energy tax is required to have a significant impact on economy-wide emissions in the Sri Lankan context. This results in an increase in electricity generation cost by approximately Rs 1 /kWh and Rs 0.65 /kWh under carbon and energy tax regimes respectively. The reduction in emissions is also strongly coupled with the value of price elasticity of electricity.

Also the study concentrates on tackling the barriers for the promotion of clean and energy efficient technologies in Sri Lanka. Barriers for renewable sources; wind and biomass (dendro thermal) and cleaner technologies; IGCC (coal) and LNG fired combined cycle were identified, based on a survey and strategies are proposed to tackle the major barriers. Analytic Hierarchy Process is used to rank the barriers and the strategies are proposed to address the three major barriers for each technology. For wind a Feed-In-Tariff, geographical diversification and capacity building in commercial banks are suggested. For dendro investment incentive and streamlining of wood production are proposed. Incorporating environment costs into the planning process and delayed implementation are suggested for IGCC and LNG.

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List of Acronyms

TOE	Tons of Oil Equivalent
GJ	Giga Joule
GHG	Green House Gases
TRP	Traditional Resource Planning
IRP	Integrated Resource Planning
LNG	Liquefied Natural Gas
IPP	Independent Power Producers
GDP	Gross Domestic Product
GWh	Giga Watt Hour
MW	Mega Watt
LF	Load Factor
SPM	Suspended particulate matter
PAA	Project Approving Authority
EIA	Environmental Impact Assessment
T & D	Transmission and Distribution
LRAC	Long Run Average Cost
tC	Tonne of Carbon
MBtu	Mega British Thermal Units
IGCC	Integrated Gasification Combined Cycle
BIGCC	Biomass Integrated Gasification Combined Cycle
PFBC	Pulverized Fluidized Bed Combustion
GT	Gas Turbine
CEB	Ceylon Electricity Board
SLEMA	Sri Lanka Energy Managers Association
NERD	National Engineering Research and Development Centre
RERED	Renewable Energy for Rural Economic Development
SARI	South Asian Regional Initiative
USAID	United States Agency for International Development
CO_2	Equivalent carbon dioxide
SO_2	Equivalent Sulphur dioxide
NO_x	Nitrogen oxides