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ECONOMIC FEASIBILITY OF CARBON EMISSION REDUCTION IN ELECTRICITY GENERATION

A CASE OF SRI LANKA

By

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The dissertation was submitted to the Department of Management of Technology of University of Moratuwa in partial fulfillment of the requirement for the Degree of Master of Business Administration

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Declaration

I certify that this thesis does not incorporate without acknowledgement, any material previously submitted for a degree or diploma in any university to the best of my knowledge and belief. It does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text.

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Abstract

Green House Gas (GHG) absorbs infrared radiation from earth and thereby, creates the global warming. Carbon dioxide (CO_2) is the dominance GHG generated by fossil fuel burning. During last 100 years there is 1.2°C of rise in average global temperature due to anthropogenic activities and industrialization. Global warming has significantly increased during last 25 years where average global temperature rise is about 0.6°C. This value will be increased up to 2.5°C - 3°C within this century if the existing trend of fossil fuel burning is continued as it is.

According to World Development Report (WDR)-2010, increase in 2°C of global temperature within this century will create a global disaster. About 400Million people will die in hunger due to collapse in world food production in consequence of global climate change. About 2Billion people will die without drinking water. More than 100 of scarce species will be doomed to extinction due to change in eco system. Therefore, reduction in carbon dioxide emission in fossil fuel burning is the only solution to avert the global disaster to come within this century.

According to the research, it was found that present annual GHG emission with respect to the electricity generation in Sri Lanka is about 2.7 Million Metric Tons. This is about 25% of the total national GHG emission in year 2009. By year 2029, this level will be increased up to 26 Million Metric Tons per year. The identified total GHG emission reduction potential in Electricity generation in Sri Lanka is about 37GW. However, in this thesis identified potential for implementation within next 20 years is 3 GW and it will cost 8.5 Billion USD. The total reduction in GHG will be 16 Million Metric Tons per year. If one ton of CO_2 is valued as 20US$, then total earning potential only on reduction of GHG will be 320 Million US$ per annum. Considering the savings on avoided fossil fuel combustion, total investment can be recovered within 6 to 7 years even without considering carbon trading at all . In order to achieve these benefits broader policies and guide lines are needed to be introduced in this sector. Evaluation of present situation, GHG reduction methods and their economic feasibility and finding of broader policies and guidelines on these issues will be deeply explored during the cause of this research.

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List of Abbreviations

ADB	Asian Development Bank
AQ	Air Quality
B/C	Benefits to Cost Ratio
BaU	Business as Usual
BOO	Build Operate and Own
CAS	Compressed Air Storage
CCAS	Carbon Capture And Storage
CCY	Combined Cycle
CDM	Clean Development Mechanism
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CFC	Chloro Fluoro Carbon
CH4	Methane
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO_2eq	Carbon Dioxide Equivalents
COP	Conference of Parties
Ddom(t)	Demand in Domestic Sector in year (t)
DGEU	Department of Government Electrical Undertaking
Di(t)	Demand in industrial sector in year 9t)
Dos(t)	Demand in other sector in year(t)
ECBM	Enhanced Coal Bed Methane
EHV	Electric Hybrid Vehicles
EOR	Enhanced Oil Recovery
FFOV	Fossil Fuel On road Vehicles

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GDP(t)	Gross Domestic Product in year (t)
GDPPC(t)	Gross Domestic Product per Capita in year(t)
GHG	Green House Gas
GT	Giga Ton
GtC	Giga Gram Carbon
GWh	Giga Watt Hour
HFO	Heavy Furnas Oil
IFO	Industrial Furnace Oil
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power PRODUCER
ITM	Ion Transport Membrane
JBIC	Japan Bank for International Corporation
JI	Joint Implementation
kg	kilo gram
KP	Kyoto Protocol
KPS	Kelanitissa Power Station
LAD	Liquid Auto Diesel
LHF	Liquid Heavy Fuel
LNG	Liquid Natural Gas
LPG	Liquid Petroleum Gas
LULUCF	Land Use Land Use Change and Forestry
MCM	Million Cubic Meter
MHP	Mini Hydro Project
MMT	Million Metric Tons
MOE&NR	Ministry of Environmental & Natural Resources
MUSD	Million US dollar
MW	Mega Watts
N2O	Nitrogen Dioxide
NCRE	Conventional Renewable Energy
NCV	Net CALORIFIC value
NH3	Ammonia
NMVOC	Non Methane Volatile Organic Compound
NOx	Nitrous Oxide
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
O3	Ozone
OECD	Organization for Economic Corporation and Development
PFC	Per fluoro Carbon
PFCHEV	Plug in Fuel Cell Hybrid Vehicle
PHEV	Plug in Hybrid Vehicles
R&D	Research & Development
SF6	Sulfur Hexafluoride
Sox	Sulfur Oxides

SPPA	Standard Power Purchase Agreement
SPPS	Sapugaskanda Power Station
SSCR	Specific Steam Consumption Ratio
ST	Steam Turbine
TJ	Terra Joule
TOD	Time of Day
UNFCCC	United Nations Frame work Convention on Climate Change
USA	United States of America
WASP	Wien System Planning Software
WHO	World Health Organization
WTE	Waste to Energy