

**EVALUATING THE POTENTIAL OF ADOPTING
CLEAN DEVELOPMENT MECHANISM FOR
IMPLEMENTING RENEWABLE ENERGY BASED
PROJECTS IN SRI LANKA**

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Department of Mechanical Engineering

University of Moratuwa

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Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of
Science in Mechanical Engineering

Department of Mechanical Engineering

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April 2014

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master of Science thesis under our supervision.

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ABSTRACT

Sri Lanka has had a hydropower dominated electricity generation for many years with relatively high rainfall mainly in the central hilly region. This factor has led to a greater dependence on hydropower for its power generation. However, at the same time, Sri Lanka is heavily dependent on imported fuel and for energy security it is imperative that we take steps to harness the renewable energy sources. The government is trying to respond to the energy supply issue by relying heavily on fossil fuel based electrical power, which may not be the correct energy option for Sri Lanka.

Therefore, the large scale fossil based power plants are not environmentally friendly in comparison to other energy options. This will result in a gradual increase in greenhouse gas (GHG) and other environmental emissions in the power sector and, hence, there has been a lot of opposition from the people, especially environmentalists, civil society and residents in the locations where fossil based plants have been planned.

The main intention of this study is to form an internationally consistent view to answer the question as to whether and to what extent the adoption of renewable based combustion technologies in projects could be economic and sustainable in, place of the nonrenewable based combustion dominant projects. The study will consider the appropriateness of existing perspectives and policy imperatives in the above regard also. Special emphasis will be given for the local environmental protection, mitigation of climate change, legislation and quality of service in a context of global competition.

It is a fact as well as the general perception that adoption of renewable energy technology based projects and the Clean Development Mechanism (CDM) created under the Kyoto Protocol, are directly linked. The Clean Development Mechanism (CDM) act as a bridge to link the industrialized countries and developing countries. The CDM intends to assist developing countries achieve sustainable development by providing incentives for industrialized countries to invest cost-efficient GHG reduction projects in these countries. The developed countries can receive some credits by investing and implementing GHG emission reduction projects in the developing countries, then use the credits to fulfil their legally binding quantitative obligations laid down in the Kyoto Protocol. Although the Clean Development Mechanism (CDM) does not have an

explicit technology transfer mandate, it may contribute to technology transfer by financing emission reduction projects using technologies currently not available in the host countries.

The study presented in this thesis first analyse the potential technology possibility under the CDM in power generation. This study is a theoretical study focused on the survey of the current state of art of CDM and related issues. The results show that the potential of CDM opportunities in mini hydro, biomass including dendro power and wind energy , which can be identified as the leading, sustainable, non-conventional forms of renewable energy promoted in Sri Lanka for electricity generation to feed into the thermal grid. Also the main intention of this study is to investigate the technological and regulatory interventions on overall power sector emissions and economic and environmental benefits of such interventions.


Based on the analysis it was found that present annual CO₂ emission with respect to the thermal power electric generations in Sri Lanka is about **0.75** Million Metric Tons and Wind, mini-hydro and bio mass will be very attractive with CDM funding. Out of the selected CDM options, the Mini Hydro plant that Sri Lanka need to choose is particularly important. Considering that this is the option giving the highest carbon reduction within the planning horizon while having the highest profit. But when considering the local energy tariff structure, the tariff is highest for Biomass.



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Key words: Greenhouse Gases, Climate Change, Kyoto Protocol, Clean Development Mechanism

DEDICATION

 *This research Report is Dedicated to my beloved husband
Asoka and to my three daughters Manesha, Achini and
Radhika*

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List of Figures

Figure 1.1	3
Figure 1.2	4
Figure 2.1	19
Figure 2.2	22
Figure 2.3	26
Figure 2.4	27
Figure 2.5	31



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List of Tables

No	Description	Page
Table 1.2	– Per capita emission of CO ₂ in South Asian countries compared to USA	6
Table 2.1	- Capacities of wind farms in Sri Lanka	27
Table 2.2	-Present Hydro Power Generation	32
Table 2.3	- Thermal Generation owned by CEB	33
Table 2.4	-Independent Thermal Power Producers in Sri Lanka	33
Table 2.5	-Present Generation Mix	34
Table 3.1	-Summary of National CDM Potential by Sector	37
Table 3.2	– Methodologies for Renewable Energy Project	39
Table 3.3	- Weighted average approximate emission factors	54
Table .4.1	-Ambien Air Quality Standards for Thermal Generation	58
Table 5.1	- Micro/Mini Hydro potential in Sri Lanka	69
Table 5. 2	-Details of house hold distribution of Sri Lanka	71
Table 5.3	- NRFL Wind Resources Classes applicable to Sri Lanka	74
Table 5.5	-Data and formula used for economic calculations for the research	81
Table 5.6	- Data of Fuels	82

List of Abbreviations

ADB	Asian Development Bank
CDM	Clean Development Mechanism
CEB	Ceylon Electricity Board
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CH ₄	Methane
CNG	Compressed Natural Gas
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalents
COP	Conference of Parties
ET	Emission Trading
GCV	Gross Carbon Value
GDP	Gross Domestic Product
GHG	Green House Gas
GT	Giga Ton
GGC	Giga Gram Carbon
GWh	Giga Watt Hour
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
JI	Joint Implementation
Kg	kilo gram
KP	Kyoto Protocol
KPS	Kelanitissa Power Station
LAD	Liquid Auto Diesel
LNG	Liquid Natural Gas



LPG	Liquid Petroleum Gas
LOI	Letter Of Intent
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
NCRE	National Conventional Renewable Energy
NCV	Net Calorific Value
NH ₃	Ammonia
NMVOC	Non Methane Volatile Organic Compound
NO ₂	Nitrous Oxide
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
PDD	Project Design Document
R&D	Research and Development
SPPA	Standard Power Purchase Agreement
SPS	Sapugaskanda Power Station
ST	Steam Turbine
TJ	Terra Joule
TOD	Time of Day
UNFCCC	United Nations Frame Work Conventional on Climate Change
WTE	Waste To Energy



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Table of Content

List of Figures	i
List of Tables	ii
List of Abbreviations	iii
Chapter 1	
Introduction	1
1.1 Background	1
1.1.1 Climate Change	1
1.1.2 Greenhouse Gases (GHGs)	2
1.1.3 Greenhouse Effect	2
1.1.4 Global Warming	3
1.1.5 Impacts due to Global Warming	4
1.1.6 Impacts of Climate Change	6
1.1.7 Global Initiatives to Counter Climate Change Issues	6
1.1.8 United Nations Framework Convention on Climate Change (UNFCCC)	6
1.1.9 Kyoto Protocol	8
1.1.10 Kyoto Mechanisms	8
1.1.11 Application of CDM	9
1.1.12 International Carbon Market	10
1.1.13 Sri Lanka Carbon Market	11
1.1.14 Sri Lanka Carbon Fund Limited	13
1.1.15 Objectives of the Sri Lanka Carbon Fund Limited	13
1.1.16 Bundling Small CDM Projects	15
1.2 Objective of the Study	15
1.3 Scope of the Study	16
1.4 Significance of this Work	16
1.5 Limitations of the Study	17

Chapter 2

Literature Review	18
2.1 Basic Data of Sri Lanka	18
2.2 Economic Development in Sri Lanka	19
2.3 Sri Lanka Power Sector	22
2.3.1 Energy Source and Supply Situations	22
2.3.2 Indigenous Primary Sources of Energy	22
2.4 Electricity Generation	29
2.4.1 Power Generation in the National Grid	29

Chapter 3

Methodology	35
3.1 Existing CDM Methodologies for Renewable Energy Power Plants	35
3.2 Analysis of CDM Potential in Renewable Power Generation Sector of Sri Lanka	36
3.2.1 National Potential	36
3.2.2 Applicable CDM methodologies	38
3.3 Applicable Baseline Methodology for Renewable Energy Project	46
3.3.1 Small Scale Baseline Methodology Applicable to Sri Lanka	46
3.3.2 Baseline Emission Calculation	47

Chapter 4

Analysis of Policy Status on Power Sector and CDM	57
4.1 Policy Implications	57
4.1.1 Environmental Pollutions	57
4.1.2 National Air Quality Standards	58
4.1.3 Emission in Stationary Combustion	58
4.1.4 Local Context	59
4.1.5 Ambient Air Quality Standard for Thermal Generation	59
4.1.6 Natural Resources Management	60
4.1.7 Waste Management	60
4.1.8 National policies on GHG Emission Reduction	60
4.2 Policies on Thermal power Plants	61
4.2.1 Ensuring Energy Security	61
4.2.2 Promoting Energy Efficiency and Conservation	61
4.2.3 Promoting Indigenous Resources	62

4.2.4	Adopting an Appropriate Pricing Policy	62
4.2.5	Enhancing Energy Sector Management Capacity	63
4.2.6	Enhancing the Quality of Energy Services	63
4.2.7	Protection from Adverse Environmental Impacts of Energy Facilities	63
4.3	Policies on Climate Change	64
4.3.1	National Forestry Policy (NFP)	64
4.3.2	National Policy for Wildlife Conservation (NPWC)	64
4.3.3	Agriculture Policy (AP)	65
4.3.4	Energy Policy of Sri Lanka (EPSL)	65
4.3.5	National Transport Policy (NTP)	65
4.4	Policies on Renewable Energy	65
4.5	Policies on Waste to Energy	66
4.6	Policies on GHG Registry	67
4.7	Immediate Policies to Implement	67
4.8	Establish Policy on GHG Reduction Targets	68

Chapter 5

GHG Reduction Projects and Economic Feasibility	69
5.1 Introduction	69
5.2 Mini/Micro Hydro Potential	70
5.2.1 Calculation of Emission	71
5.3 Solar Power Potential	72
5.3.1 Calculation of Plant Emission	74
5.4 Wind Power Potential in Sri Lanka	75
5.4.1 Calculation of Plant Emission	76
5.5 Biomass Energy Potential in Sri Lanka	77
5.5.1 Solid Waste Potential in Sri Lanka	79
5.5.2 Calculation of Plant Emission	81

Chapter 6

Conclusion and Agenda for Future Research	84
6.1 Discussion	84
6.2 Viable CDM Projects	85
6.3 Policy for energy and CDM in the context of enhancing the CDM opportunities	86
6.4 An Agenda for Future Research	87

