# EVALUVATING THE POTENITAL OF ADOPTING CLEAN DEVELOPMENT MECHANISM FOR IMPLEMENTING RENEWABLE ENERGY BASED PROJECTS IN SRI LANKA

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09/8111



Degree of Master of Science

Department of Mechanical Engineering

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

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## 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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J.B.Samarasinghe



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

| | |
|---|---|
| Prof. R.A.Attalage | Prof. K.K.C.K.Perera |
| Supervisor | Supervisor |
| Date : | Date : |

## 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 $CO_2$ 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.



**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



# List of Tables

# List of Abbreviations

| | |
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| 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 |
| $CO_2e$ | Carbon Dioxide Equivalents |
| COP | Conference of Parties |
| ET | Emission Trading |
| GCV | Gross Calorific 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 |
| NH3 | 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 |

# Table of Content