PRICING ON EMBEDDED GENERATION

MASTER OF SCIENCE

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PRICING ON EMBEDDED GENERATION

THESIS PRESENTED

By

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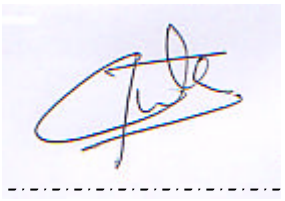
DECLARATION

The work submitted 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 degree.



Signed

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Prof. Priyantha D.C. Wijayatunga

(Supervisor)

Dedicated to

my loving farther & mother

and

teachers

who encourage me

for my education

EXECUTIVE SUMMARY

Power generation sources which are connected to the medium voltage distribution system of the National Grid with relatively small installed capacities are presently classified as **Embedded Generators**. Most of embedded generators including small-hydroelectric in many countries have been financed, developed and operated by the Private sector.

The purpose of this research was to develop an appropriate pricing methodology for the embedded electricity generation with emphasis on the Sri Lankan system. The study recommended that the embedded generation tariff be based on the avoided cost, and this avoided cost calculation should include the cost of externalities in the energy sector and the exact cost of avoided network loss.

Traditionally electricity tariff reflects only the cost of production and delivery electricity to the consumers, which includes cost of labour, capital, operation, taxes and insurance. But the production of electricity causes some damage to environment, which associated some cost. Level of environment damage due to electricity generation varies with the technology, site etc.

Since there are no Sri Lankan studies on the damage costs related to the pollutants associated with the power sector. Estimation of externalities of electricity production in this study mainly depends upon the results of studies done elsewhere specially the "ExternE" Project of the European Commission. Therefore an adjustment was made to those results by using a factor based on per capita GNP ratio to adopt those values for Sri Lanka. From that, it was found that there is an external cost of 0.22 ECU cents/kWh for the oil based power generation in Sri Lanka and that would be around 11-14% of the total avoided energy cost.

The study recommends nodal based avoided network loss calculation for the embedded generation tariff. It is also found that there is a considerable contribution of the cost of avoided network loss to the proposed embedded generation tariff and final tariff would vary significantly with the location of the node.

The proposed pricing methodology would provide important information for the investors to choose the most economical site. This can be done by examine the tariff at each node, which can also be used to optimize the network use and finally improving on the benefit of society.

Guidelines were suggested to improve accuracy of the tariff and to minimize the uncertainty of the calculation. These will allow the developers of embedded generation facility and the Utility to maximize the potential of embedded generation and the net benefit of the society.

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Table of Contents

List of Figures

List of Tables

Abbreviations

IPP	-	Independent Power Produces
SPP	-	Small Power Produces
CEB	-	Ceylon Electricity Board
SRMC	-	Short Run Marginal Cost
LRMC	-	Long Run Marginal Cost
ECU	-	European Currency Unit
Incr.	-	Incremental
DSCR	-	Debt Service Coverage Ratio
ROE	-	Rate On Equity
INR	-	Indian Rupees
Rs.	-	Sri Lankan Rupees
n/a	-	Not Applicable
LDC	-	Load Duration Curve
O&M	-	Operation and Maintenance
WTP	-	Willingness to Pay
WTA	-	Willingness to Accept
GNP	-	Gloss National Product
GTR	-	Kelanitissa Gas Turbines
GTNW	-	Kelanitissa New Gas Turbine
KPST	-	Kelanitissa Steam Turbines
DLTL	-	Lakdhanavi (Pvt) Ltd., Diesel Power Plant
APPL	-	Asia Power (Pvt) Ltd., Diesel Power Plant
DSP	-	Sapugaskanda Diesel
DSPX	-	Sapugaskanda Diesel (Extension)
BARGE	-	Barge Mounted Power Plant