

SRI LANKA COUNTRY REPORT ON ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION

Prepared by Harsha Wickramasinghe
Country Expert (Sri Lanka)

August 2009

Correspondence : harsha@energy.gov.lk

LIST OF ABBREVIATIONS

BMS	Building Management System
CCC	Ceylon Chamber of Commerce
CDM	Clean Development Mechanism
CEB	Ceylon Electricity Board
CER	Certified Emission Reductions
CFL	Compact Fluorescent Lamp
CPC	Ceylon Petroleum Corporation
CPEEB	Code of Practice for Energy Efficient Buildings
DSM	Demand Side Management
E Friends	Environmentally Friendly
ECF	Energy Conservation Fund
EEBC	Energy Efficiency Building Code
EEl	Energy Efficiency Improvement
EEI&C	Energy Efficiency Improvement & Conservation
EES	Energy Efficiency Services
ESCO	Energy Services Company
ESDP	Energy Services Delivery Project
FMCG	Fast Moving Consumer Goods
GWh	Giga Watt Hour
IDEA	Integrated Development Association
IFL	Incandescent Filament Lamp
IPMVP	International Performance Monitoring & Verification Protocol
ITDG	Intermediate Technology Development Group
JBIC	Japan Bank for International Cooperation
JICA	Japan Institute for International Cooperation
kWh	Kilo Watt Hour
LECO	Lanka Electricity Company
LFL	Linear Fluorescent Lamp
LIOC	Lanka Indian Oil Company
LKR	Sri Lankan Rupee
M&V	Monitoring & Verification
MWh	Mega Watt Hour
NARESA	Natural Resources Energy & Science Authority
NEPC	National Energy Conservation Programme
NREDC	National Engineering Research & Development Centre
NSF	National Science Foundation
PEP	Promotion of Eco-efficient Productivity
PEU	Pre Electrification Unit
PFI	Participating Financial Institutes
PUCSL	Public Utilities Commission of Sri Lanka
RCL	Regional Centre for Lighting

RERED	Renewable Energy for Rural Economic Development Project
SAARC	South Asian Association for Regional Cooperation
SARI/E	South Asian Regional Initiative on Energy
SEA	Sri Lanka Sustainable Energy Authority
SEC	SAARC Energy Centre
SEGF	Sustainable Energy Guarantee Fund
SGF	Sustainable Guarantee Facility
SLEMA	Sri Lanka Energy Managers Association
SLSEF	Sri Lanka Sustainable Energy Fund
SLSI	Sri Lanka Standards Institute
USAID	United States Agency for International Cooperation
VSD	Variable Speed Drives

This work is dedicated
to the unsung heroes,
the vocal, visible and iconic individuals
such as **Dr.Tilak Siyambalapitiya,**
and
the less visible, yet committed individuals
which present themselves
in the form of **Mr.Ranjith Pathmasiri,**
whose perseverance
before, after and during
energy crises
paved the way
for the many successes
we enjoy today
in reducing
energy consumption
in Sri Lanka

CONTENTS

1.0	EXECUTIVE SUMMARY	7
2.0	INTRODUCTION.....	9
3.0	OBJECTIVES.....	14
4.0	METHODOLOGY	15
5.0	NATIONAL POLICIES AND LEGISLATIVE FRAMEWORKS RELATING TO ENERGY EFFICIENCY & CONSERVATION	16
	Energy Conservation Fund act No.2 of 1985.....	17
	Energy Policy for Sri Lanka 1995.....	19
	Strategy Paper on Energy Efficiency 2002	20
	Strategies to Improve the Delivery of Energy Efficiency Services in Sri Lanka 2003.....	21
	National Energy Policy & Strategies 2005	22
	Sri Lanka Sustainable Energy Authority Act No. 35 of 2007	26
	Public Utilities Commission of Sri Lanka Act No. 35 of 2002	34
	Sri Lanka Electricity Act No. 20 of 2009	35
	Review of National Policies and Legislative Frameworks	37
6.0	REVIEW OF PROJECTS AND PROGRAMMES IN ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION	40
	Efficient Cook Stoves Programme (1986)	40
	Energy Auditor Training programme (1984)	42
	Funding Development and Special Lending Programmes (1998)	43
	Monitoring & Verification Protocol (2003)	45
	Sustainable Guarantee Facility (2005)	46
	Energy Labelling Programme (2000)	48
	Energy Efficiency Building Code – EEBC (2000)	51

Loss Reduction efforts of Utilities (1985)	52
7.0 BEST PRACTICES IN ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION	55
Utility driven CFL promotion Programme (1996)	55
National Energy Conservation Programme (2006)	57
Sector Specific Programmes (2006)	61
8.0 ENERGY CONSERVATION DIRECTORY.....	63
9.0 AN ACTION PLAN ON REGIONAL COOPERATION	66
Assessment of Energy Efficiency Improvement & Conservation potential	66
Barrier Identification	67
Identification of Measures	68
10.0 R&D ACTIVITIES & PROGRAMMES	70
11.0 POSSIBILITIES OF REGIONAL COOPERATION	72
12.0 IMPLEMENTATION STRATEGY AND METHODOLOGY	75
technology transfer & promotion of eei&C	77
regional cooperation in developing specific programmes	78
promotion of public private partnerships	79
sharing experience and capacity building	79
development & harmonisation of standards & labels to promote EEI&C	80
13.0 RECOMMENDATIONS.....	81
14.0 CONCLUSION.....	85
15.0 REFERENCES	86
16.0 ACKNOWLEDGEMENT	88
17.0 ANNEXES.....	89

1.0 EXECUTIVE SUMMARY

In the emerging energy and environmental crises, SAARC region stands quite vulnerable, compared to developed economies. The luxuries enjoyed by the developed economies such as low cost energy and minimal environmental implications are not available for a developing SAARC region. Another barrier present for the SAARC region is the lower importance placed on economic planning, a key attribute of development in a resource constrained world. However, SAARC region can look forward to embrace efficient technologies, processes and systems much easily, due to the infant stage most countries in this region when considering economic development. Speedier implementation is also possible, due mostly to the lesser developed systems and processes acting against new initiatives. Hence the SAARC region is in a position to reap the benefits of energy efficiency improvement and conservation (EEI&C) than any other economic bloc. Regional cooperation is identified as a vital need for the accomplishment of low energy intensity of economy in the SAARC region.

Sri Lanka, being a pioneering nation in many initiatives on EEI&C is in a position to share her experience in developing a legal framework and other implementation aspects of efficient use of energy. In compilation of this report, review of available documents, meetings, discussions and interviews with practitioners in the energy sector were widely used. Information thus gathered is presented after rearrangement in a logical sequence.

Evolution of energy efficiency legislation in Sri Lanka is strongly linked to the oil crises which affected the whole world in 1970s, 1980s and in mid 2000s. Similarly, energy policies of Sri Lanka also reflect the deep impact each oil crisis made on the national economy. There were many papers, reports and publications prepared by Sri Lankan energy sector and two noteworthy legislations. The first piece of legislation is the Energy Conservation Fund act No.2 of 1985 and the second one is the Sri Lanka Sustainable Energy Authority act No.35 of 2007. These documents and legislations spanning decades show a remarkable change of character from a generic / simple to a very specific / complex nature. The recent legislations pay a close attention to implementation and rely much on mandatory measures compared to older legislations which were formulated to promote and encourage energy consumers to save energy.

In implementing programmes in EEI&C, Sri Lanka can boast of many success stories, ranging from efficient cook stoves to nationwide publicity campaigns, which provided valuable experience whilst delivering economic benefits. Among these, there are many best practices worthy of discussion. These include the utility driven CFL programme which paved the way for Sri Lanka to become one of the most deeply penetrated CFL markets in the world and sector specific programmes, which realised sector wide benefits in energy saving.

An action plan on regional cooperation is proposed which can be initiated by assessing the EEI&C potential in each member country and identifying barriers for implementation. Once good opportunities are identified, all measures required for successful implementation needs to be packaged into a single programme, it is argued. Piecemeal attempts hitherto undertaken and less than satisfactory achievements are a case in point for the selection of 'packages of measures' approach.

Sri Lanka has gained access to a number of technologies on EEI&C and these are presented in the form of a directory. Even though not many R&D is taking place in EEI&C in Sri Lanka, the available few cases are also presented.

The possibilities of regional cooperation are many, and ranging from sharing experience to developing capacities, markets and financial resources. This is especially important, as certain member countries are in a position to guide other member countries for speedier implementation of EEI&C measures.

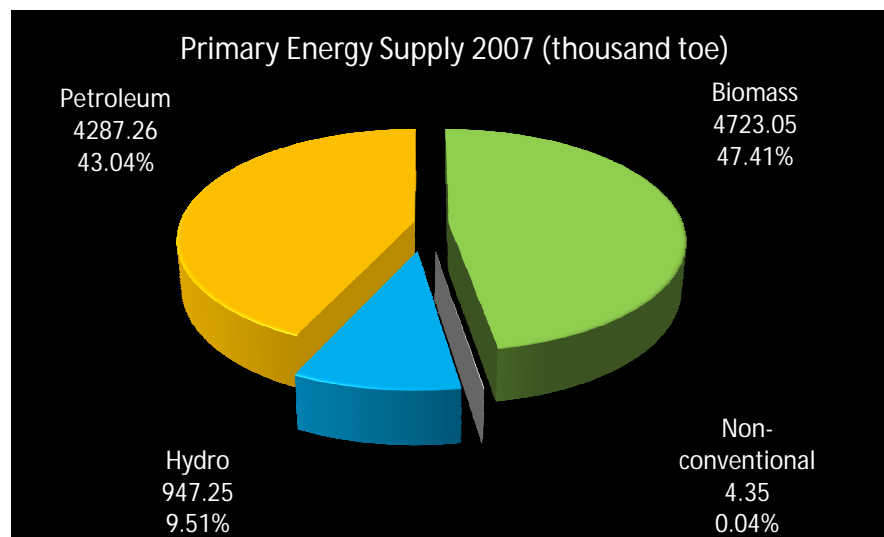
A detailed programme, initiated at an appropriate regional forum and concluding with the formulation of a sizable regional funding proposal targeting the donor community is proposed, as an action plan on regional cooperation. Major thrusts in this programme are; technology transfer, development of specific programmes, promoting public private partnerships, sharing experience / capacity building and achieving a regional harmonisation in standards and labelling.

In conclusion, several attributes are identified as ingredients of successful implementation. These range from choice of proven technologies, cutting across all uses of energy, tapping existing knowledge resources in the region, learning from success, need for champions in each country to lead the programmes. Understanding the present context and making the full use of available capacity in the region are also presented as key attributes of the programme of regional cooperation. Taking EEI&C as a marketing challenge and working towards developing a new market by promoting EEI&C, segmenting and prioritising the new markets thus developed is proposed as the most sustainable approach to realise the full potential of EEI&C in the SAARC region. Finance is identified as the key driver of successful implementation in conclusion.

2.0 INTRODUCTION

Energy requirements in Sri Lanka are satisfied by either locally available sources or those sourced from global energy markets. Hydropower, wind power and solar power are three indigenous sources with a high potential for productive use in Sri Lanka, while petroleum and coal are the two main sources readily available for importation. Studies have indicated that there is a large potential for wind power development in the country and based on certain conservative estimates, its technical potential can be as high as 24,000 MW. Sri Lanka is already using most of its hydropower resources for electricity generation. Studies are also presently underway to establish whether offshore petroleum resources are available within territorial waters of Sri Lanka.

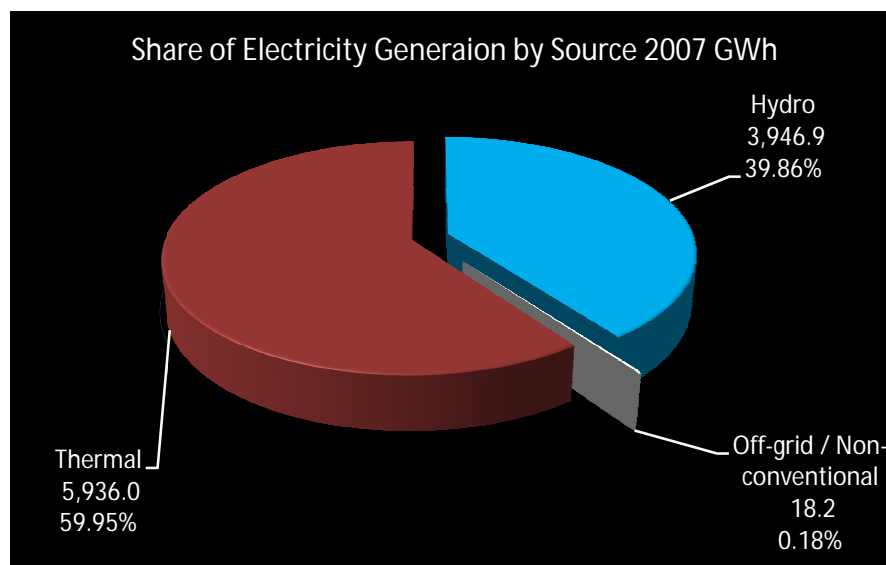
At present total primary energy requirement of the country is supplied by biomass, hydropower and petroleum while electricity remains as the main secondary energy source. Sri Lanka Energy Supply portfolio in terms of primary energy is illustrated in the chart below.



Source: Sri Lanka Energy Balance 2007

Figure 1: Share of Primary Energy Supply

A portion of this primary energy is converted to the secondary energy form, electricity. Total electrical energy generated during year 2007 was 9,901.1GWh of which 59.95% came from oil burning thermal power plants while a 39.86% share was from hydropower (including small power systems and the only wind power plant) and the balance 0.18% was generated in off-grid non-conventional renewable energy.



Source: Sri Lanka Energy Balance 2007

Figure 2: Share of Electricity Generation by Source

Energy distribution is discussed in detail for electricity and petroleum as both forms of energy have a significant dependence on their distribution network for delivery up to the end-user. During the recent past, electricity distribution expanded through state sponsored rural electrification schemes and other interventions, connecting more households to the national grid. By the end of the year, country-wide electrification had passed 85% mark of the total households through grid extensions. A further 2.7% of households obtained a basic electricity connection using renewable resources such as solar PV based home systems and community owned mini-grids powered by micro-hydropower or small biomass gasification systems.

The petroleum distribution network also experienced significant changes in the last decade, especially in the ownership of retail filling stations. Along with the entry of Lanka Indian Oil Company (LIOC) to the downstream petroleum sector in the year 2003, petroleum distribution underwent a liberalisation process against the previous monopoly held by the Ceylon Petroleum Corporation (CPC). In addition to the originally acquired 100 filling stations, in the year 2004, LIOC started acquiring many privately owned filling stations and refurbishing them to provide a better service to their customers. In this respect, petroleum distribution network at the retail level improved considerably during the year. Upstream distribution network also underwent a major expansion during the year with the commissioning of Muthurajawela storage facility with a total petroleum finished product storage capacity of 250,000 MT.

The consumer demand for energy increased in all sub sectors; electricity, petroleum and biomass. However, compared to previous years, the electricity demand growth was considerably low. The total electricity generation increased by only 4.2%, but the maximum demand recorded a 2.7% decrease, which is considered a rare phenomenon in a developing economy. Households and commercial

organisations had the highest demand for energy, consuming 48.44% of the total energy demand in the country whilst industries and transport sectors shared the balance consumption of 25.64% and 25.92% respectively.

The electricity sector financial performance as a whole was poor with the dominant player in the sector; the state owned CEB incurring heavy losses during the last few years. The main reason for this state of financial distress was the undesirable pricing policy, with average selling price remaining lower than the actual delivered cost of electricity. In contrast, the CPC, the counterpart of the CEB in the petroleum sector recorded a profit after several years of losses due to the cost reflective price variations adopted.

Keeping retail energy prices at the present level would be difficult in the coming years, until the sector diversifies into more price-competitive primary energy sources such as coal for electricity generation and end-use sources such as electricity for railways. Diversification into renewable sources for thermal requirements and electricity generation would also assist increased self-reliance, and coping with the challenge of rising oil prices.

The contribution of renewable energy to the overall energy supply is on the decline, with the energy demand in the electricity sector and households being increasingly met with fossil fuels. Fuel switching from renewable energy to fossil fuels for household and commercial use continues, and the contribution of non-conventional energy sources for electricity generation is so far not significant to reverse this trend. With price and technology barriers still to be addressed, the share of renewable energy contribution to the economy is expected to further decline over the next few years.

By the end of 2009 a 300MW combined cycle power plant was commissioned while this power plant will relieve the capacity shortage in the short term, similar capacity additions are required every year to keep pace with the increasing demand. Since cheaper solutions such as large scale coal power plants are added to meet this electricity demand, the financial burden of fuel oil based power generation will further strangle the CEB.

Dozens of small hydroelectric power plants and one wind power plant was added to the system recently, strengthening the total renewable base in the electricity sector. However, with electricity prices remaining stagnant in the face of rising oil prices, CEB's financial position is not expected to improve over the next few years, unless electricity prices are increased substantially.

Importance of demand side management strategies have rapidly grown in the context of rising oil prices as well as extensive delays in implementing low cost electricity generation projects. Low cost generation options refer not only the commissioning of a coal power plant but also other efforts such as capacity enhancement of refinery and development of indigenous renewable energy resources. In this light, the priority areas for future planning could be identified to be increased investment in energy efficiency improvement at all levels and renewable energy development, which will off-set the adverse impacts of delayed projects until such project are commissioned.

Macro level interventions such as improved mass transport systems, electrification of railways and effective delivery of energy efficiency services are thus required to be considered as long term strategies which will allow Sri Lanka to be competitive in the global markets.

Numerous benefits both for the economy as well as for the individual energy users result from improvement of energy efficiency. Most of the benefits are obvious, but others can be obscure but are equally important. The following table shows the economic analysis of the potential savings of the domestic, industrial and transport sector. The implementation strategies include increase use of efficient equipment and change of user behaviour.

Table 1: Energy conservation potential in various sectors

Source	Sector	Conservation Potential % of Annual Consumption
Petroleum	Industry	25.0
	Transport	5.0
	Domestic / Commercial	2.0
Biomass	Industry	10.0
	Domestic / Commercial	25.0
Electricity	Industry	20.0
	Domestic / Commercial	12.0
All Sources	Overall	9.3

Source: Corporate Plan 2008-2010, Sri Lanka Sustainable Energy Authority

Although the investment cost for the initial improvements are relatively high, the internal rate of return of most energy efficiency improvement projects are very attractive. The payback period for most of the energy improvement programmes lie between 3 and 5 years.

Compared to most mature economics elsewhere in the world, South Asian region looks into a future with rapidly increasing energy demand. Growing energy demand, a true characteristic of an evolving economy poses many challenges today, than challenges faced then, by the today's mature economies, as the evolution of those economies happened during an era of unhindered access to natural resources which included energy resources. As a result of this disparity, developed economies had the luxury to disregard environmental impacts of energy use during the high growth periods and also, the cost of energy did not hamper economic development as they now threaten the SAARC region. The luxury of low cost energy and virtual unlimited access enjoyed by developed economies allowed them countless possibilities in using energy for economic activities during the important period of growth and also offered sufficient time until the oil crises to carry on regardless of energy waste and inefficient end use practices. It had been a common practice in many commercial buildings built in the early part of last century in the United States to be without individual lighting controls [1] as cost of electricity was quite insignificant at the time, compared to other costs associated with the operation of a building. However, the present context of those developed economies are quite different now, and the series of

energy crises has compelled those economies to embrace energy efficiency improvement and conservation measures to stay afloat in an energy constrained world.

The context of the SAARC region with respect to economic development and productive use of energy is quite different to the context in which the developed economies grew. The differences ranging from environmental aspects to social aspects are numerous and cover a wide area.

SAARC region will have to grow in a resource constrained context compared to the period of growth underwent by developed economies, paying much higher percentage of economic output on energy supplies. SAARC region will have to grant due regard to environmental concerns such as emissions in choosing energy resources. Large number of household consumers without access to modern energy forms in SAARC region demanding priority over industrial and commercial energy applications, in contrast with relatively well served household sector in developed economies during their period of growth.

Often unplanned and vast habitats which require considerable resources to serve compared to well planned habitats and economic zones. Lack of established systems and processes required to change markets to achieve energy efficiency improvements, compared to well laid out systems available in mature economies is yet another difference.

Due to these differences, and also considering the differences of a mature economy embarking on energy efficiency improvement programme and a developing economy struggling on many other fronts including energy efficiency improvement, the approach and methods of engaging stakeholders in an energy efficiency improvement programme in the SAARC region could be quite different.

However, on the positive side, a developing economy is in a better position to take up many technological innovations in delivery energy of efficiency services in sharp contrast to the attempts of a developed economy which largely confined to retrofits applied an existing systems. A case in point will be lighting, where the developed economies have to work within the confines of changing light sources in existing buildings to efficient sources compared to limitless possibilities offered by advances in lighting technologies and approaches which can be readily incorporated in to new building system.

Counting the challenges of keeping a good balance between economic growth and efficient use of energy, possibly having to inbuilt energy efficiency to systems and processes rather than having to attend to energy efficiency improvement in a post economic development context, SAARC region could be seen to be in a better position to reap the full benefit of energy efficiency improvement than many mature economies. However, limitation of available time and other resources make regional cooperation a sine-qua-non for speedy realisation of the benefits of energy efficiency improvement. Such cooperation will make it possible to bring all member countries to an equal footing expeditiously whilst offering a homogeneous market for products and services.

3.0 OBJECTIVES

This report, apart from the stated objectives mentioned below, tries to capture the evolution of policies on energy efficiency improvement in Sri Lanka as well as to present a chronicle of energy efficiency improvement initiatives taken in Sri Lanka. The objective was to capture the major developments, programmes and projects undertaken mainly by the state sector. It would be quite valuable if the private sector initiatives also recorded here, but due to time constraints, only the major initiatives had to be incorporated.

This country report on Sri Lanka will attempt to present the series of initiatives taken by Sri Lanka to deliver energy efficiency services and other measures aimed at improving energy efficiency and conservation. Unlike other countries in the region, Sri Lanka has achieved quite a little in transport sector and agricultural sectors with respect to energy efficiency.

However, Sri Lanka has achieved quite a lot in terms of domestic, industrial and commercial energy uses in the last few years. These achievements will be explained in detail, to assist other SAARC countries to draw up their own programmes. It is hoped that several elements from Sri Lanka will be integrated in the SAARC Road Map for Energy Efficiency and Energy Conservation.

Apart from the above objectives, several avenues for future cooperation will be explored and documented in view of the proposed action plan on cooperation in efficient use of energy and its conservation. This country report will also highlight issues and constraints faced by the authorities and other stakeholders in their quests for efficient use of energy. It is expected that the synthesis of country reports will bring out these issues and probable ways of addressing the issues, delivering value to all SAARC countries. The final objective of this country paper is to document the many steps taken by various agencies in Sri Lanka to implement energy efficiency improvement programmes for future reference.

4.0 METHODOLOGY

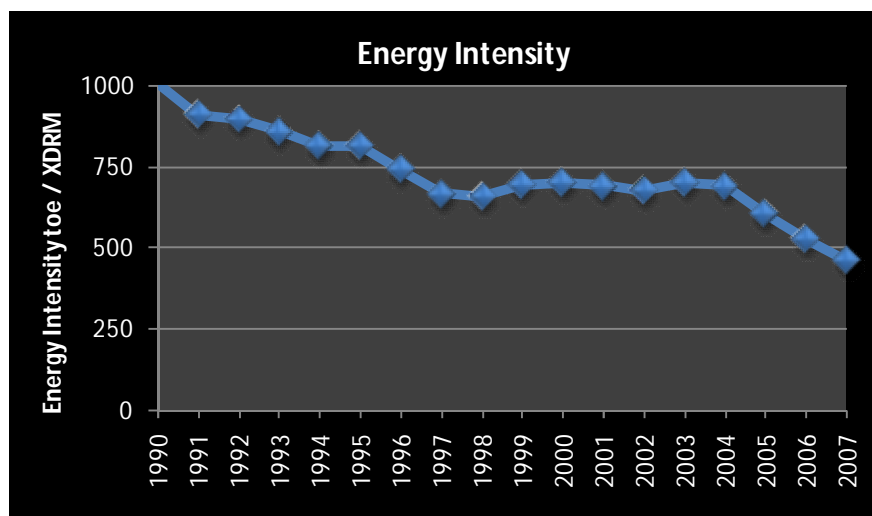
Due to the vastness of the study, a methodical approach was necessary to gather information and compile it in a neat sequence. The best approach to obtain information was to conduct a series of interviews where personal knowledge of the energy sector professionals and whatever documentation available with them. Apart from these valuable interactions, following tasks were undertaken.

- (i) Collection and review of documents related to the area under consideration
- (ii) Meetings/discussions with managers of programmes conducted in Sri Lanka
- (iii) Discussions with energy efficiency services industry practitioners
- (iv) Discussions with large scale users of energy
- (v) Documentation and rearrangement of information derived from the above for presentation in the country report

Apart from the above, personal knowledge of the country expert, gained mainly as a co-architect of the Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007 was extensively used in compilation of the country report.

5.0 NATIONAL POLICIES AND LEGISLATIVE FRAMEWORKS RELATING TO ENERGY EFFICIENCY & CONSERVATION

National economy of Sri Lanka had been quite low in energy intensity since days under colonial rule. Many factors have contributed to this, the relatively stable weather conditions throughout the year, considerable lower transport needs due to the smaller geographical size and low level of industrialisation could be cited as the key drivers of the lower energy intensity of the Sri Lanka's economy. With the ever increasing cost of energy, the energy intensity of economy has shown a trend of going down even further, as depicted in the graph below [2].



Source: Corporate Plan 2008-2010, Sri Lanka Sustainable Energy Authority

Graph 1: Decreasing Trend of Energy Intensity of Economy

However, this seemingly stable energy intensity may display an upward trend when economic conditions improve with the industrial and commercial developments envisaged in a post war Sri Lanka.

The lower energy intensity of economy in the 1970's was a blessing for Sri Lanka to withstand the first oil crisis. This blessing which insulated Sri Lanka from adverse impacts of oil price likes also prevented any meaningful policies being formulated at national level, targeting energy efficiency improvement and conservation during this period.

However, the second oil crisis, which adversely affected all economies in the mid 1980's saw nearly a half of Sri Lanka's export earnings consumed for oil imports [3]. This severe blow managed to influence government policy towards energy efficiency to a certain extent. Under severe strain from the oil price like, the Ministry of Industries initiated the first ever coordinated energy management programme in early 1980's, appointing Energy Managers to all Corporations functioning within the Ministry. An ensemble of around 20 Energy Managers conducted many energy conservation projects

and conducted monthly meetings to report progress as well as to share experiences [4]. This collection of Energy Managers gave birth to an important institution – Sri Lanka Energy Managers Association (SLEMA) which celebrated their 25th Anniversary in 2009. This association has kept a group of likeminded professionals together, contributing to preserve a vital knowledge base in times of lower energy costs where any government tend to lose interest in energy efficiency improvement and conservation. A further strength was added to SLEMA when the association was formally incorporated by the Sri Lanka Energy Managers Association (Incorporation) act No.1 of 1994 by the Parliament of Sri Lanka. This gave the association a new level of legitimacy in carrying out energy management work.

Formation of SLEMA and also the training given to the Energy Managers appointed by the Ministry of Industries in the 1980's was the first foray of the then Ministry of Irrigation & Power in to the area of Energy Management. The efforts of the Ministry of Irrigation & Power to compile a policy guideline through a committee of the Natural Resources Energy & Science Authority (NARESA), renamed now as the National Science Foundation (NSF) could be cited as the first instant where a policy element was included in a national document. An important outcome of the policy guideline was the establishment of Energy Conservation Fund (ECF) by an act of Parliament in 1985. The following sections attempt to explain the various policy development attempts and legislations framed by the Government of Sri Lanka. The programmes and projects which were undertaken along with the evolution of policies and legislative frameworks are described under chapter 6.0 and only the policy changes and developments of legislative frameworks are described in this chapter.

ENERGY CONSERVATION FUND ACT NO.2 OF 1985

The Government having indentified lack of access to funds required to implement energy efficiency improvement projects created this Fund within the Ministry of Irrigation & Power. Hence, the main focus of the legislative framework behind the *Energy Conservation Fund Act No. 2 of 1985* [5] was on finances, as detailed below. The full document is given in annex i.

Board of Management The board of management had representations from the General Treasury, Department of Forests, Major Energy Users, Secretary of the Energy Ministry, Chairmen of Ceylon Electricity Board (CEB) and Ceylon Petroleum Corporation (CPC). This board was chaired by a person with experience in the energy sector. The composition of the board clearly covers the major energy supply sectors, major users and also the key elements of the government machinery.

Objects and Powers The primary objective of the ECF was 'to finance, promote and initiate activities and projects relating to the improvement of any or all aspects of energy demand management and conservation programmes in Sri Lanka'. This phrasing clearly identified funding as the key responsibility of the ECF. The ECF also had a detailed mandate covering the full spectrum of energy supply and demand as explained below.

- (a) Identifying available technologies for improving efficiency in energy use (in agriculture, industry, commercial, domestic and transport sectors; and also in energy supply sector (including conversion, storage and heat recovery)
- (b) Identifying policy measures such as economic incentives / disincentives, education & information provision and institutional arrangements
- (c) Creating a core of active managerial level personnel to develop action oriented energy conservation programmes
- (d) Promote energy efficiency improvement and demand side management (DSM) programmes and provide funds and to support such programmes initiated by other parties
- (e) Assisting public and private sector agencies to carry out energy efficiency, DSM or conservation programmes
- (f) Initiating, promoting, conducting and coordinating energy efficiency, DSM and conservation related R&D efforts
- (g) Organising seminars and workshops and provision of information and education to general public on efficient use of energy
- (h) Specifying standards, norms, codes and other criteria for maintaining quality and for reducing wastage
- (i) Carrying out R&D and pilot studies leading to energy substitution schemes with a focus on new and renewable energy
- (j) Promoting and carrying out long term energy planning and policy analysis
- (k) All dissemination services with regard to energy efficiency, DSM or conservation
- (l) Providing funding for participation in international programmes

In addition to the above mentioned wide mandate, which incidentally had negligible references to renewable energy, the ECF was empowered to do many things as detailed below.

- (a) To raise funds, grants, gifts or donations in cash or kind from local or foreign sources
- (b) To conduct lotteries and award prizes
- (c) To hold competitions and award prizes
- (d) To enter into any agreements
- (e) To invest funds belonging to the ECF and collect income accruing from such investments

Being located in the office of the ministry, the ECF shared many resources with the ministry and showed no signs of gaining the status of an independent and competent agency for many years. In fact, most of the key officers who served the ECF did so whilst serving in other agencies such as the CEB or the ministry. It had a very limited number of support staff and failed to gain a consciousness of its own in the first decade of its existence.

Activities initiated by the ECF and the Ministry of Irrigation & Power suffered a blow, due to the decision by a new political authority to create a special ministry for energy conservation in early 1990's. Without competent officers and a clear mandate, the ministry constricted the sole agency coming under its purview – the ECF resulting in many setbacks within the ECF and in the energy efficiency services sector as well [6].

After these setbacks, the ECF finally managed to break away from the Ministry and found new directions under a few capable officers and managed to initiate several key programmes and projects such as variable speed drives in tea withering, micro hydro powered community electrification and inclusion of energy conservation as a subject matter in school curriculum by late 1990's. Subsequent developments with regard to the ECF which saw it transforming to a fully fledged authority is presented in the ensuing sections.

ENERGY POLICY FOR SRI LANKA 1995

With the formation of a new government in 1994, the Ministry of Power & Energy managed to bring back all energy sector agencies back to its fold and also commissioned a yet another policy formulation effort. This task was assigned to a committee comprising of eminent persons who managed to produce a comprehensive policy document titled *Report of the Committee Appointed by Hon. General Anuruddha Ratwatte, Minister of Irrigation, Power & Energy to formulate the Energy Policy for Sri Lanka* (given in annex ii) 3 years later in 1997. The subject of energy efficiency improvement is dealt with under the section 3.5 & 4.5 of this document [7]. However, this policy was not formally accepted by the Ministry, leaving many issues related to energy efficiency improvement and conservation as they were before.

In the Section 3 of the document which introduced the policy elements, specific reference to energy waste in production, transmission and distribution is made and the main focus had been on energy conservation, not energy efficiency improvement. However, in the Section 4 of the document which laid out implementing strategies, a reference to promotion of efficient equipment is made. This could be identified as the starting point of many subsequent processes initiated in the area of appliance energy efficiency. However, the failure to accept the policy document by the government due to other issues which burdened the authorities at the time provided only a limited mileage to these concepts. Nevertheless, this paved the way for many future activities in the decade which ensued.

STRATEGY PAPER ON ENERGY EFFICIENCY 2002

With the directives issued by a newly elected government in 2001, another attempt was made to compile a strategy paper on energy efficiency, conservation and demand side management, one among three such papers. The paper was titled *Energy Efficiency, Conservation & Demand Side Management Strategies for the Electricity Sector of Sri Lanka* [7] and is given under annex iii. As the name suggests, the document covered only the functions of the electricity sector.

The strategy paper identified the institutional framework of that time dealing with energy efficiency and attempted to define specific roles for each entity in the sector, which were actively engaged at the time in the electricity sector. The Paper proposed a five pronged strategy as given below.

- (i) Energy efficiency and Conservation Policy Review – Voids in existing policy environment were clearly identified and proposed to amend the *Energy Conservation Fund act 2 of 1985*, to empower it to implement energy efficiency programmes.
- (ii) Implementation Framework – A new framework, albeit many complicated overlaps of roles and responsibilities were proposed, in anticipation of electricity sector regulatory reforms.
- (iii) Sourcing & Disbursement of Funds – The biggest issue faced in implementing energy efficiency improvement projects – the lack of finances was identified and strengthening of the mandate of ECF to generate funds through a levy and involvement of commercial banks in disbursement were proposed.
- (iv) Search for Technologies for Improving Energy Efficiency – The need to carry out R & D in both energy efficiency improvement and renewable energy development was emphasised.
- (v) End use Education and Awareness – The need to educate the end use consumer and the important roles to be played by consumer tariff and distribution companies in curtailing waste were identified.

Apart from the above strategies, the important aspects of engaging private sector ESCOs in commercially viable energy efficiency improvement projects and areas which require continued government support were discussed and an implementation time table was also proposed. This paper was approved by the Cabinet of Ministers in June 2002 and was tabled in the Parliament in November 2002.

Although not many significant changes took place in the energy efficiency services sector after the strategy paper, several key elements, which shaped the activities of the sector in years to come, became visible. These elements formed the foundation of many policy initiatives could be presented in summary as below.

- Need to change ECF act to establish an empowered agency.
- Necessity of funds to drive energy efficiency improvement efforts.
- Need to network many players in the sector to achieve mutually beneficial goals.

STRATEGIES TO IMPROVE THE DELIVERY OF ENERGY EFFICIENCY SERVICES IN SRI LANKA 2003

Year 2001 saw the country going through the worst load shedding programme in history and immense pressure was building up for a better DSM programme – Thus, a follow up of the strategy paper presented above, a Working Group on Energy Efficiency, Conservation & Demand Side Management Strategies was appointed in August 2002, also in partial fulfilment of a loan condition stated in a World Banks' Aide Memoire. The mandate of the Working Group covered three areas.

- (i) Review the ECF act with a view to realisation of its objectives and structures with overall energy efficiency goals and current institutional arrangements, such as the role of the DSM Branch of CEB.
- (ii) Explore the status of the CEBs' DSM Branch in the light of anticipated structural changes in the sector and unbundling of CEB under the proposed Electricity Reforms act.
- (iii) Measures to accelerate the creation of private sector ESCOs

The Working Group, after many meetings and consultative sessions proposed many changes to ECF act with the view of operating in a reformed energy sector. The report (given in annex iv) produced by the Working Group was titled *Strategies to Improve the Delivery of Energy Efficiency Services in Sri Lanka* [8] Key aspects at the proposals were;

- Expansion of the Board to accommodate new players in an unbundled energy sector.
- Acquisition of more power, especially to enforce energy efficiency measures.
- Expanding Objects to be expanded to cover renewable energy, energy policy & planning, information management and fund management.
- Acquisition of Powers to frame regulations on mandatory measures.
- Levying an energy cess for a steady flow of funds to energy efficiency and renewable energy sectors, and developing a fund management capability.
- Co-ordinate R & D among all players.

A new structure too was proposed and was implemented successfully marking the beginning of the new era for the ECF. However, the proposed changes to the act were not done as expected.

In the area of institutional arrangements, the important tasks carried out by the DSM branch and the Pre-Electrification Unit (PEU) of the CEB were distributed among ECF and proposed new entrants to the unbundled electricity sector. However, the anticipated reforms never took place and only the closure of DSM branch and PEU of the CEB resulted, causing an irreparable loss of knowledge mass along with capacity acquired through years of active services in industry.

The Working Group also proposed several measures to let the private sector ESCOs to carry out a successful business. They are listed below.

- Making project financing easier by training bank personnel, providing credit guarantees and helping bankers to access cheaper funds.
- Making good use of tools such as the Monitoring & Verification protocol to build confidence in energy efficiency projects.
- Developing capacity of ESCOs by training and providing quality measuring instruments on rent.

The Working Group proposed to retain industry expertise available at the now defunct DSM branch and similar places through a few expert committees. However, the implementation of this concept was later found to be impossible. Alternative measures to seek donor assistance to build capacity were successful to a greater extent, in the medium term.

Out of the many recommendations, only the restructuring of the ECF was implemented fully, and changes in many other spheres occurred simultaneously but took considerable period to take effect. Provision of low cost equipment rentals to ESCOs managed to bring out several small scale energy management practitioners to carry out energy audits and related consulting tasks to industrial & commercial sectors. However, implementation of energy efficiency improvement projects seldom happened, primarily due to lack of confidence in energy efficiency improvement projects and continued risk aversion by the banks.

NATIONAL ENERGY POLICY & STRATEGIES 2005

A Committee was appointed by the Ministry of Power & Energy to initiate a policy formulation effort to gather all aspects of the energy sector into a single process in 2005. The compilation of the policy document was preceded by many rounds of consultations and meetings of the Committee, and a draft paper was submitted to the Ministry in 2005. Ministry of Power and Energy then discussed the draft document with a wide group of stakeholders, obtained the views of members of the public and made

the necessary amendments before publishing this document title *National Energy Policy and Strategies of Sri Lanka* [9]. This document, given in annex v, declares the National Energy Policy of Sri Lanka, and spells out the implementing strategies, specific targets and milestones through which the Government of Sri Lanka and its people would endeavour to develop and manage the energy sector in the coming years in order to facilitate achieving its millennium development goals. Specific new initiatives are included in this policy to expand the delivery of affordable energy services to a larger share of the population, to improve energy sector planning, management and regulation, and to revitalise biomass as a significant resource of commercial energy.

This document was taken up by all stakeholders with a lot of enthusiasm, as it was the first ever comprehensive policy document prepared in Sri Lanka, which touched all players in the energy sector. Another reason for the wide acceptance of the document was the engagement of all stakeholders at the formulation stage and approval of the policy by the cabinet of ministers on 25th October 2006 and clearance by the Parliament on 19th February 2008, which reached a state of finality with the publication of the gazette notice on 10th June 2008. The document is considered as the guideline in all matters related to the operation of the energy sector until now. However, as the petroleum sector came under a new ministry than the Ministry of Power & Energy (which originally had both electricity and petroleum sectors under its wing), certain programmes in the petroleum sector seems to be formulated outside the stated policy. The main elements of the policy are presented below.

1. Providing Basic Energy Needs
2. Ensuring Energy Security
3. Promoting Energy Efficiency and Conservation
4. Promoting Indigenous Resources
5. Adopting an Appropriate Pricing Policy
6. Enhancing Energy Sector Management Capacity
7. Consumer Protection and Ensuring a Level Playing Field
8. Enhancing the Quality of Supply
9. Protection from Adverse Environmental Impacts of Energy Facilities

Out of the above elements, the bullet 3 requires focussed attention of this country paper. Hence the detailed description of this policy element is presented in the ensuing section.

The main policy statement states: 'Energy supply systems will be efficiently managed and operated while also ensuring efficient utilisation and conservation of energy' and is further elaborated as follows. Efficient management and operation of the energy sector utilities are vital to ensure minimum cost of supply to consumers. Efficient utilisation of energy by all concerned, from utilities (supply-side management) to final consumers (demand-side management) not only saves valuable resources of the

country but also reduces the overall cost of energy to the consumer. Meaningful conservation of energy will be pursued at all times.

This statement is followed by several strategies, explaining how the stated policy objectives would be met by the relevant player. The implementing strategies are;

- Supply side and end-use energy efficiency will be encouraged through financial and other incentives / disincentives in respect of energy end-use and mandatory measures such as appliance energy labelling, building codes and energy audits.
- Private sector participation in providing expert services on energy efficiency will be promoted and facilitated.
- Financial resources required to continuously improving efficiency in energy conversion, transmission, distribution and utilisation will be acquired from within and outside the energy sector by levying appropriate energy charges and formulating long term funding programmes with financiers.
- The Energy Conservation Fund (ECF) will be entrusted to coordinate all the activities relating to energy conservation and management, and the Energy Conservation Fund Act will be amended to accommodate these new responsibilities.
- An aggressive public education and awareness program on energy efficiency and conservation will be carried out on a priority and a sustainable basis.
- Technologies such as efficient stoves will be widely disseminated in the household and informal commercial/industrial sectors.
- The use of existing petroleum distribution infrastructure will be optimised.
- Power generation and network losses will be brought down to the lowest possible levels and capacity will be improved through necessary generation, transmission and distribution investments and efficient management of the supply systems.
- Efforts will be made to encourage electrification of viable sectors of the railway network and inter-modal shift in passenger and goods transport towards more energy efficient systems.
- A modal shift towards larger-capacity vehicular transport modes, which are less energy intensive per passenger kilometre or freight-tonne kilometre, will be promoted. Railway transportation will receive priority over road transportation.
- Better coordination of road and rail transport will be promoted as a key implementation strategy of achieving greater efficiency of the transport sector.
- A strategic plan for street lighting will be formulated for the country to ensure proper management of street lighting, which will enhance the safety of motorists and pedestrians, and also contribute to energy conservation with a better aesthetic sense.

The document goes even further, to pinpoint implementation responsibilities on selected stakeholders. This component is dealt with a two different approaches for supply side and demand side.

Supply-side Energy Efficiency Institutional responsibility to implement this strategy and to achieve targets was placed with the electricity utilities and the PUCSL. However, the empowerment of the Public Utilities Commission of Sri Lanka (PUCSL) took a longer than expected period, finally happening in year 2009.

- Transmission and distribution energy losses (the sum of technical and commercial losses) in the electricity sub-sector will be gradually brought down to a maximum of 13.5% net generation by end 2009. Every effort will be made to expedite the loss reduction programme and exceed these expectations.
- Present system control procedures towards optimal operation of the integrated hydro-thermal power system will be improved by end 2007 to ensure maximum energy output from the hydropower system.
- Informed rehabilitation/new investment decisions will be made in the national interest, to improve electricity generation, transmission and distribution efficiency, guided by information gathered from continuous measurement of energy entering and leaving specific power system components.

Demand-side Energy Efficiency Institutional Responsibility to implement these strategies to reach the targets specified was placed with the then ECF, and shall be assisted by electricity and petroleum utilities, the PUCSL and other stakeholders.

- All appliances which substantially contribute towards electricity demand will be identified and labelled based on their energy efficiency by end 2010, allowing consumers to make informed purchase decisions. Labelling will be also used to lay more emphasis on appliance life cycle cost rather than the cost of acquisition, and thereby guiding fiscal policy, especially in deciding import duty on appliances.
- Continuous refinement of the labelling programme will be used to introduce efficient technologies and to gradually phase out the import and manufacture of inefficient appliances. The appliance labelling programme will be made mandatory to identified appliances by mid 2007.
- Delivery of energy efficiency services will be accelerated by further developing the capacity of private and public sector energy service providers. New entrants to provide energy efficiency services will be encouraged and supported by interventions such as provision of expensive instruments on loan basis and analytical information relevant to local circumstances.
- Benchmarks on energy intensity of specific industries will be established by end 2007. Specific benchmarks for energy consumption of commercial, transport and domestic sectors will be established by end 2008.

- The National Energy Database will be enhanced with further disaggregated and refined demand-side data by end 2007.
- A variety of financing mechanisms will be made available by end 2007 to finance energy efficiency improvement projects in all sectors. These will include credit enhancement facilities. Capacity of financial institutions will be developed and assisted to treat energy efficiency improvement financing as a standard item in a portfolio of loans.
- State sector agencies identified as major energy consumers will be closely monitored and their energy expenditure will be separated from recurrent expenditure to assist energy efficiency improvement and cost control. Such agencies will be mandated to take the lead in procuring energy efficient equipment. A code of practice on street lamps will be introduced by 2008, to minimise the uncontrolled growth and use of street lamps, and to assign the cost to the beneficiaries.
- The Energy Efficiency Building Code will be updated and made mandatory to state sector entities by end 2007. Indirect measures through permit issuing agencies will be implemented to encourage the practice of the code by other entities, within the same time frame.
- Information pertaining to ways and means of energy efficiency improvement will be collected and disseminated through mass media and other suitable channels, facilitating consumers to undertake energy efficiency improvement programmes.

Many years later, several strategies mentioned above were implemented and some remain to be implemented. Overall, the time delay between the stated timeline and actual implementation remained at around two years, resulting from the long delays in getting the policy paper through the Parliament system.

The key policy change in energy efficiency improvement strategies took place with the enactment of Sri Lanka Sustainable Energy Authority Act No.35 of 2007, and resulted in dramatic changes in the legislative framework which governed the energy efficiency improvement and conservation (EEI&C) activities of Sri Lanka. The next section explains these changes.

SRI LANKA SUSTAINABLE ENERGY AUTHORITY ACT NO. 35 OF 2007

This piece of legislation could be cited as the first-ever focused attempt to tackle the EEI & C programme in a comprehensive manner in Sri Lanka. Enacted on 1st October 2007, this act repealed the *Energy Conservation Fund act No. 2 of 1985*. This landmark piece of legislation titled *Sri Lanka Sustainable Energy Authority Act No.35 of 2007* [10] and is given under annex vi.

Board of Management Considering the wider mandate of the new Authority, a powerful board of management with 21 members was appointed, with ex-officio representation of all key ministries

through 11 Secretaries and the Director General of the PUCSL. Apart from the Government representation in the board of management, nominees of Sri Lanka Energy Managers Association SLEMA, development banking sector renewable energy industry, Ceylon Chamber of Commerce (CCC) were appointed in addition to 5 more sector experts.

Objects of the Authority Among the four objects of the Authority, energy efficiency improvement and conservation received a prominent place as given below.

Section 4. The objects of the Authority shall be to –

- (a) to develop Renewable Energy Resources
- (b) to declare Energy Development Areas
- (c) to implement Energy Efficiency Measures and Conservation Programmes
- (d) to promote Energy Security, Reliability and Cost Effectiveness in Energy Delivery and Information Management

Except the object (b) on renewable energy development the remaining two objects (c) & (d) too have a signification bearing on the energy efficiency improvement & conservation.

Power, Duties and Functions of the Board The *Sri Lanka Sustainable Energy Authority Act No. 35 of 2007* confers significant amount of power to the Authority, targeting two aspects, Renewable Energy Development and Energy Efficiency Improvement. Out of the many powers, duties and functions the items relevant to EEI & C area are quoted below.

Section 5. The Board shall exercise, perform and discharge the following powers, duties and functions:-

- (a) assist the Minister in the formulation of the national policy on energy;
- (b) identify, conserve and manage all renewable energy resources and appropriate conversion technologies, including the:-
 - (i) preparation, maintenance and updating an inventory of all renewable energy resources in Sri Lanka, indicating the geographical location of sites, exploitable potential, land ownership and existing infrastructure facilities; and
 - (ii) preparation, maintenance and updating of an inventory of all renewable energy technologies, indicating their level of maturity for commercial deployment and typical performance data;

- (c) develop a conducive environment for encouraging and promoting investments for renewable energy development in the country, including:-
 - (i) development of guidelines on renewable energy projects and disseminating them among prospective investors;
 - (ii) development of guidelines in collaboration with relevant state agencies, on evaluation and approval of on-grid and off-grid renewable energy projects;
 - (iii) entertainment of applications for carrying on of on-grid and off-grid renewable energy projects;
 - (iv) providing assistance to investors by formulating project proposals in new types of renewable energy resources and technologies and
 - (v) exploring avenues and facilitating the process of overcoming technical or any other limitations that retard the growth of renewable energy development, in accordance with the national policy on energy;
- (d) analyse and recommend policies and prepare plans aimed at promoting and developing renewable energy resources, including:-
 - (i) preparing long-term development plans with interim targets for specific technologies and promotion and facilitation of the implementation of such plans; and
 - (ii) devising incentive mechanisms based on principles of competitiveness and specific technologies based on actual energy production;
- (e) develop a conducive environment for the encouragement and promotion of investments in renewable energy development, energy efficiency improvement and conservation, rural energy services and for ensuring the sustainability and well-being of the energy sector in the country including:-
 - (i) the promotion of programmes to mobilize funds for renewable energy development, promotion of energy efficiency, improvement and conservation and rural energy services through credit enhancement and other facilities; and
 - (ii) the provision of funds, including subsidies and seed capital for pilot projects in renewable energy development, energy efficiency improvement, conservation and rural energy services that reduce the dependence on imported energy;
- (f) provide technical and financial assistance for capacity building of the energy sector stakeholders and for research and development activities carried out by any stakeholder, consistent with the objects of the Authority;

- (g) function as a National Technical Service Agency of Clean development Mechanism (CDM) in Sri Lanka that provides technical assistance to the Designated National Agency for Clean Development Mechanism and project developers, on energy sector clean development project activities, including –
 - (i) design, develop and implement innovative schemes that assist project developers to overcome barriers and access commercial financing; and
 - (ii) facilitate and assist project developers to access concessionary finances made available under any environment protection initiative by any organisation;
- (h) conduct preliminary studies and investigations in any geographical area to ascertain the renewable energy potential;
- (i) collect necessary data and carry out renewable energy resource planning and assessment within any Development Area, subject to any directions that may be given by the Minister;
- (j) obtain relevant data required for renewable energy planning and assessment, from any public or private institutions or any other sources;
- (k) monitor, refine and follow up the approval process of on-grid and off-grid renewable energy projects in consultation with relevant agencies and to provide technical and other logistical assistance and facilities to such agencies to simplify the procedural requirements and to accelerate the project approving mechanism;
- (l) facilitate the access to green funds for investors in on-grid and off-grid renewable energy projects, for energy efficiency improvement and conservation measures and rural energy services;
- (m) provide funds and design, develop and implement credit enhancement facilities, such as loan guarantee schemes and access to commercial credit for investors in on-grid and off-grid renewable energy projects, investments in energy efficiency improvement and conservation and knowledge management in the energy sector;
- (n) enter into joint schemes with any person approved by the Minister, to achieve the objects of the Authority;

- (o) render professional services and undertake projects connected with the development of renewable energy resources and the improvement of energy efficiency, energy conservation and demand management for and on behalf of state and private sector organizations, and charge as fees such amounts as may be determined by the Board; and
- (p) initiate and implement any other programmes and do any other acts as may be necessary or conducive to the attainment of the objects of the Authority.

Energy Efficiency Improvement & Conservation programme The above duties and functions which are to be performed using power vested in the authority. The act goes even further to derive many programmes on EEI & C under the Part VII of the act dealing only with EE & C programmes. The provisions in this part are quoted as below.

Section 35(1) The Board shall be responsible for the adoption and implementation of measures to conserve energy and improve efficiency in harnessing energy, processing, conversion, transportation, storage, co-generation and heat recovery techniques, in the use of energy in all consumer sectors.

(2) For the purpose of carrying out its responsibilities under section (1), the Board shall:-

- (a) identify, analyse, develop and recommend policy measures which can be implemented by all consumer sectors, to prevent wastage of energy used by them in their various activities;
- (b) promote and facilitate the implementation of energy efficiency and energy conservation policy measures, by organizing seminars, workshops and courses in energy efficiency, demand management or conservation;
- (c) educate and provide information to the public regarding energy demand management and conservation;
- (d) improve any or all aspects of energy demand management which promotes rational use of energy and reduces the use of non-renewable energy sources in Sri Lanka;
- (e) identify the available technologies and facilitate deployment of such technologies for improving efficiency in the harnessing of energy, processing, conversion, transportation, storage and use of energy;
- (f) implement energy labelling programs for appliances and devices and establish benchmarks;
- (g) specify and enforce standards, norms, codes, measurement and verification protocols and building codes, for the efficient use of energy and for reduction of wastage of energy in building ;and

- (h) initiate, promote, conduct and co-ordinate research, surveys and investigations in regard to specific aspects of energy efficiency, conservation and demand management.

Powers vested in the Authority Powers vested in the Authority to carry out the above mentioned programmes are presented in the Subsequent section.

Section 36(1) The Board may from time to time by regulations made in that behalf, establish specific energy consumption benchmarks to be complied with by all energy consumers.

(2) For the purpose of ensuring that the benchmarks established under subsection 91) are being complied with, the Board may, where it considers it necessary:-

- (a) enter and inspect with the consent of relevant persons concerned, any premises, compound or facility, collect information, verification of information and conduct any other investigations;
- (b) direct any person to furnish information relating to energy utilization, production, procurement and sales;
- (c) monitor, with the consent of all relevant persons concerned, energy consumption in buildings and industrial premises and monitor fuel efficiency of land vehicles, ships and aircrafts, in association with relevant agencies;
- (d) specify in association with relevant agencies, energy consumption limits and energy performance standards of appliances and direct the display of such particulars on labels attached to appliances, in such manner as may be prescribed from time to time;
- (e) control the manufacture, import, sale or purchase of appliances which do not conform to the specifications prescribed under paragraph (d);
- (f) enforce limits and codes of practices for existing and proposed buildings, industrial premises, land vehicles, ships and aircraft, in association with relevant agencies; and
- (g) develop educational material and recommend educational curricula, on efficient and rational use of energy and conservation of energy.

Curtailment of Energy Waste The curtailment of energy waste is dealt with separately under the section 37 which also proposes a fairly elaborate measures as shown below

Section 37 (1) Where the Board is of the view that any person or categories of persons (including any public body), is consuming unacceptable levels of energy in their respective premises or installations, over and above the benchmarks, established by the Board under section 36 of this Act, such person or category or persons may be called upon to submit to the Board a detailed audit report compiled by an accredited energy auditor and a detailed plan of action on remedial measures that are proposed to be taken by such person or

category of persons, as the case may be, to reduce the energy consumption to acceptable levels.

Mandatory Energy Auditing The first step in EEI&C, the thorough investigation of energy using facilities, which status from energy auditing and concludes with post improvement monitoring is extensively dealt with in the act. All actors in the energy efficiency services (EES) provision is identified and are expected to be accredited and ranked by the Authority as detailed in the section 38. Mandatory energy auditing is dealt with in the section 39 which follows.

Section 38(1) The Board shall appoint and rank persons having such qualifications as prescribed, to be:-

- (a) Energy managers, who shall assist in promoting practices relating to efficient energy management;
- (b) Energy Auditors, who shall be qualified to conduct energy audits; and
- (c) Energy Service Providers.

Section 39(1) The Board shall from time to time by rules made in that behalf, specify:-

- (a) the persons or categories of persons including public bodies, who shall be required to have an energy audit carried out in their respective installations or premises; and
- (b) the manner and the period during which an energy audit shall be required to be carried out.

Policy Formulation Apart from the above mentioned specific measures, wide ranging policy formulation tasks too are given in the mandate of the Authority under section 41.

Section 41 The Board shall be responsible for promoting security and reliability and ensuring cost effectiveness of energy delivery within Sri Lanka, and for that purpose:-

- (a) examine the energy sector performance, review and integrate institutional and sub-sectoral plans, conduct policy analysis, review compliance with national energy policy and strategies and make policy recommendations to the Ministry on the energy sector in general, and more specifically on renewable energy resources and energy efficiency;
- (b) conduct surveys and investigations, collect and compile data in collaboration with the Department of Census and Statistics, publish national energy balance reports and other documents providing information relating to the energy sector in general, and more specifically to energy resources, conversion, supply, utilization, conservation and economics;

- (c) identified and analyse policy measures and recommend to the Ministry and other relevant agencies, specific policy measures pertaining to fiscal incentives and disincentives, including pricing policies, taxation and institutional arrangements;
- (d) obtain information relating to energy resources, research, reserves, conversion facilities and conversion levels, storage facilities and storage levels, transmission and distribution systems, sales, customers, costs, prices, income from sales losses, employees and development plans of any institution, company or individual engaged in the business of energy or having jurisdiction over resources that possess an energy value; and
- (e) inspect and obtain information about potential or existing energy supply facilities and their utilization and consumption.

This Section is seen to be a vital piece of legislation in deriving fiscal policy measures in battling entry of inefficient energy wasting equipment and appliances into the Sri Lankan market.

Financing Aspects Financing, being a significant barrier in promoting EEI&C, is extensively treated in the Part VIII of the act. The section 44 touches on the sources of funds for the general financing of the Authority. However, main funding uses for operation of EEI & C programmes are identified under section 45. Further, two important instruments are introduced under sections 46 and 47. As quoted below.

Section 45 (1) There shall be charged, levied and paid a cess on all fossil fuel products imported, calculated at such rate as may be determined by the Minister from time to time with the concurrence of the Minister in charge of the subject of Finance, by Order published in the Gazette.

Section 46 (1) There shall be established a Fund called the “Sri Lanka Sustainable Energy Fund” (in this Act referred to as “Energy Fund”).

(2) There shall be credited to the Energy Fund:-

- (a) an initial grant of five hundred million rupees to be paid out of the Consolidated Fund;
- (b) the proceeds of the cess imposed under section 45;
- (c) fees chargeable from developers for managing the carbon asset of Sri Lanka;
- (d) amounts paid as royalty or charges by developers and permit holders under section 19 and section 26 of this Act;
- (e) fees charged by the Board for rendering any professional services;

- (f) money received as lease rentals from the lease of land or interest in land for carrying on of any on-grid and off-grid renewable energy project;
- (g) fees charged for entertaining applications submitted to the Director-General for engaging in on-grid and off-grid renewable energy projects; and
- (h) fees and shared savings earned from undertaking projects connected with the development of renewable energy resources and the improvement of energy efficiency, energy conservation and demand management, for and on behalf of State and private sector organizations.

Section 47 (1) There shall be established a fund called the “Sustainable Energy Guarantee Fund” (in this Act referred to as the “Guarantee Fund”) for the purpose of providing guarantees on behalf of investors who apply for loans to carry on any project relating to energy efficiency.

Debentures Another significant feature of the act is the provision to access public money through a debenture issue, guaranteed by the government. This paves the way to finance the most difficult projects such as Municipal EEI projects through a long term source of finance. The basic framework of this valuable piece of legislation is presented below.

Section 48 (1) The Board may with the consent of the Minister given in concurrence with the Minister in charge of the subject of Finance, borrow temporarily by way of overdraft or otherwise, such sums of money as the Board may require for covering expenditure incurred by it in the exercise, performance and discharge of its powers, duties and functions;

Provided that the aggregate of the amounts outstanding in respect of any temporary loans raised by the Board under this subsection, shall not at any time exceed such sum as may be determined by the Minister in consultation with the Minister in charge of the subject of Finance.

Section 49 (1) The Minister in charge of the subject of Finance shall guarantee the repayment of the principal and of the interest due on Sustainable Energy Authority Debentures issued under section 48.

PUBLIC UTILITIES COMMISSION OF SRI LANKA ACT NO. 35 OF 2002

This piece of legislation could be cited as the basic legal framework meant to regulate energy sector utilities. The skeletal nature of the structure requires other industry acts to be enacted to draw power for regulation. In this regard, Petroleum industry act, which is still in the draft bill stage and the Sri

Lanka Electricity act No.20 of 2009 which was enacted in April 2009 provide the vital base of the *Public Utilities Commission of Sri Lanka act No.35 of 2002* [11] given in annex vii.

It is understood that utility level EEI&C matters are to be dealt with by the PUCSL through conditions embedded in licences, enforced through issuance of orders. Setting of performance levels (benchmarks) and promotion of inter utility competition through tariff orders could drive the utilities towards better energy efficiency. References to EEI&C in this act are cited below.

Section 14(2) Without prejudice to the provisions of subsection (1), the Commission shall exercise, perform and discharge the powers, functions and duties conferred on or assigned to it by or under this Act and any other industry Act, in a manner which it considered is best calculated-

- (b) to promote competition;
- (c) to promote efficiency in both the operations of, and capital investment in, public utilities industries;
- (f) to benchmark, where feasible, the utilities services as against international standards;

SRI LANKA ELECTRICITY ACT NO. 20 OF 2009

This is the latest piece of legislation (given in annex viii) made in view of the regulatory reforms in the electricity sector titled *Sri Lanka Electricity Act No.20 of 2009* [12] This is one of the industry acts which empower the PUCSL. Through this act, many distribution entities, a transmission entity and a generation entity is created and the business is regulated by way of a licence scheme. The enactment of this act saw the repeal of Ceylon Electricity Board act no. 17 of 1969 and Electricity Reforms act No. 28 of 2002.

Under the Duties of the PUCSL, EEI&C had been identified under section 3.

Section 3(1) The functions of the commission shall be to act as the economic, technical and safety regulator for the electricity industry in Sri Lanka and-

- (h) to promote the efficient use and conservation of electricity;

Through this provision, the involvement of distribution companies in Energy EEI&C will be institutionalised it is hoped. Further, the objects listed in this act identify EEI&C within places where electricity is supplied as a key object under section 4 (1)

Section 4 (1) The Commission shall discharge the functions assigned to it by or under this Act in a manner which it considers is best calculated-

(d) to promote the efficient use of electricity supplied to premises;

A further provision is made under special conditions applicable to distribution licensees in section 18 (b), where the PUCSL can direct a distribution licensee to ensure efficient use of electricity at consumer level.

Section 18(b) requiring the licensee to publish and conform to codes of practice in relation to consumer issue, containing such provisions as the Commission considers necessary for the protecting of consumers, including provision relating to-

(vi) the efficient use of electricity by consumers;

Another specific provision covering the area of Energy Efficiency Improvement & Conservation is the fraction of collecting information regarding the achievement of benchmarks in promotion of efficient use of electricity, laid out in section 42.

Section 42(1) The Commission shall from time to time collect information with respect to-

(c) the levels of performance attained by such licensees in connection with the promotion of the efficient use of electricity by consumers.

This implies a compulsory regime of promotion of EEI&C by each of the distribution licensee. When these elements work in tandem with regulatory provision in the *Sri Lanka Sustainable Energy Authority Act No. 35 of 2007*, a greater benefit would result in the EEI&C effort.

REVIEW OF NATIONAL POLICIES AND LEGISLATIVE FRAMEWORKS

The evaluation of EE policies was presented in a chronological sequence, to elaborate the necessity of an all encompassing approach in formulation of policies and designing legislative frameworks. In this respect, a clear evolution is seen in the policy focus as depicted below.

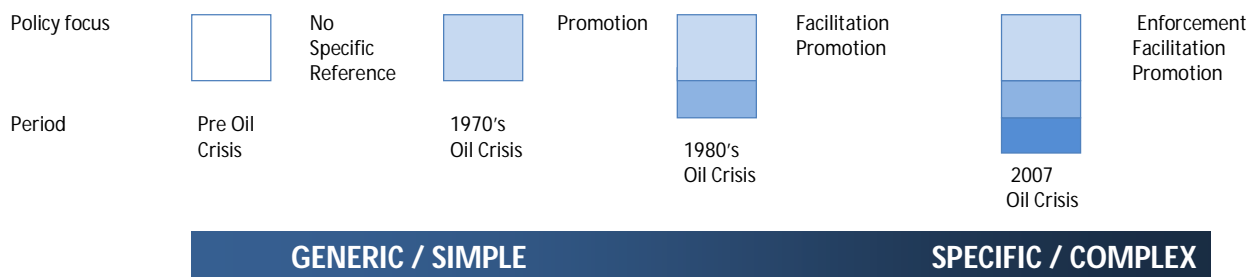


Figure 3: Changing Policy Focus

From the above, it is obvious that the policy has undergone a continuous expansion of focus areas, roles a continuous increase of complexity within a span of four decades.

This evolution could have two underlying forces beneath the path it has taken. Firstly, the understanding of the inadequacy of area under focus, roles and failure of simpler approaches may have driven the policies towards the complex form which exist today. Secondly, the economic and technology development which made most previous approaches ineffective or obsolete may have driven the energy policies towards the current status. It is most likely that both these factors may have contributed towards the policy development in Sri Lanka. However, the role played by energy prices shall not be discounted here, as it was one of the most dominant forces which catalysed all policy development efforts in the energy sector of Sri Lanka. Another significant aspect of policy evolution is the change of policy format from quite abstract generic nature to a very descriptive specific nature over the years, this too may have been due to the inability of a generic policy to effect any change in the vast array of energy uses and consumers, present in the complex energy markets of today.

In the more recent *Sri Lanka Sustainable Energy Authority Act No. 35 of 2007*, provisions have been left open to frame regulations on energy efficiency, which extend the legal framework to very specific area such as 'health sector energy efficiency improvement'. These provisions in the act make it possible to design individual policy and regulatory framework to any energy utilisation aspect. Eventually the legal framework will evolve into a complex structure of many such specific regulations linked to a central piece of Legislation. A comparison between 1985 legislation and 2007 legislation is presented for better understanding of the evolution process.

Table 2: A comparison of the 1985 Legislation and 2007 Legislation

Aspect	Energy Conservation Fund Act	Sri Lanka Sustainable Energy Authority Act
Composition of Board of Management	Strong presence of utilities	No presence of utilities except PUCSL heavy presence of ministries, industry and non-governmental sector
Objects	Limited to technology, financing, policy, capacity building, dissemination, training related to EEI programmes	Covers almost all aspects of energy security, with strong focus on renewable energy and energy efficiency.
Focus of Objects	Programme focused	Attempts for reaching market changes
Powers, duties and Functions	Confined mainly to fund management aspects	Covers the whole spectrum of functions related to renewable energy development and energy efficiency improvement
Role	Confined to limited area of promoter of EEI efforts, focused on enabling	A facilitator and enforcer, focused on implementation
Structure	Abstract / Generic	Descriptive / specific
Responsible for	No specific responsibility assigned	Eightfold very specific responsibilities assigned
Enforcement Procedure	No mention	Laid out in great detail
Mandatory Mechanisms	No Mention	Laid out in detail, complete with accreditation of Energy Auditors, Energy Managers and Service Providers
Finances	Depend solely on grants and related means	Based on a wide portfolio of sources including an energy cess on imported fossil fuels
Other Finance related Mechanisms	No mention	Credit enhancement, debentures and many other mechanisms
Regulations	No provision	Many provisions
Special Powers	None	Entry and Inspection of premises, Request Energy Information
Offences	None	Covers all provisions in the act and regulations made thereunder

Fragmentation of Legal Framework Just as energy efficiency legislation evolving into a complex and specific form, relative positioning of the energy efficiency legislation among other laws and interrelationships between energy efficiency laws and other laws have undergone many changes. Since most other laws too have changed into more complex forms, well defined relationships (between acts and regulations) which was possible in a less complex context has now become almost impossible to visualise. For an example, even the few references to CDM in the *Sri Lanka Sustainable Energy Authority Act* has failed to attract attention of the legal experts working in the environmental protection legislations who prepared the incorporation papers of the Sri Lanka Carbon Fund, the future focal point on CDM in Sri Lanka.

This apparent fragmentation is a direct result of the virtual absence of legal expertise among energy sector professionals and adequate subject specific knowledge among the legal draftsmen who frame various pieces of Legislations in Sri Lanka. The fragmentation of legislation has given rise to a situation where implementation of most energy efficiency policy require other means of integration such as standing committees, working groups and advising committees to iron out differences between non complementary legislative frameworks. Another drawback of the fragmented legislative framework is the poorly defined roles of agencies. For example, the energy labelling programme requires close interactions between several organisations whose roles and responsibilities sometime overlap whilst certain tasks remain unsigned to any agency.

Implementation Issues In spite of significant developments in energy efficiency legislative framework in Sri Lanka, opportunities for improvement crop up in the efforts to implement the policy changes. A closer examination of proven systems in other countries where the policies were implemented before would have made implementation a much easier task. Special attention must be paid to areas where enforcement is required as more often than not, existing legal entities and instruments have to be used (e.g. customs, the police and other arms of the law enforcement establishment) to implement many energy efficiency policies. Hence the policy development effort must be preceded by a detailed analysis of existing enforcement structure of the country with regard to intended policy implementation.

Prioritisation Having laid out a wide mandate covering all aspects of energy use, the SLSEA now find it difficult to focus on a particular area, as the political authority is expecting speedy implementation of all provisions. Ideally, the implementation time table would have been derived from an in depth study of benefit/cost aspect of each measure. Absence of such guidance has led to a lack of focus in the implementation programme.

Utility Involvement Just as ill defined roles of energy sector agencies hamper implementation, specific assignment of all EEI tasks to a new agency too has created a situation where the utilities severing all relationships with DSM activities, as they see the entry of a new agency as a certain exit of the utilities from EEI efforts. The much needed cooperation of utilities in driving are EEI programme can suffer when such things happen. Even though the new Legislation has freed up capacity of utilities to focus on supply side efficiency programmes, the role to be played by them in DSM cannot be down played, even after the entry of SEA into the system. A clearer understanding of utility role in DSM and laying out legislative framework to assure utility participation in EEI programmes would have been helpful. However, this situation will change for the better with the latest addition of *Sri Lanka Electricity Act No. 20 of 2009* to the legislative framework, which implies a mandatory role for distribution licensees in promoting EEI among electricity consumers.

6.0 REVIEW OF PROJECTS AND PROGRAMMES IN ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION

Having braved the many oil crises and several load shedding periods, all spheres in the energy sector started many programmes to deal with issues facing the energy sector. The development of energy efficiency services sector, took a long path of evolution through these programmes. Among these developments, there had been many projects and programmes conducted by various state and private sector organisations. However, unlike in many other countries, these programmes have focused only on certain sectors which completely left out agricultural sector and only touched on transport sector. In other words, previous programmes have dealt mostly with domestic, commercial and industrial sectors. Few agriculture sector projects carried out in Sri Lanka lacks the flavour of EEI, and in most cases deals with switching of pumping energy fuels or reduction of water pumping energy requirements. The following sections describe the projects and programmes conducted in Sri Lanka during the past few decades, in the chronological order.

- Efficient Cook Stoves (Anagi Stove) Programme of CEB
- Energy Auditor Training Programme of SLEMA
- Loss Reduction Efforts of Utilities
- Utility Driven CFL Promotion Programme
- Energy Labelling Programme
- Energy Efficiency Building Code
- Monitoring & Verification (M&V) Protocol
- Funding Development and Special Lending Programmes
- Sustainable Guarantee Facility of ECF
- Sector Specific Energy Conservation Programmes of SEA
- National Energy Conservation Programme

The constraints which prevented energy efficiency improvement projects from being implemented were identified and several specific measures were taken to solve those with and without technical assistance from donors. Out of these, few can be identified as best practices in Sri Lanka in the EEI & C area and are cited under a different chapter on best practices.

EFFICIENT COOK STOVES PROGRAMME (1986)

Initiated in 1986, this programme was a joint effort of the CEB and the Intermediate Technology Development Group [13] better known as the ITDG. Involvement of CEB in a fuel wood cook stove could be quite a coincidence, but the reasons for the affiliation could be absence of any other player with such deep penetration of the domestic energy user and also the interest of CEB to take out part of

load from cooking applications. This extensive island wide programme, a part of the bigger National Fuel Conservation Programme targeted low and middle income groups for an improved cook stove which had one hearth providing heat to two mouths, named *Anagi*. This was a single unit clay model, an improvement of the *Sarvodaya* Stove, a two pieced clay unit which targeted the rural sector. Tests carried out on the stove and numerous field-cooking tests have revealed a near 50% fuel wood saving over the traditional stoves.

The immediate success of the stove in urban sector paved the way to popularise the stove in rural areas as well, by institutions such as the Integrated Development Association (IDEA).



Figure 4: *Anagi* Stove, being made and installed with insulation

Rather than getting involved in all aspects of the programme, like the way CEB carried out the programme through the tile industry, IDEA identified the gaps in the market chain of efficient stoves and played a true enabler role. The efforts of IDEA allowed many traditional potters to get trained in manufacturing the improved stove, simultaneously elevating them from a cottage industry to a medium scale enterprise. This approach was criticised at that time by certain parties as a futile exercise, citing the poor skills of the traditional potters. They have advocated machine moulded stoves instead, done at a central location with heavy investment but lower unit cost of the end product. However, the approach taken by the IDEA proved to be a success, as *Anagi* has now reached complete commercial status with no state support. Further, the loss of interest of the programme owners (beyond planned time horizon) which usually signals the end of the programme failed to deter the well trained potters, who to this date are gainfully engaged in the trade.

Although the results of the programme was not fully evaluated in a post programme monitoring effort, the emergence of *Anagi* stove as the preferred stove speaks volumes of the success of the programme. It is estimated that 37.0% of households which use fuel wood for cooking now use *Anagi* stove and a further 16.6% uses some kind of an efficient stove [14]. Translated to fuel wood savings, this indicate a 38.3% saving of fuel wood used in Sri Lanka, counting all improved cook stoves in use.

Table 3: Programme Summary – Efficient Cook Stove Programme

Programme	Efficient Cook Stove Programme
Period	1986 to this day
Beneficiaries	More than 300,000 houses in introductory phase, presently estimated at 1.76 million houses
Other Impacts	Development of a sustainable pottery industry, lower indoor air pollution, reduced drudgery for womenfolk
Energy Savings	51 PJ
Lessons Learnt	<p>This programme demonstrated the value of market reach of an established player such as the CEB in driving a country wide programme. A similar programme carried out by any other player would have entailed numerous marketing costs, barriers and delays which could fatally affect the programme. Even though the programme objectives could have been completely outside of CEB's objectives, the extensive market reach, trust earned by CEB and image it had may have lead to the success.</p> <p>Another factor which may have contributed to the success is the strenuous efforts made to emulate traditional cooking practices of Sri Lanka, which make the switching decision that much easier. The necessity to keep a close focus on the end user needs is a good lesson for any future EEI&C programme.</p> <p>The programme also proves the fact that sustainable programmes are seldom 'created' but rather 'grown' from existing elements which can add value and also be nurtured in return as demonstrated by the wide decision to use traditional potters instead of a mechanised factory to produce the stoves. The long term sustainability of the programme is a most certain outcome of this organic approach.</p>

ENERGY AUDITOR TRAINING PROGRAMME (1984)

As briefly explained under chapter 5.0, Sri Lanka was fortunate to have an early entry to energy auditing thanks to the second oil crisis of 1980's. The Energy Auditor training programme, the first of which gave birth to SLEMA was carried forward at biennial intervals from 1984 to 2007. The programme has trained more than 300 energy sector professionals during the 10 programmes conducted thus far [3]. Basic structure of the programme allows the fundamentals of energy theory to be imparted even in non-Engineering trainees and conclude with an actual energy audit conducted in a complex installation. The course is designed to cover almost all theoretical and practical aspects of energy auditing and lasts for two intense weeks containing exhaustive near 24 hour engagement. Conducted as a residential course, the programme has now evolved to become a sought after programme as the cost of participation is usually kept at affordable levels through donor assistance. However, ways and means of complete self sustenance is being explored, in the context of dwindling donor funds.

The programme, through the frequent updates in course material also kept the faculty of the programme (usually the senior membership of SLEMA) continuously engaged in the programme and energy sector activities. This forum has kept a strong network of energy professionals alive, during a

considerable period of time, helping the continuity of the programme. The trainers, with the trained auditors conduct another visit to the host organisation in which the programme was carried out after a year of the event to witness any implemented projects. After this visit, no formal record of the projects initiated or implemented by the trained auditors is maintained by SLEMA. Hence impact assessment of the programme has not taken place.

Table 4: Programme Summary – Energy Auditor Training Programme

Programme	Energy Auditor Training Programme
Period	1984 to this day
Beneficiaries	Energy Efficiency Services Sector, Industrial and Commercial sectors and Energy Supply industry
Other Impacts	Development and continuous nurturing of an active core group of energy professionals
Energy Savings	Not estimated
Lessons Learnt	<p>Long term training programmes conducted at regular intervals manage to gradually change perceptions which are otherwise difficult to change. Such programmes are looked up on as good resources and become sought after events with time.</p> <p>A better outcome could have been realised, if Continuing Professional Development (CPD) activities and other alumni tracer activities were carried out, targeting the successful trainees of the programme. This would have been a far reaching consequence of a long term programme, which can directly impact the employers of the successful trainees.</p>

FUNDING DEVELOPMENT AND SPECIAL LENDING PROGRAMMES (1998)

Many previous studies have shown project finances as a key element of implementing EEI & C projects. Apart from the credit enhancement effort undertaken in the form of the Sustainable Guarantee Facility (SGF), there had been few financing programmes which targeted EEI projects among other environment protection measures. Of the few such programmes, E-Friends I and E-Friend II loan schemes supported by JBIC/JICA in 1998 and 2004 respectively deserves reference. Both these programmes offered credit for a very low interest 6.5-8.5% causing many industries to take part. The attractive interest rate thus mobilised the capacity of local ESCO industry and many projects were developed to implementation. However, the project operated in a narrow band of proven technologies and was not meant for introducing new technologies. However, the project saw wide replication of success across sectors (e.g. introduction of variable speed drives in tea withering fans) delivering substantial benefits. The projects saw more than 16 projects in energy saving, getting loan funds of LKR 136.884 million, mostly in the plantation sector [15].

In a more recent programme funded by the Royal Netherland Embassy in Sri Lanka which was executed by the Ceylon Chamber of Commerce, a grant was provided which amounted to 50% of the project cost under a ceiling of LKR 5 million. The project titled the Promotion of E coefficient Productivity (PEP) managed to launch 51 projects of which 36 or 70% were energy related projects [16].

Both these programmes managed to engage many institutions to implement EEI projects and the implementation success can be attributed to the concessionary financing terms offered by the project. Further, consultant's services too were inbuilt to the programme resulting in an active pool of consultants, which drove the projects to implementation.

Both schemes functioned on simple operating guidelines laid out well ahead of the commencement of the project. The project management units in both cases were lean organisations attached to a bigger, well functioning organisation.

Another significant fund source available to EEI&C projects come from the World Bank. Two projects – Energy Services Delivery (ESDP) and Renewable Energy for Rural Economic Development (REREDP) were implemented one after the other, ESDP from 1997 – 2002 and REREDP from 2002 to date. Unlike in the two previous projects, these projects had a primary focus on renewable energy, which resulted in healthy disbursement, mainly due to the strong support provided to meet project development costs. However, the technology available to EEI&C projects were left largely unutilised, probably due to the absence of project development support. Grant support which was available from ESDP to establish a refrigerator testing facility too was not utilised due to a problem in local commitment. So far, the two projects have funded only 3 projects in EEI&C area, with total loan disbursements of LKR12.889 million [17].

Table 5: Programme Summary – Funding Development and Special Lending Programmes

Programme	Funding Development & Special Lending Programmes
Period	1998 to this day
Beneficiaries	Industrial and Commercial sectors, Energy Efficiency Services Sector and Energy Supply sector
Other Impacts	Environmental benefits and Awareness creation in the financial sector
Energy Savings	Not estimated
Lessons Learnt	<p>If financing schemes are to be taken up by the industry, the funds must come in an attractive terms, remarkably better than the market rates. Simple operating guidelines, application processes, low risk and low project development costs felt by borrowers (due to technical assistance provided by the project) and availability of capable consulting and other intermediaries are essential prerequisites of a successful funding programme for EEI&C projects.</p> <p>Implementation success rates can be quite low, if the funding programmes fail to provide necessary risk mitigation measures to borrowers, such as provision of third party technical evaluations.</p>

MONITORING & VERIFICATION PROTOCOL (2003)

Identifying the absence of a proper system to account for savings resulting from an energy efficiency improvement project, a Monitoring & Verification (M&V) protocol for Sri Lanka was developed under the SARI/E initiative of the USAID. This protocol, modelled on the International Performance Monitoring & Verification Protocol (IPMVP), provided the basic legal foundation for an ESCO to develop and implement an energy efficiency improvement project under a predetermined set of rules. The M&V protocol paved the way for developing energy efficiency improvement projects on a commercial basis, using such models as shared savings model, where investments are mainly borne by the ESCO.

Basic elements of the M&V protocol which makes all parties to speak in monetary terms foundation of energy efficiency improvement project development and implementation are presented below.

Table 6: Elements of the M&V Protocol

Function	Coverage
Providing a legal basis for three types of contracts	Guaranteed Savings Model Shared Savings Model Vendor Financing Model
Mitigation of risks associated with projects	Financial risks Operational risks Performance risks
Containing Performance variability	Defining variables taken into consideration Agreeing on levels, set points, limits etc.
Managing project implementation	Placing responsibilities among parties Documenting all factors which affect project performance Deciding a baseline figures at the onset

The protocol is mainly meant for industrial and commercial end use sectors and can be used in the SAARC region without much difficulty. The protocol offers many measuring options, with varying degrees of sophistication, M&V cost and complexity to accommodate almost all types of EEI projects. The protocol also provides an important quality assurance service, as it contains the players to work within a well accepted norm in design and implementation. The protocol being a generic guideline allows the users to develop it with time, to suit the evolving complexity of a programme of energy efficiency improvement is considered a 'living' document rather than a prescription dictated by another party.

Considering these factors, it was taken up by the energy efficiency services industry with a lot of enthusiasm. A complex building energy project (commercial sector) first used it quite successfully, on a

shared savings model and provided a deep insight to the functioning of the protocol and room for improvement. However, the necessity of a third party to facilitate the impartial measurements and practices is still felt as necessary in the Sri Lankan energy efficiency services sector. This is mainly due to the complex nature of the energy efficiency improvement initiatives.

Table 7: Programme Summary – Monitoring & Verification Protocol

Programme	Monitoring & Verification Protocol
Period	2003 to this day
Beneficiaries	Energy Efficiency Services Sector, Industrial and Commercial sectors
Other Impacts	Establishment of a legal basis for implementation of EEI projects, awareness creation in the financial sector
Energy Savings	Not estimated
Lessons Learnt	A better understanding of the complex systems and their unpredictable behaviour impacting EEI & C projects was possible due to the structured approach offered by the protocol. Another lesson learnt from the introduction of the protocol is the apparent dislike of stakeholders for complexity of the transactions which occur in an EEI & C contract. These complex transactions can be afforded only when the project size is considerable and also when the savings are substantial

SUSTAINABLE GUARANTEE FACILITY (2005)

This was an initiative taken by the Energy Conservation Fund, to address the issues in accessing project financing due to want of collateral. The Participating Financial Institutes (PFI), which are dominant commercial banks in Sri Lanka failed to respond to many project financing proposals put forward by ESCOs or energy consumers, as the projects were quite complex and were associated with many risks unknown to the banking community. The SGF was designed to provide repayment assurance to banks by a third party – namely the ECF who operated the facility. Under the scheme, when an ESCO develops an energy efficiency improvement project to a bankable level, or when a consumer receives a bankable proposal, either of them can seek a credit guarantee from the SGF. The PFI will assume 25% of the risk and the SGF the balance 75%. The SGF had an upper limit of LKR 10 million per project, but did not have a lower limit [18]. Absence of a lower limit, in spite of having to bear a sizable transaction cost was to ensure the engagement of as many ESCOs and consumers in the energy efficiency improvement projects in the early stage of the SGF development.

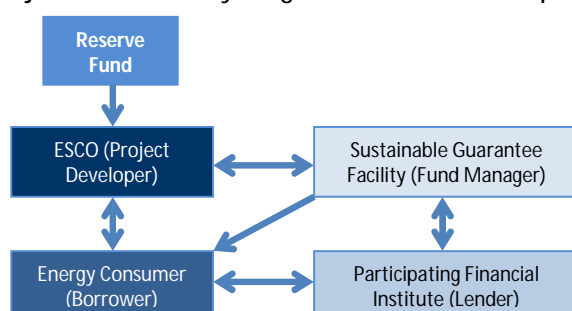


Figure 5: Operation of the Sustainable Guarantee Facility

In view of the security offered by the SGF, the banks were expected to lower lending rate by 1.5 to 2 % as the risk of non-payment and risk of non performance was taken up by the operators of the SGF. The project evaluation tasks and performance assurance was done by the operators and for these third party services, a premium of 0.5% on the credit amount was paid to the SGF operator.

Launched in December 2005 as a major credit enhancement initiative, the SGF managed to engage few ESCOs in the beginning but managed to offer a guarantee only to a single building energy project. The lower success rate of the SGF could be attributed to the following reasons:

- Availability of an attractive credit scheme from E-Friends II, a JICA assisted loan package which offered credit for energy efficiency improvement projects at 6.5% interest compared to rate offered through SGF which stood above 15% at the time.
- Stringent prequalification criteria in selecting borrowers – which required borrowers to be quite credit worthy, which left out most of the consumers which required credit and took in only the consumers which had other means of accessing credit
 - A favourable Letter of Reference from their bank.
 - A favourable Credit Report (CRIB)
 - A positive operating cash flow for the latest year.
 - A positive net income over the latest two years.
 - A debt-service-coverage-ratio of 1.25
 - A positive business plan for the next two years
- Shorter planning horizons of both ESCOs and consumers who for the most of the time were on 'annual budget' mind set – far shorter than the payback periods envisaged by the SGF
- Poor performance of ESCOs registered with the ECF at the time in convincing consumers.
- Complex nature of the transaction which kept the banking community disinterested.

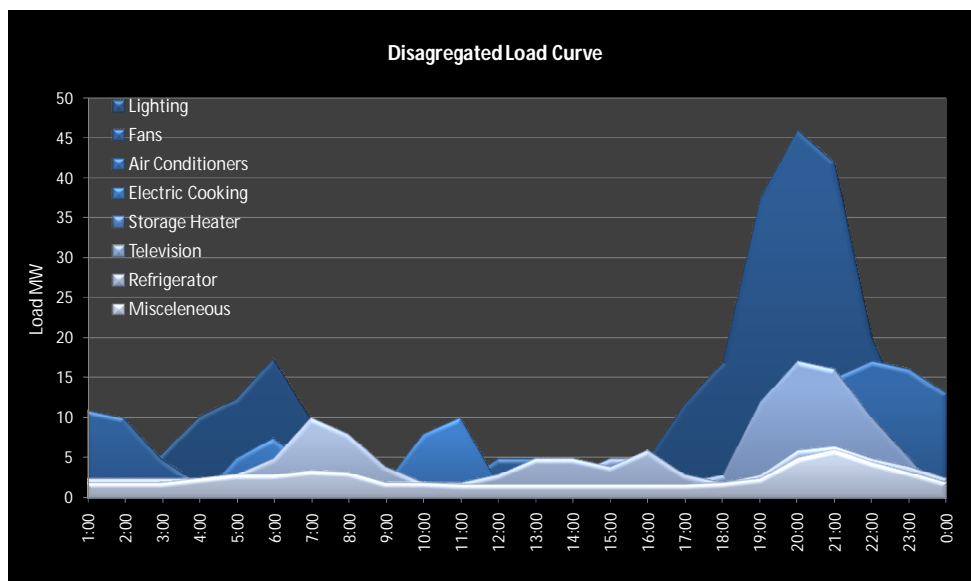
Even with the limited success, the only project which took the guarantee is performing quite well and is continuing to this day, to the satisfaction of all parties to the project [19]. This paved the way to realisation of value of credit enhancement mechanism in other energy projects and the government took the SGF to a higher plane by incorporating provisions for a guarantee facility named Sustainable Energy Guarantee Fund (SEGF) to guarantee energy efficiency improvement as well as renewable energy development projects under the clause 47 of the *Sri Lanka Sustainable Energy Authority act 35 of 2007*. The operation parameters of the SEGF is kept wide open, to be prescribed by the Minister in charge of the subject of energy, so that any future requirement can be met by way of regulations framed from time to time.

Table 8: Programme Summary – Sustainable Guarantee Facility

Programme	Sustainable Guarantee Fund
Period	2005 to this day
Beneficiaries	Financial Institutes, Energy Efficiency Services Sector, Industrial and Commercial sectors
Other Impacts	Taking EEI & C concepts across to the highest level decision making processes of the Government, awareness creation in the financial sector
Energy Savings	Demand Saving 1,620kVA, Fuel Saving 395,000 litres/yr., Total Monetary Value LKRM24/yr.
Lessons Learnt	Credit enhancement strategies work only when the financial markets properly function without distortions. A substantially lower lending rate offered by other mechanisms can render credit enhancement facilities unutilised. Cross sector mechanisms such as the SGF offers the opportunity to different sectors and stakeholders to work together and exchange views, which result in better understanding of the other stakeholders concerns. Such understanding is vital for delivery of EES.

ENERGY LABELLING PROGRAMME (2000)

Appliance market is showing steady growth in Sri Lanka, the impending energy crisis and the dire need for mechanisms to cope up with the increasing electricity demand has necessitated an energy efficiency improvement programme on end use energy efficiency. The Sri Lankan markets have been inundated with various energy-consuming appliances, mostly from low cost sources which invariably turn out to be inefficient. Whether these appliances are energy efficient or not is always a matter of debate as very little is known of their energy performance. This leaves the consumer in a dilemma and places the onus on the energy sector agencies in finding solutions. Therefore, realising the urgent need to curtail this disturbing trend, the DSM branch of the CEB, in association with Sri Lanka Standards Institution (SLSI) and the National Engineering Research and Development (NERD) Centre jointly introduced an energy labelling scheme for CFLs in 2000. CFLs were chosen as the first appliances of the labelling programme since they were in wide usage, and could have the key to resolve the significant evening peak resulting from the lighting load [20].



Source: Load Research Programme, Ceylon Electricity Board 2000

Graph 2: Disaggregated Load Curve – Colombo West

This scheme, launched as a voluntary scheme had no incentive other than a marketing proposition for vendors. To get vendors into the scheme, CEB made it compulsory for vendors to reach 3 star level if they are to be included in the loan scheme offered by CEB to its consumers. Many CFL vendors volunteered to adopt the standards initially, to gain from the increased market resulting from the loan scheme but their commitment gradually decreased after the withdrawal of the loan scheme by the CEB in 2004.



Figure 6: Energy Label in Voluntary Labelling Programme

With the enactment of SLSEA act 35 of 2007, the SLSEA took the labelling programme to the next logical level, which is the mandatory regime. This effort streamlined the energy labelling process rendering it highly beneficial to consumers as well as traders, thereby creating motivation for compliance. In this instance also, the first appliance selected was the CFL, mainly to counter the importation of poor quality lamps to the country. The agencies involved in the scheme remained as it was, in the form of a committee. In year 2008, the labelling standards were revised to incorporate other concerns and also to make it more accommodative and a new performance grading formula was agreed upon.

$$\text{Performance Grading} = \{(\text{Efficacy} \times 0.9) + (\text{Power Factor} \times 100 \times 0.1) + \text{Colour Correction Coefficient}\}$$

Table 9: Parameter Used in Energy Labelling of CFLs

Performance Grading	> 70	65 – 70	58 – 65	54 – 58	50 – 54
Number of stars	5	4	3	2	1

The number of stars designates the efficiency of the appliance, ranging from 1 to 5. The higher the number of stars, the more efficient an appliance is. The new label also displayed the following additional details:

- Actual power consumption (in Watts) of the appliance
- Likely monthly electricity consumption based on actual power consumption
- Model Number
- Brand

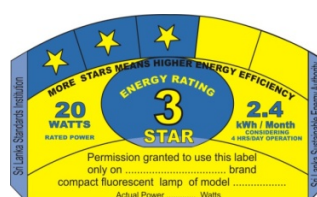


Figure 7: Energy Label in Mandatory Programme

The difference in power consumption in lamps with different number of stars was quite significant. For instance, the difference between lamp which fails to obtain star rating and 3-star CFL was 5 watts, while the difference between a non-qualified lamp and a 5-star lamp was estimated to be around 9 watts. Furthermore, the country could save over LKR 3,710 million per annum by replacing no star CFLs with three star CFLs.

Table 10: Programme Summary – Energy Labelling Programme

Programme	Energy Labelling Programme
Period	2000 to this day
Beneficiaries	Domestic and Commercial Electricity Consumers, Utilities, Vendors and Government
Other Impacts	Establishment of an extensive mechanism for product testing, quality assurance and control of import and manufacture of electrical appliances
Energy Savings	Premature to estimate
Lessons Learnt	<p>Voluntary labelling programmes may not be successful in a market where substandard products are tolerated. Hence a labelling programme without a minimum performance standard will be ineffective in quality assurance and gaining vendor acceptance and participation.</p> <p>In developing countries where import control and quality assurance schemes are less stringent, energy labelling programmes must be implemented on a mandatory basis. Cost of testing facilities could be very high and result in higher testing costs, and require measures such as regional test facilities. Otherwise the high testing costs may reduce the variety of products available in the market</p>

ENERGY EFFICIENCY BUILDING CODE – EEBC (2000)

This effort can be highlighted as the first comprehensive approach to reduce building energy in Sri Lanka. Funded by the World Bank, the project was managed by the DSM Branch of the CEB. Consultants to this effort were Lawrence Berkeley National Laboratory of the United States. The project was supported by all the lending building services consultants in Sri Lanka in the main areas of Lighting, Ventilation and Air Conditioning, building Envelope, Electric Power & Distribution and Service Water Heating. The purpose of the EEBC was to encourage energy efficient building designs and guide building retrofits towards high energy efficiency. This initiative covered commercial buildings of a particular size which had several minimum parameters.

- (i) Four Stories or Higher
- (ii) Floor Area more than 2,000m²
- (iii) Enclosed Volume 5,600m³ or more
- (iv) Peak Electricity Demand 125kVA or more
- (v) Air Conditioning Capacity 350kW output

The code exempted residential and industrial buildings and applied only to commercial buildings on a voluntary basis. The code was considered by the industry as a perspective guideline and failed to interest the dominant stakeholder group of architects. As a result, the building code was never practiced in Sri Lanka, and went into disuse with the winding up of DSM branch of CEB.

Code of practice for Energy Efficient Buildings in Sri Lanka – 2008 (CPEEB) is a later initiative of the SEA, undertaken to take the original EEBC to a much higher level. The new code of practice catered to a smaller buildings for floor area more than 500m² and also included industrial Buildings [22]. Framed with the intention of mandatory implementation, the new code extensively deals with implementation mechanisms such as the building permits granted by the Urban Development Authority. Urban Development Authority and its designated building approving authorities in the local government system are expected to ensure compliance of buildings through the existing certificate of conformity which cover only the building regulations at present. The code also will cover common residential facilities, hotels and other similar buildings in the near future it is hoped.

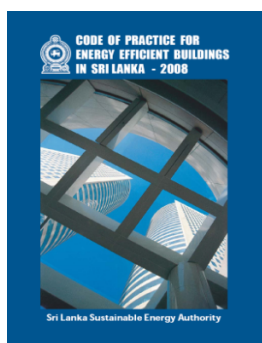


Figure 8: Code of Practice for Energy Efficient Buildings 2008

Table 11: Programme Summary - Energy Efficiency Building Code

Programme	Energy Efficiency Building Code
Period	2000 to this day
Beneficiaries	Building Operators, Building Services Sector
Other Impacts	Energy Savings to Utilities, Improved Standardisation
Energy Savings	Estimated to be 25-40% range
Lessons Learnt	<p>The initial attempt and its failure to implement a voluntary regime draw the attention to the importance of understanding the different expectations of stakeholders. Architects, the dominant group in new building design treated the code as a limiting factor in creativity. It should have been projected as a driver of sustainability than a constraint of creativity.</p> <p>Another valuable lesson to be learnt is the apparent futility of introducing voluntary schemes in cash strapped building construction sector, where no immediate value can be realised from compliance to the code. It is important to implement a mandatory scheme and also incorporate other benefits such as improved sustainability image of building for long term success.</p>

LOSS REDUCTION EFFORTS OF UTILITIES (1985)

An organised loss reduction programme was launched under a World Bank assistance in 1985 by setting up a Loss Reduction Cell within the CEB. Before this interventions, loss reduction programmes were carried out under various rural electrification projects, lead by the present region 1. Parallel to activities undertaken to takeover distribution systems operated by local authorities by both CEB and LECO, coordinated programmes were carried out by both utilities to bring losses down. Distribution substations which had loss levels reaching beyond 30% were tackled first, and the losses were brought down to a 20% level.

A complete overhaul of distribution area which came under LECO areas saw most of the areas achieving a single digit loss level. Similar efforts are still being carried out by CEB in the Colombo city distribution system and Kandy city distribution systems already achieving 7% loss levels and single digit loss levels respectively [23].

LECO Programme The starting point and the most important aspect of the loss reduction programme had been the well planned metering programme, where substation level bulk energy out flows were reconciled with energy sales coming within the relevant distribution areas. This measurement programme carried out under a well laid out methodology allowed no room for lapses and no room for deviations. This practice was further improved by assigning a single revenue officer to a distribution area, after making him responsible for both energy and revenue. The programme first focused on high loss substations and once all substations achieved near 10% loss levels, attention was focused on the next level of loss reductions [24]. Upon realising elimination of most of the metering issues, the utility took measures to reduce the overall length of low voltage distribution lines by promoting the concept of pole mounted substations. This measure was coupled with the introduction

of aerial bundled conductors for low voltage lines, further reducing losses and theft through illegal tapping.

CEB Colombo City Programme With a higher consumer density and a higher energy sales volume, the Colombo city operations of the CEB focussed its attention to loss reduction from very early days. Having renamed the Loss Reduction Unit as the Energy Management Unit in early 2000s, a renewed effort was made to curtail the loss level from 12.6% to 7.3% by year 2008. The achievement of this programme is given below in the form of a graph and a table [25].

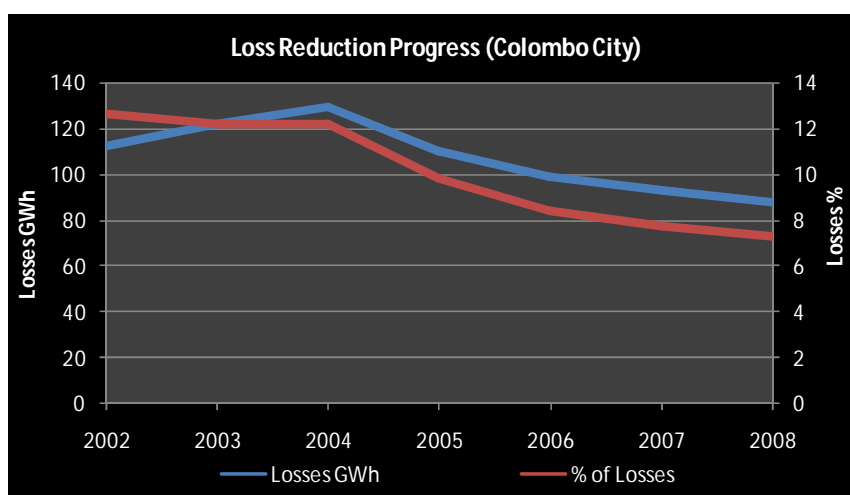
Table 12: Progress of Loss Reduction Programme

Year	2002	2003	2004	2005	2006	2007	2008
Energy Input GWh	892	999	1,057	1,125	1,174	1,213	1,200
Energy Sold GWh	780	877	928	1,015	1,075	1,119	1,112
Losses GWh	112	122	129	110	99	93	88
% of Losses	12.6	12.2	12.2	9.8	8.4	7.7	7.3
Energy Savings GWh				31.0	50.4	61.5	66.0
Monetary Savings LKR Million				301	554	781	1,201
Average Price LKR / kWh				9.7	11.0	12.7	18.2

Source: Ceylon Electricity Board

Main thrusts of the loss reduction programmes undertaken by CEB included power factor improvement through feeder pillar mounted capacitors, elimination of faulty meters, rationalisation of consumer accounts and reduction of low voltage line lengths. An important element of rationalisation of consumer accounts is the revenue gain achieved by reconnecting consumers which operated several meters for same premises to a single meter. Attempts are underway to balance the loads taken by the three phases, in anticipation of lower neutral current. However, this task has proved to be a difficult one, as the loads are almost impossible to move from phase to phase.

With the enhancement of Sri Lanka Electricity Act No. 20 of 2009, the regions within the CEB are poised to make breakthrough in loss reduction, as the energy metering at boundaries is going to be practiced in a wider scale than ever before, making officers responsible for energy consumption and sales revenue.



Source: Ceylon Electricity Board

Graph 3: Progress of Loss Reduction Programme

Table 13: Programme Summary – Loss Reduction Efforts of Utilities

Programme	Loss Reduction Efforts of Utilities
Period	1985 to this day
Beneficiaries	Utilities, Electricity Consumers
Other Impacts	Reduced generation costs, savings at national level and improved service levels.
Lessons Learnt	<p>There programmes shows the importance of a good measurement scheme being inbuilt to an EEI & C Programme. Knowing the present level of achievement and aiming at a very visible target provide a healthy implementation culture. Keen measurements also invite attention to detail in the places it is most needed.</p> <p>The programme also highlighted the importance of a methodical approach to any problem; where the available resources can be aligned to only a part of the problem, identifying the part which can deliver the best results when resolved.</p>

7.0 BEST PRACTICES IN ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION

Apart from the many programmes described in the previous chapter, there are three programmes undertaken by various agencies over the years, which can be cited as best practices. This chapter presents these programmes which were carried out at different times, delivering considerable EEI & C benefits to the country.

UTILITY DRIVEN CFL PROMOTION PROGRAMME (1996)

The CEB with intrinsic understanding of the load pattern considered lighting, an important area in a DSM programme. The first trial involved 600 lamps which gave excellent results. This encouraged CEB to initiate a programme to bulk purchase 100,000 lamps as a pilot project. This in turn gave confidence to embark on a large scale CFL programme and gave birth to the CFL loan scheme.

The CFL loan scheme was designed to increase the penetration of efficient lighting among the domestic consumer sector. At the height of the programme, 12 vendors were registered with CEB vending more than 1,400,000 lamps per annum collectively. In this scheme, the utilities (both CEB and LECO) paid upfront money to vendors upon receipt of evidence of purchase. However, the lamps were released immediately to consumers and the dues were recovered in 12 instalments without interest. Further, the VAT payable by vendors was absorbed by the utility, bringing down the cost of CFLs to affordable levels [20].

The participating vendors had to enter the labelling scheme and display the comparative energy label prominently in the cartons. Due to this, the voluntary energy labelling scheme assumed a partially mandatory status, resulting in satisfactory vendor participation. Increased publicity and market acceptance of the product saw a dramatic rise in sales volume, which got a 'free ride' on the bulk purchased CFL programme. The results, both direct and indirect are summarised below, as at end 2000.

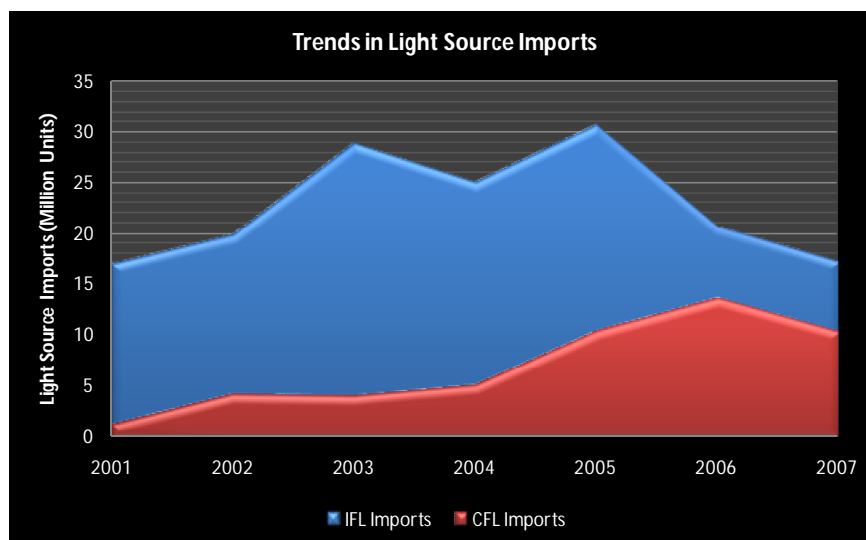
Table 14: Benefits of the CFL Promotion Programme

Number of Lamps Purchased	261,000 Nos.
Number of lamps sold due to increased publicity	1,235,000 Nos.
Demand saving	74MW
Energy saving	110GWh / annum
Reduced generation costs	650 LKR million / annum
Electricity bill reductions	456 LKR million / annum
Programme cost	18 LKR million / annum
Net benefit to utility	176 LKR million / annum

Source: Ceylon Electricity Board

The continued popularity of CFLs as a preferred light source can be attributed to the strict quality assurance practices adopted by the utility in the pilot scale of the project. Comparison with other countries where CFL programmes have failed to deliver results show the early product success is a vital

asset in ultimate customer acceptance. The growth in CFL imports and decline in incandescent lamp imports amidst healthy price signals in the years which followed the programme is a testimony to this fact.



Source: Sri Lanka Sustainable Energy Authority

Graph 4: Trends in Light Source Imports

Table 15: Programme Summary – CFL Promotion Programme

Programme	Utility Driven CFL Promotion Programme
Period	1995 to 2003
Beneficiaries	Domestic and Commercial Electricity Consumers, Utilities, Vendors and Government
Other Impacts	Establishment of an extensive market chain for promotion of CFLs, changing of consumer risk perception on new technologies
Energy Savings	110 GWh / annum
Lessons Learnt	<p>The programme proved the value of initial product success for sustainable market development of a product. Once market acceptance is gained, the product can be allowed to expand, with minimum interventions.</p> <p>The success of the programme proved beyond doubt that DSM is the least cost strategy in bridging demand/supply gaps. The benefits of DSM for a utility serving a steadily growing market were found to be very high.</p> <p>Participation of a utility with direct access to consumers and the hassle free repayment option offered to customers can be utilised for promotion of other efficient appliances to domestic consumers. The model, with slight modifications can be used to serve other market segments as well.</p>

NATIONAL ENERGY CONSERVATION PROGRAMME (2006)

Foreseeing a major crisis with the escalating oil prices and a possible power shedding scenario due to the widening demand / supply gap, a committee on “Energy Conservation” was appointed by Hon. Minister of Power & Energy in the middle of year 2006. Several programmes were implemented by the Committee after recognising energy conservation is an important national priority. With the launch of National Energy Conservation Campaign by His Excellency the President Mahinda Rajapaksha, on 14th July 2006, the National Energy Conservation Programme attained a significant milestone of being the first ever EEI&C effort lead by the Head of State.



Figure 9: Campaign Logo of National Energy Conservation Programme

Many aspects of electricity conservation were taken into consideration in this programme and the details of the programme are as follows.

- Circular from the President's Office to all state sector organizations with the aim of reducing energy demand by 20%
- Appointment of Energy Managers to expedite the energy conservation programmes in state sector
- Arrival at a consensus on reducing street light burden by convening meeting of Heads of Local Authorities

- Engagement of the public in a dialogue on energy conservation using an information feedback on electricity demand, etc. through television media
- Coordinated awareness campaign using public and private, print/radio media on energy conservation targeting the general public
- A direct mailer urging domestic sector consumers to conserve energy and dispatched through meter- readers



Figure 10: Direct Mailer sent to Domestic Consumers

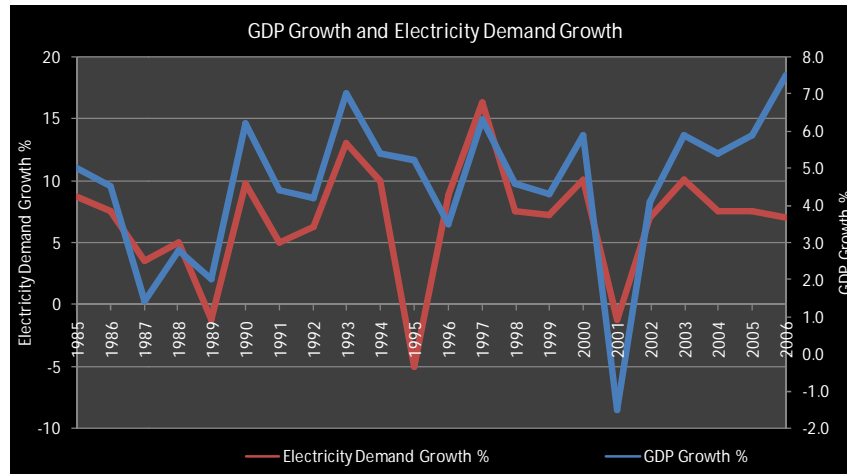
- Imposition of a restriction on poor quality CFLs being imported to the country
- Erection of a permanent display on curtailment of street lamps to all Local Authorities



Figure 11: Permanent Display to Discourage New Street Lamps

Through this programme, a clear decoupling of the GDP growth and electricity demand growth was achieved. Energy consumption growth rate in 2006 has shown a reduction of 5% from 2005 in an economic context of increasing the GDP. The trend of reduction in energy consumption when the GDP is growing had been noticed since 2004 and it became quite apparent in 2006. This is the first time in

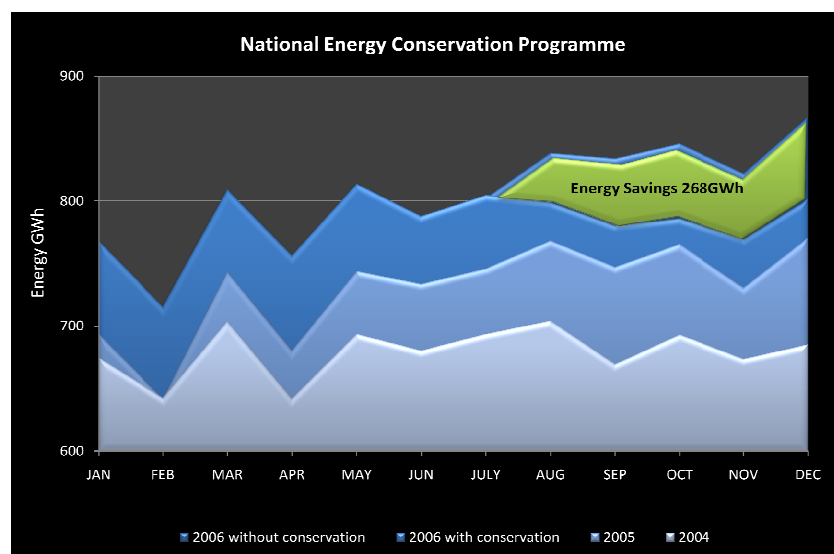
recent past where such a decoupling occurred. Although many other factors may have contributed to this, effect of the programme cannot be discounted.



Source: Sri Lanka Sustainable Energy Authority

Graph 5: Variation of percentage GDP growth and electricity consumption

According to the forecast data the total electricity generation of year 2005 would have been 9,663 GWh, but in actual situation it was only 9,395 GWh and the difference is 268 GWh.

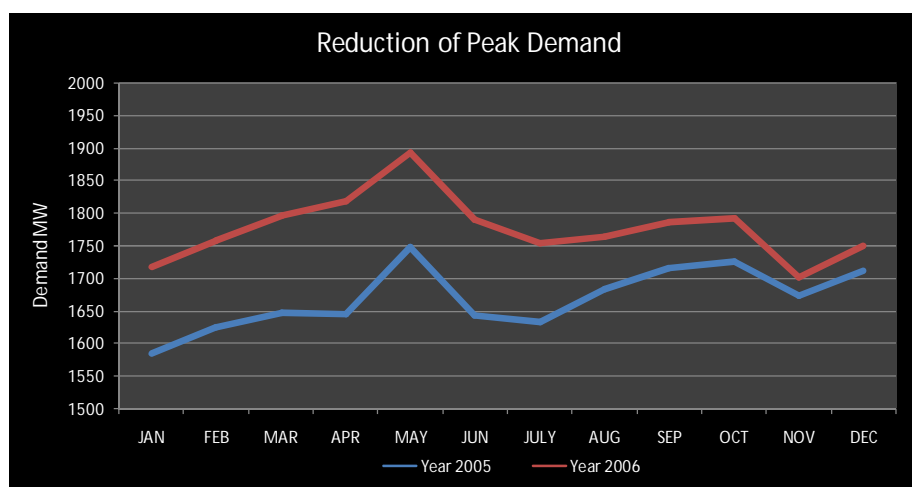


Source: Sri Lanka Sustainable Energy Authority

Graph 6: Variation of monthly electricity consumption

The red colour graph of the above picture indicates the forecast electricity generation and the green line indicates the actual situation. The area between green and red lines represents the savings.

There is a reduction in monthly peak demand from January to December in year 2006 while it was increasing in year 2005.



Source: Sri Lanka Sustainable Energy Authority

Graph 7: Variation of monthly electricity peak demand

There are no much unexpected situations recorded during 2006. So the above indicated savings are mainly due to conservation of energy, and the respective amount is 268 GWh.

Table 16: Programme Summary – National Energy Conservation Programme

Programme	National Energy Conservation Programme
Period	2006 to 2007
Beneficiaries	Domestic and Commercial Electricity Consumers, Utilities, Vendors and Government
Other Impacts	A mass consciousness on energy conservation and its benefits was created, resulting in considerable increase in peak demand saving CFLs
Energy Savings	268 GWh
Lessons Learnt	<p>The programme demonstrated the value of political leadership from the highest levels of authority in implementing EEI&C programmes. The difference between energy sector personnel making and appeal and the Head of State making the same appeal was found to be profound.</p> <p>The advertising campaign which was conducted on a very low budget managed to have a considerable impact due to the state endorsement of the campaign. This allowed the campaign to be more visible, among the general advertisements. This additional mileage allowed the advertising effort to be enlarged to a great extent.</p>

SECTOR SPECIFIC PROGRAMMES (2006)

Widespread industries, where similar manufacturing operations are undertaken by various operators in similar circumstances can be treated as a sub sector of the industrial sector. The operators within the sub sector experience similar issues and problems and this factor is true to energy use as well. Due to these similarities, EEI&C programmes can be tailored to suit particular needs of the sub sector, with greater benefits than a generic programme which can cater to any industry. Tea industry, Hotels and Apparel industry are some of the leading sub sectors which have higher energy intensities and wider spread across Sri Lanka which qualified for this approach. The programme is further strengthened when several factories in an industry is operated by the same company. Due to the formation of regional plantation companies, hotel chains and apparel manufacturing groups many possibilities surfaced for a sectoral approach to EEI&C programmes.

The first target sector was the tea industry, and targeted the in-house staff for training on improved energy utilisation, with the aim of capacity building within the tea manufacturing sector. The programme successfully trained 330 factory officers (the person in-charge of tea manufacturing facility) during a one week intense programme with hands on learning components. The programme was expanded to cover 14% of the tea sector which covered many estates owned by different management companies. The results of the programme show that certain trainees managed to bring down energy consumption by around 15% and the best performers managed to lower the specific energy consumption to 0.63kWh/kg of made tea – which is the baseline energy consumption level established for the industry. If the programme is extended to cover the whole tea sector, 30GWh of electricity can be saved in the 600 factories in operation. This translates to a 50MWh saving per factory during a year of operation.

The case of the hotel sector is no different, but the description refers to a particular hotel chain, which implemented the programme quite successfully. The group had nine hotels in operation and the programme targeted various stakeholders in the energy services provision in the hotels, ranging from mechanics to maintenance engineers. The programme also targeted the water sector, on a request made by the participants, although it was not directly related to energy use. The hotel chain managed to save 3.6GWh of electricity during a year, within the nine hotels which came under their management. Except for few capital investments in EEI&C, the programme mainly touched on no cost or low cost measures to produce this saving. In another case, the trainees of a particular hotel grouped to provide services to other hotels in the chain in the true spirit of capacity building.

Table 17: Programme Summary – Sector Specific Programmes

Programme	Sector Specific Programme
Period	2006 to this day
Beneficiaries	Tea Manufacturing Sector and Hotel Industry
Other Impacts	A new level of understanding on efficient use of energy among the industry was achieved, gaining the confidence of the decision makers to drive more EEI&C programmes. Capacity of the energy services sector multiplied for each sector
Energy Savings	As reported above
Lessons Learnt	This programme managed to change a whole industry in the way they perceived energy and inculcated knowledge on the best possible ways to use energy. This was possible due to the clear focus of the programme which was quite industry specific. Another lesson learnt from this programme is the dire need for sector specific knowledge on energy use (such as the factory's level of energy performance compared to industry average) and the need for energy service providers and trainers to gain a deeper understanding of a consumer sector before project formulation and course design respectively.

8.0 ENERGY CONSERVATION DIRECTORY

During the period spanning almost three decades, there had been many attempts to implement EEI&C efforts in Sri Lanka. Through this valuable experience, certain technologies have become the dominant technology in almost all sectors. However, a successful implementation in a particular industry has failed to impress other sectors (e.g. the great success enjoyed in the tea manufacturing industry with VSD technology has not gone very far in other industrial sectors) allowing large scale energy waste.

The technologies which can contribute to EE&C efforts in large measures were first compiled to a table by the Consultants JPower Inc. of Japan which was assigned to quantify the EEI&C potential in the country in early 2000's. The Consultants produced a report titled *JBIC Pilot Study on the Energy Efficiency Improvement Fund Project in Sri Lanka* [31] and the energy conservation directory presented below is an improved version of a table presented in that report. However, no attempt was made to quantify the saving potential of each technology, due to non-availability of accurate end use information.

Table 18: Energy Efficiency Improvement & Conservation Directory

Sector	Technology	Remarks
Domestic	Compact Fluorescent Lamps	National penetration levels have reached 50% mark. Initial cost remains a significant issue. Low voltage in certain remote areas has prevented wide scale penetration. A strong utility driven programme can further increase penetration
	Linear Fluorescent Lamps	Non-availability of warm white lamps and start up issues in urban and rural sectors respectively have prevented many households from adopting LFL as the primary light source. A trustworthy electronic ballasted unit could increase usage considerably.
	Refrigerators	Presently, the purchase cost and features play the major roles in buying decisions. Introduction of energy labelling will change this situation for better. The large variety of units available in the country has confused many buyers, affecting informed decision making.
	Air Conditioners	Not a widespread appliance. However, addition of a single unit pushes the domestic consumer to higher tariff bracket. Hence a good opportunity exists for promoting labelled products.
Commercial	Electronic Ballasts for LFL	Often viewed as a ready to fail device, due to poor quality units which were available in the market during the early periods. Also, the heavy frequency of lightning has contributed to failure of units. With adequate protection, the large scale users are now beginning to use these.
	Efficient Chillers	Many buildings operate air conditioning plants with unsuitable capacity. Most of the buildings use old and inefficient chillers. Building operators shun any change to

		better systems due to inability to disrupt the operation of the building and the high cost. A major fund line will change this situation
	Air Conditioners	Apart from central air conditioners, many buildings use split type units and package units to gain operational flexibility. However, energy efficiency is seldom considered a selection criterion. A good opportunity exists for energy labelling.
	Integrated BMS	Certain newer buildings use advanced building management systems (BMS) to control access and off-time lighting. However, ability of these systems to control air-conditioning systems via closed loop control is seldom used.
	Sun Control	The knowledge and skills in using sun control films and surfaces remain very low. Roof insulation and attic ventilation systems are installed with little or no scientific evaluation.
Public Space	Metal Halide Lamps	Certain work areas (such as ports) which operate throughout the night uses inefficient mercury lamps for long hours. Considerable opportunities exist to change these to metal halide lamps.
	Sodium Vapour Lamps	Street lamps used in Sri Lanka do not conform to any standard or norm. Light sources ranging from LFLs to mercury vapour lamps are used under variety of conditions. A national street lamp code is under preparation and will lead to group replacement of the available units with efficient units such as sodium vapour lamps.
	People Sensors	Most public place lighting needs cease after 2200hrs yet, the places are illuminated throughout the night. Simple infrared sensor controls for such situations can reduce energy demand significantly
	VSD Operated Conveyance	Travelators and escalators used in busy public areas also work on full duty levels, even under lower traffic conditions. People sensors coupled with VSD units could achieve significant savings
Pumping	Efficient Pumps	Large volume pumping needs in potable water networks and drainage networks uses considerable amount of energy. However, little attention is paid to energy efficiency in selection of pumps. A good opportunity is available in EEI&C in these areas.
	Efficient Motors	Even though large motors used in pumping systems are quite efficient, smaller units in the network do not conform to efficiency grading. A motor replacement programme could yield large savings.
	Network Improvement	Since most pumping networks evolve with time, no proper records are kept or evaluation of network anomalies is carried out as in the case of electricity networks. Hence the room for improving networks is considerable.
Utilities	Loss Reduction	The loss reduction programmes are carried out by utilities in project basis, and is yet to become an organisation wide drive. Such an initiative can reap valuable energy savings.
Government	Electronic Ballasts	A common programme to replace all magnetic ballasts with electronic ballasts can be readily implemented through a fresh procurement guideline.
	Air Conditioners	Similar to the electronic ballast, a fresh procurement

		guideline can ensure that all new procurements and replacements adhere to a minimum performance standard, offering a good opportunity for savings.
	Modified Building Management	Although state sector buildings can hardly afford a state of the art BMS, a simpler version such as timer driven lighting / fan controllers and programmable air-conditioner controllers could provide a solution for office energy management in many circumstances.
Hospitality	Room Appliance Controls	Ranging from simple key switches to advanced occupancy sensors, many technologies are available to control room appliances in hotel rooms. A need is felt to accelerate the slow rate of adaptation, especially in the medium and smaller hotels.
	Compact Fluorescent Lamps	Absence of a light source policy in many hotels results in ad-hoc replacement of CFLs even after a carefully planned group replacement. A stronger mechanism if required to increase and retain a higher penetration level of CFL in the sector.
	Efficient Chillers	Hotel operators too, shun any change to better systems due to inability to disrupt the operation of the building and the high cost. A major fund line will change this situation. A closer look at chiller sizing strategy is needed, especially to meet the cooling loads of function rooms.
Industries	VSD Controlled Motive Power	Although tea manufacturing industry has benefited immensely by adopting VSD systems in withering fans, many other industries still use large amount of variable motive power from fixed speed systems. A comprehensive analysis will yield many more opportunities for VSD systems.
	Efficient Motors	Most industrial concerns use aging motors for their motive power requirements. No load losses range from 10-40% in most situations. A motor replacement programme, targeting Eff.I and Eff.II class motors could yield large savings.
	Closed Loop Controls	There are many industrial systems which uses automated controls for production management purposes. However, simple closed loop systems such as pressure sensor operated compressed air systems are not aggressively used to curtail energy demand. These opportunities require identification and exploitation.
	Electronic Ballasts for LFL	This can be a component of an industry wide energy efficiency programme.
	Efficient Kilns	Older kilns used in rubber and ceramic industries date back to many decades, and are devices which were designed before the energy crisis. Hence, even the simpler heat recovery and insulation technologies are seldom used in such kilns. A comprehensive analysis would lead to many viable EEI&C projects.
	Insulation Improvement	Similar to kilns, boilers, steam systems and hot air systems offer good opportunities for EEI&C by way of insulation improvement. Leakage prevention and insulation improvement opportunities require to be identified using modern technologies such as thermal imaging.

9.0 AN ACTION PLAN ON REGIONAL COOPERATION

The preparation of this country paper, which will form a part of the regional report, could be cited as the first step in a regional action plan for cooperation. It is also an important step, as this exercise will establish the status quo of the EEI&C initiatives taken by the countries in the region. It is important to obtain the status quo of Energy Efficiency Improvement & Conservation in all countries of the region, irrespective of the level of achievement. Knowledge of certain countries leading in some EEI aspect and another lagging provide ideal opportunities for mutual cooperation. Based on this assumption, elements of the proposed action plan are presented below.

ASSESSMENT OF ENERGY EFFICIENCY IMPROVEMENT & CONSERVATION POTENTIAL

This potential for EEI & C can be assessed at several levels. The total technical potential, economically feasible potential and financially viable potential are some such levels. Since the study is taking a regional flavour, it is advisable to limit the study to the economically feasible potential. The study would involve electricity, petroleum and other sectors and all end use sectors. It is advisable to commence the study from the high end energy sources (such as electricity) and then proceed to other sources as appropriate. The study can be limited to the dominant energy user appliances and applications across the end use sectors. The study will have to consider a bench mark, or else an improved Energy Efficiency level, possibly a scheme such as the Japanese Top Runner Programme. This desired level of Energy Efficiency can be compared with the status quo and potential benefits in energy savings by incorporating such data as usage patterns of a particular appliance etc.. This exercise will yield a matrix of Energy Efficiency Improvement & Conservation potential as depicted below for such consumer sector.

Table 19: Matrix of EEI&C Potential

Technology	Base Case	Improvement	Saving	Incremental cost	Payback
Light Sources	IFL	CFL			
	Metal Halide	CFL			
			
	MR 16	LED			
Ballasts	High Loss Magnetic	Electronic			
...			
...			
Irrigation	Flooded	Drip Systems			

Once the matrices are compiled, a marginal cost based economic impact assessment can be conducted to identify priorities for implementation. Compilation of these matrices for all countries in the region will ensure the economies of scale benefits in implementation. Smaller countries such as Sri Lanka which has a small marketing would benefit is a regional programme can be launched, targeting the

total Energy Efficiency Improvement potential form a given technology. Output of this study will be the EEI potential and corresponding incremental cost in relating such EEI potential.

BARRIER IDENTIFICATION

If such an attractive potential is there to be exploited, why isn't the market move from present status to the improved state? would be the logical question. The reasons for inability to change the markets, systems and people are many. A comprehensive survey of available policy frameworks, legal instruments, Institutions and actors would provide the answer to this question. Individual countries may have already carried out such studies and may have also taken certain corrective measures. A better understanding of barriers and identification of possible barrier removal measures can be released if the analysis is carried out under the following classification of barriers.

- (i) Policy/Regulatory
- (ii) Economic / Financial
- (iii) Institutional / Relationships
- (iv) Technology / Knowhow
- (v) Awareness / Acceptance

Output from the individual country reports would be useful in mapping the institutional arrangements in each country and make voids and gaps more visible when compared and contrasted. It would be ideal to assess the capacity of Energy Efficiency Services sector in country, so that gaps can be identified easily. Similar comparison in other aspects also would identify country level barriers, issues and gaps as well as regional deficiencies. These deficiencies must relate to the target Energy Efficiency Improvement level, status quo and the capacity necessary to change the market from the status quo to target Energy Efficiency Improvement level within a pre planned period. A good example in this area is the study on appliance testing facilities in the region conducted under a SARI/E programme [27]. Output from this study will be the barriers and capacity availability deficiencies of the regional Energy Efficiency Services sector.

Table 20: Matrix of Energy Efficiency Enablers and Barriers

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
EEI & C Policy								
Institutes								
Finances								
ESCO Capacity								

IDENTIFICATION OF MEASURES

Energy Efficiency Improvement & Conservation is seldom enforced without the willingness of the end user. Hence a strong focus must be maintained on the end user at all time, especially so in the case of devising measures. Devising measures to overcome barriers identified in the previous phase will involve policy formulation, institutional development, financing schemes and many more diverse activities. Some measure may be prerequisite for all other measures. A classic example in this regard is the national energy policy. If there are countries without an energy policy, many things will remain unattended, as there is no compulsion or prohibition to either carry out or to refrain from carry out Energy EEl&C programmes.

Hence establishment of measures in an implementation sequence is important. After taking the preliminary measures such as formulating national policies on Energy Efficiency & Conservation, other measures which push and pull the markets towards a more energy efficient point could be taken. In this respect, market segmentation becomes a key aspect which requires close attention. For example, an efficient motor programmes is best carried out by an industrial service provider on a business to business level. A similar approach in the agriculture sector which involves thousands of farmers will be ineffective. In certain mass market situations there is a possibility of having very low returns which prevent profit seeking private sector from participation. Understanding these differences shed light to plot market chain to each consumer group.

Once such consumer groups are taken as market segments in an overall Energy Efficiency Improvement Programme, packages of measures can be aligned to implement a particular energy efficiency improvement strategy. For each such package of measures, different service providers, different financing mechanisms and different promotional strategies would be needed. To highlight this, two energy efficiency improvement strategies are graphically depicted below.

In the first case, depicted in Figure 10, the complete changeover of a fleet of induction motors which can be termed 'old inefficient' units are to be changed to class Eff.II motors, presently not commonly available. Various measures, ranging from regulations to promotion will be required to drive the complete fleet towards the efficient motor end, as shown.

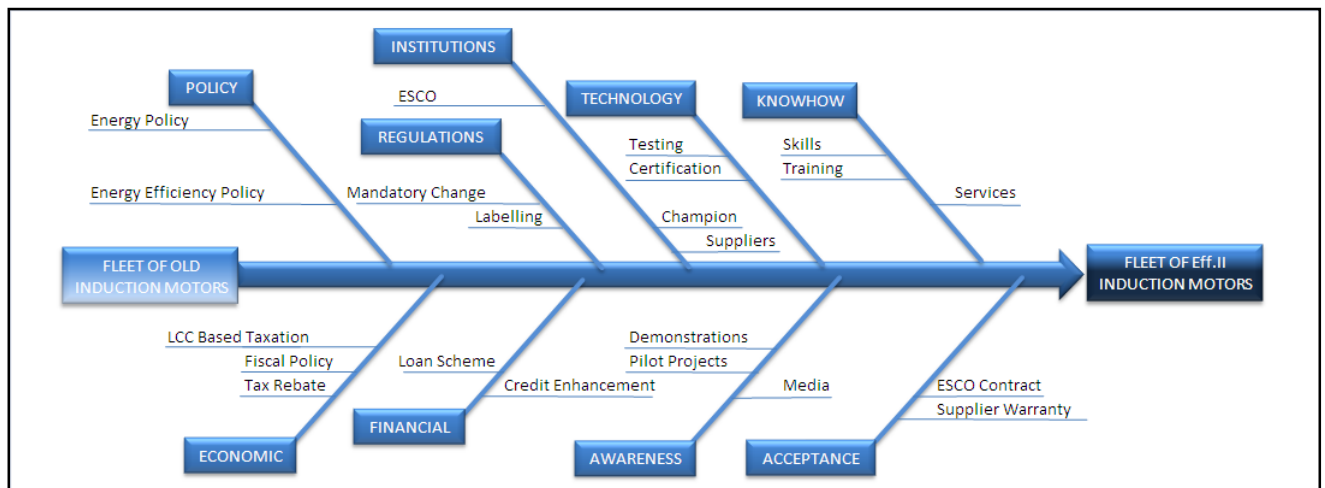


Figure 12: Elements of an Efficient Motor Programme

A completely different package of measures will be required for a market change programme to drive the low energy user groups who are on a subsidised tariff to change IFLs to CFLs as shown in the diagram. This may involve different players and different regulatory measures to have the desired impact.

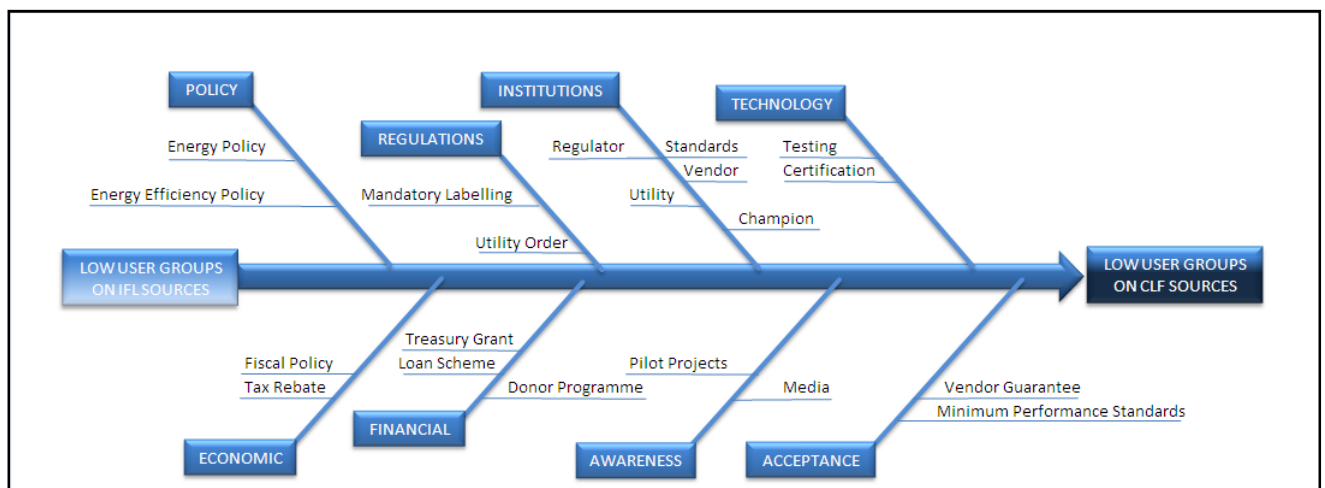


Figure 13: Elements of a CFL Programme for Low Energy User Groups

The mistake of taking one measure at a time has cost the Energy Efficiency Services sector dearly and the approach of packages of measures, which offer both market push and market pull, shall be thus derived for each end user group. Another advantage of this is the clear definitions of roles of all actors in the implementation strategy. Modelling of these packages of measures could be based on regional best practices shared through this study. Further there could be possibilities of design a package which can be implemented throughout the region.

10.0 R&D ACTIVITIES & PROGRAMMES

Energy research in Sri Lanka is not a centrally planned activity. However, there are many institutes which are involved in energy research. The areas of research undertaken span a wide area of topics ranging from bio-energy processes (such as anaerobic digestion) to macro economic analysis (such as impact of energy on economic development). The institutes which carry out energy research, along with the areas of interest are listed below.

Table 21: Energy Research & Development Programmes

Institute	Research Programme
Arthur C Clerk Centre for Modern Technologies	LED based low consumption street lamps, the basic area of research is ability of various types of LEDs to perform under varying conditions, such as lamp height.
National Building Research Organisation	Not reported
National Engineering Research & Development Centre	Efficient stoves for households, improved fuel wood stoves for institutional cooking, biogas generation systems. The type of research is mainly product development. Prototype testing in aspects ranging from user friendliness to product life takes major share of research input.
University of Moratuwa	Evaporative cooling to replace air-conditioning, electric vehicles Lighting controls, timer devices for household appliances. Research activities are more focussed on technology development and product development, with special emphasis on developing newer features for already developed products.
University of Peradeniya	Many research programmes on renewable energy, research on energy efficiency not reported
University of Ruhuna	Not reported
The Open University of Sri Lanka	Not reported
Sri Lanka Energy Managers Association	Many research on policy, R&D activities not reported
Sri Lanka Sustainable Energy Authority	Daylight harnessing devices, transport energy diversification, biogas generation systems, Wind energy conversion systems. The focus on these projects lies mainly in the technology development area, with a special focus on commercialisation of prospective technologies.
Regional Centre for Lighting (South Asia)	Street lamps, LED based lighting for rural off-grid solar home systems, load research. Most of the projects carried out here are meant to drive national level policy changes which will allow technological upgrading in lighting energy services.

From the above, it is clear that there are not many research carried out in the area of energy efficiency improvement and conservation. Apart from the above mentioned agencies, many private sector companies are also involved in certain activities which could yield technologies which can contribute to reduce the energy use.

Considering the importance of carrying out energy research and also the importance of pooling of resources, an R&D network was conceptualised by the Sri Lanka Sustainable Energy Authority. As a first step of this, a single window information clearing house was established using the website of this Authority and is now available through the link <http://www.energy.gov.lk/research/research.php>. It is expected that closer interaction between the research institutes would help to continue important research until a commercially viable solutions are found, avoiding costly duplication of effort.

11.0 POSSIBILITIES OF REGIONAL COOPERATION

By way of an extension of this study, the countries in the region can develop their own Energy Efficiency Improvement strategy as explained in the three sub topics above. The main elements of a cooperation programme are described below.

Sharing Experience If certain countries lack the knowhow in developing the Energy Efficiency Improvement strategy, the leading countries are in a position to assist such countries. To do this, areas dominated by each leading country shall be considered. Replication of the best practices after making necessary changes to suit a particular country would be quite useful.

Capacity Development When the results of the barrier analysis are shared, many possibilities for regional cooperation will emerge. For example, the best practices in energy auditing in or the sector specific programmes in Sri Lanka can be imparted in countries where lack of capacity in energy efficiency services industry had been identified as a barrier. Similarly, the Indian success with energy efficient building must be replicated across the region. In this respect, regional workshops, intensive training programmes and peer exchanges should be undertaken. In this regard, accreditation effort of Sri Lanka, where energy auditors, managers and service providers are targeted offer a good opportunity for countries which lack Energy Efficiency Services capacity. The accreditation can be elevated to a regional level and the accredited professionals and service providers should be allowed to practice within the region without national restrictions. Through this, hands on experience can be provided to professionals in countries where Energy Efficiency Services sector is not yet functioning well. Replication of Energy Auditor Training Programme of SLEMA in such countries could be the ideal starting point.

Market Development The EEI&C potential matrices of individual countries, when aligned on technology lines will identify the regional market for a particular technology. For example, the market potential in a country for CFLs could be 20 million lamps per annum. When the total regional requirement is taken, it could be even 10 times as large. If the operating conditions are found to be suitable for a homogenised product, a massive regional market could open up for manufacturers to exploit. Unfortunately at present, individual countries are taking different approaches in CFL programmes, making the technology expensive at the end user level.

Product homogenisation, as practiced by multinationals in FMCG markets offer many opportunities and the way forward in this regard is the energy labelling programme, which can be harmonised to have a regional labelling programme along with the national programmes. In this respect, the Sri Lankan experience could be very useful, as it is one of the most mature programmes in the region, which entered the mandatory regime last month [28].

Previous attempts on harmonization of energy labels under the SARI/E programme of the USAID [29] provide sound opportunities for a harmonization programme. Every effort shall be made to unify product test procedures (or at least the parameters which are measured in national labelling programmes) so that cross border trade within the region can be enhanced by translating national energy labels to imported country. This could be the starting point of a harmonised labelling programme.

In this regard, a simple appliance such as the magnetic ballasts could be targeted first, so the regional harmonization programme can at least be initiated. Better relationships among countries and better understating of national programmes through such initiatives could be used to launch programmes for more complicated appliances such as refrigerators.

Catalysis to these programmes can be provided by establishing focal points in each country to take care of a particular energy service or a group of appliances. A good example in this regard is the recently established Regional Centre for Lighting (RCL) in Sri Lanka. A string of such centres could very well propel the appliance labelling programmes to a new level. A pivotal role for SAARC Energy Centre in promoting such efforts is also indentified. The review of Appliance Testing Capabilities in South Asia [27] carried out under the SARI/E programmes provide a solid basis for a future programme in this area.

Fund Development It is a well understood fact that assessment and exploitation of EEI&C potential requires substantial finances, for all purposes from initial costs of professional services in assessing EEI&C potential and final costs incurred as incremental cost of efficient equipment and M&V costs. The South Asian region, being a developing region offers a vast potential for EEI&C programmes and these could be bundled to realise substantial energy savings and also substantial reduction of green house gas emissions. Given the potential for carbon finances ranging from simple project CDM to programmatic CDM and favourable conditions for clean energy security initiatives in the global development finance sector, a concerted regional effort is required to develop a funding proposal for a regional EEI&C programme. This could be initiated by conducting a thorough assessment of the regional potential for EEI&C through a technical assistance programme. Another significant avenue for fund development is credit enhancement and matching funds from within and outside the region. Credit guarantees and green funds available at concessionary interest rates must be tapped by providing room for such inputs in the main funding proposal. However, the effects of the global economic downturn may affect the immediate implementation of a major fund development programme. Hence, the possibility of raising finances within the region too should not be overlooked.

The keen interest shown by developed countries such as Japan and regional blocks such as the European Union in Certified Emission Reductions (CERs) would allow the formulation of a regional programme very early. Perhaps, the larger size of the funding required for a region wide programme

would make it possible even to have a consortium of lenders to provide the funding. In this regard, the region is well positioned to take a shorter route to energy efficiency than the route followed by the developed countries which had to take the retrofitting approach, since the main infrastructural elements of the respective economies were laid out during a period in which energy efficiency was not a prime concern. The regional EEI&C programme can skip many phases of the evolution and attain economic development powered by a far less amount of energy than the developed world may have used.

12.0 IMPLEMENTATION STRATEGY AND METHODOLOGY

The elements of the action plan described in the previous chapter now required to be arranged in a logical sequence to identify strategies and mechanisms required for implementation. For ease of reference the basic ten elements of the action plan is presented below.

1. Initiate a regional EEI&C programme by presenting the outcome of this study at a high level regional forum.
2. Establish link agencies at national level in each country, who will work with SEC functioning as the nodal agency in the programme and appoint a task force on EEI&C.
3. With the assistance of the national agencies, develop a proposal for a regional study programme on EEI&C, after a careful analysis of available knowledge.
4. Carry out an EEI&C potential and a capability assessment and a barrier analysis in all countries, preferably through a donor programme.
5. Analyse and identify market segments which provide tangible EEI&C benefit, especially the market segments which provide room for regional implementation.
6. Identify barriers to EEI&C efforts in each country and also the possibility of regional intervention to barrier removal and possibilities for intra region assistance to remove barriers specific to a particular country.
7. Conduct a marginal cost analysis on interventions identified as having the highest impact and identify implementation priorities.
8. Identify measures required to realise the prioritised EEI&C benefits in each country as well as in the region in case of regionally identifiable market segments, and design packages of such measures for each priority programme.
9. By convening a meeting of relevant high level officers in the region and the task force, arrive at an implementation time frame targets for EEI&C and a monitoring and evaluation plan and declare same as the Regional Cooperation on EEI&C Programme goals.
10. Develop a funding proposal for the programme for donor funding or other means of funding, including the avenues for topping green finances and carbon finances. This proposal shall incorporate all EEI&C programmes already underway in countries for additional support, so that duplication of effort and repetition can be avoided.

After the realisation of the above, the regional programme can be implemented across the region. Possibilities of supporting certain specific programmes are highlighted below, in the graphical presentation of the methodology.

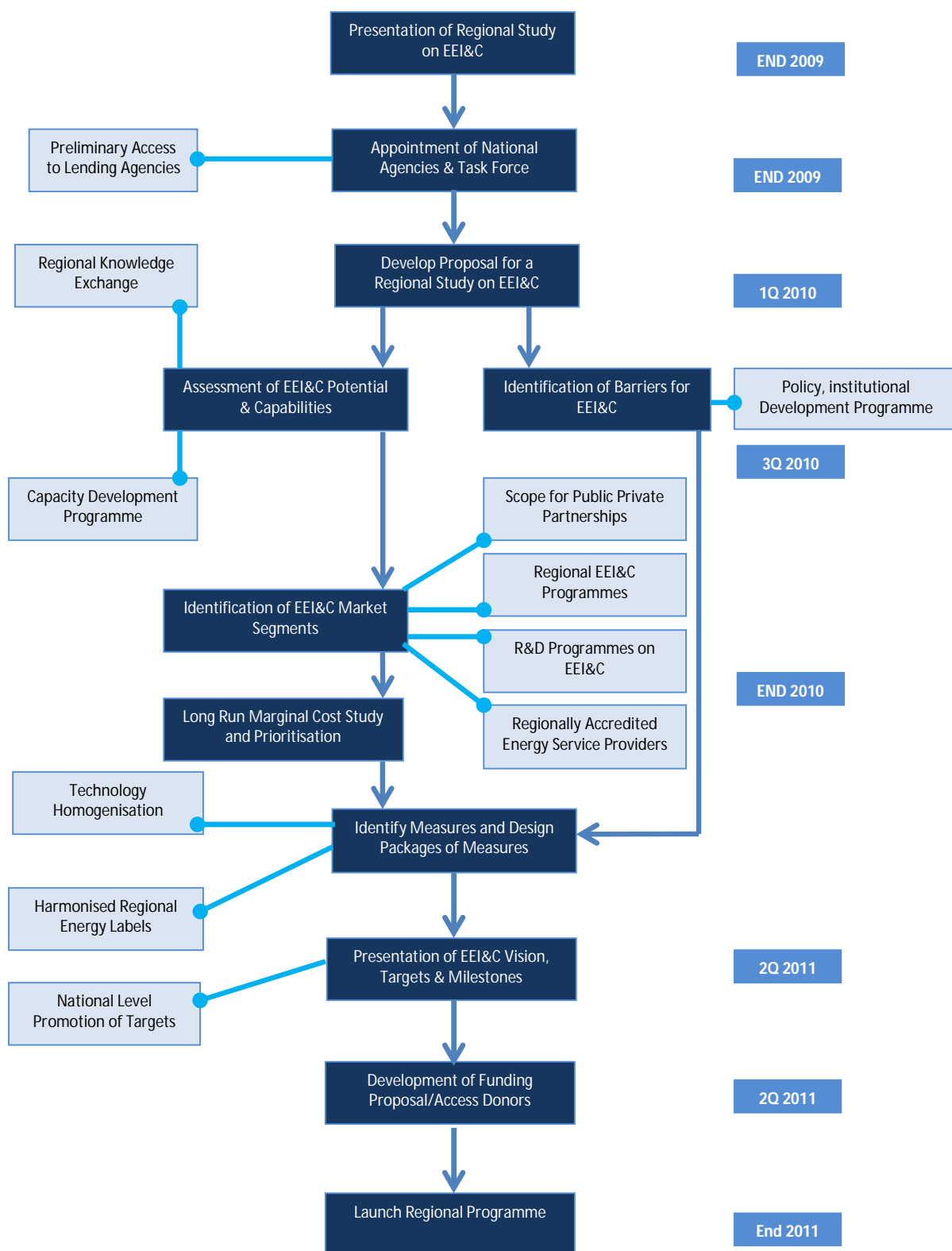


Figure 14: Proposed Implementation Sequence and Outputs

The implementation of a regional EEI&C programme proposed above can be expedited if the steps presented above are carried out parallel to development of a funding programme by a lending agency. Early access of lenders will therefore prepare lending agencies for an early disbursement, in line with the proposed launch of the programme by end 2011. It is therefore, necessary to keep the lending agencies briefed about the grand vision of the study during the first contacts with them on supporting the regional study in early 2010.

Strategies and mechanisms for implementation of five important programmes on regional cooperation are presented below. The programmes range from technology transfer to harmonisation of energy labels and would require considerable resources to implement. Hence the approach proposed above, to realise a major regional programme is worth revisiting.

TECHNOLOGY TRANSFER & PROMOTION OF EEI&C

As in the case of Sri Lanka, it is quite likely that research and development programmes in EEI&C are carried out by many agencies throughout the region, probably in isolation. As a result, there could be many duplication of effort and even waste of resources. This phenomenon could be true for larger countries in the region, where even within such countries isolated research programmes are undertaken, defeating the purpose of wide scale dissemination of developed technologies. Though it can be argued that a centrally coordinated R&D programme is a very distant goal, the advent of modern information technology provides a fresh approach.

Hence, it is proposed to collect all possible information on energy R&D through a region wide effort using a user friendly web based data acquisition interface. This interface can be hosted in the SAARC Energy Centre web site, and could be used to trace all persons engaged in energy related activities in the region. Since this is going to be the starting point of a greater programme, the opportunity could be used to gather information on areas other than EEI&C such as renewable energy and energy planning.

It is ideal if the interface is designed to inventory capacities of individuals and organisations for possible use as a pool of resources in the coming years. The interface can also be used to collect already published research work and future research intents in need of funds. A proven way to obtain participation of all concerned is to offer research funds for EEI&C through a grant programme, accessed through a comprehensive application procedure, which will divulge past experience of agencies and individuals and research intentions.

The effort can be further strengthened by tapping into other networks such as the network maintained by the SARI/E network of the USAID.

Once information on all ongoing R&D activities in the region is acquired, the information could be processed to group them into clusters based on the area of research. If instances where promising technologies have been developed, immediate steps can be taken to share it within the particular

technology cluster first and further improve same through a combined effort of the members in the cluster. Once the technology is ready for the market, it can be promoted in a regional programme. The particular technology cluster can be used as the vehicle for all future technology transfer efforts.

There agencies such as the Regional Centre for Lighting which focus on a particular technology, and this provide an ideal nodal agency to form technological clusters as proposed above. Similar clusters could be formed in the event of discovering such common interests in the region.

Promotion of the technologies can be carried out through the same network, but this would require some form of a formal agreement between national bodies appointed to coordinate energy programmes.

REGIONAL COOPERATION IN DEVELOPING SPECIFIC PROGRAMMES

Developing specific regional programmes require the cooperation and support of all member countries. As discussed previously, some countries are far ahead of other countries in certain areas, providing opportunities for sharing experience and capacity building. However, the identification of agencies capable of providing resources and countries which can benefit from such efforts requires a central coordination. SAARC Energy Centre could very well play this important role and the effort can be kick-started with the information gathering exercise proposed above.

Even though it is difficult to identify priorities for regional programmes through a desk study, there are many areas which can benefit from regional programmes. Lighting, industrial motors, energy labelling of household appliances and energy manager accreditation could be identified as programmes which can deliver benefits to all member countries.

It is proposed to initiate a dialogue within the region to identify the requirements of the member countries along the lines given in the table 19 on matrix of energy efficiency enablers and barriers. The matrix will help to establish the level of achievement of each country in the areas of EEI&C and also the gaps. After identification of such gaps and barriers, the national policy framework of each member country can be used to identify national priorities for each country. Once such information is presented in a common forum, a platform for designing regional programmes could be realised.

It is proposed to organise a series of meetings of the nodal agency of each member country, preferably at quarterly intervals to develop the regional cooperation agenda in an expeditious manner. In the event that funding constraints prevent such frequent meetings from happening, it is proposed to meet through electronic means and to have only an annual meeting (preferably at the end of the third quarter of every year) to agree on a work plan for the upcoming year.

PROMOTION OF PUBLIC PRIVATE PARTNERSHIPS

As discussed earlier, market segmentation becomes a key aspect which requires close attention, especially in the case of certain low profit market segments. In certain mass market situations like the CFL promotion in a country where the domestic sector receives electricity at a subsidised rate, active participation of the private sector could not be expected. Understanding the ultimate beneficiary of a programme could shed light to identify the best possible marketing mechanism for such a market segment.

Public private partnerships come into play in certain difficult to serve markets as mentioned above. In most cases, the ultimate beneficiary is identified as the electricity utility and in some other situations, the Government (which provide for the losses incurred by the electricity utility) itself becomes the ultimate beneficiary of EEI&C programmes. This provide a solid foundation for public private partnerships, as the operational agility of the private sector, required to drive a coordinated national marketing campaign is seldom available with many state agencies.

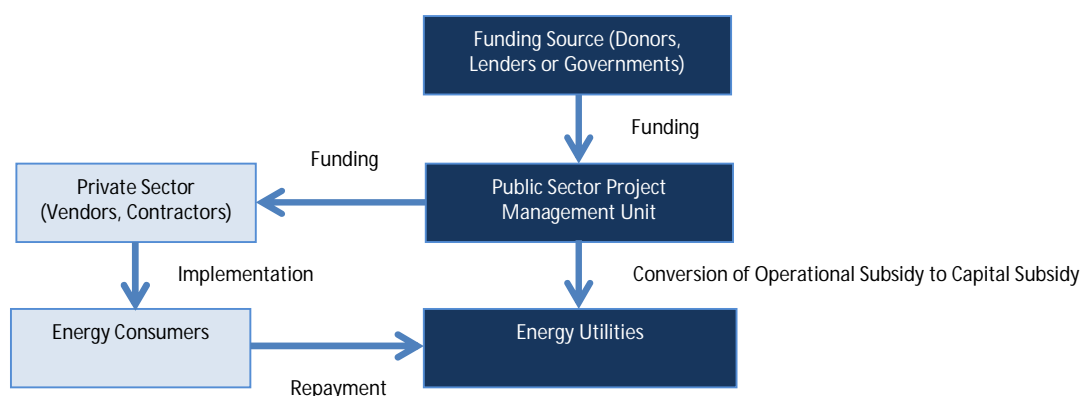


Figure 15: A Model for Public Private Partnerships

The justification for a public private partnership become even stronger, given the deeper access enjoyed by the utilities to energy consumers and their finances through monthly visits by revenue collectors and meter readers. This regular interaction between a marketer and a consumer is a luxury enjoyed by a very few marketing companies, which could be fully utilised only through a public private partnership. A good example in this regard could be found in the utility DSM programme carried out by the Ceylon Electricity Board as explained under Chapter 7.0 of this report.

SHARING EXPERIENCE AND CAPACITY BUILDING

As presented in the table 19, the regional study will provide many possibilities for regional cooperation. The best practices in energy auditing and the sector specific programmes in Sri Lanka can be promoted in countries where lack of capacity in energy efficiency services industry had been

identified as a barrier. The possible modes of knowledge sharing could range from regional workshops, intensive training programmes to peer exchanges. Any national level accreditation available in member countries can be elevated to a regional level and the accredited professionals and service providers should be allowed to practice within the region. Through this, much needed initial exposure can be provided to countries where Energy Efficiency Services are not readily delivered.

A fail safe method to gain from experience of each member country is to assign a certain aspect or an element of EEI&C to a particular country which can provide leadership in that area. The responsibility of driving the regional programme could be assigned to the leading country, securing a good balance of work load among the member countries. After distributing the elements of a regional EEI&C programme among the member countries, a common calendar of events can be derived to suit the requirements and capacities of each member country.

DEVELOPMENT & HARMONISATION OF STANDARDS & LABELS TO PROMOTE EEI&C

The starting point of a harmonised labelling programme could be the previous attempt on harmonization of energy labels under the SARI/E programme of the USAID. Efforts shall be made to unify at least the parameters which are measured in national labelling programmes, so that translation of national energy labels to a regional label becomes a possibility. An early dialogue on the test parameters leading to a better understating of national programmes could be vital for a regional labelling programme. It is proposed to start the regional labelling programme with simple appliances such as ballasts for linear fluorescent lamps and to develop the harmonisation programmed to cover complicated appliances such as refrigerators and air-conditioners.

Appliance testing laboratories, which forms the backbone of a labelling programme, provides the future direction for a regional labelling programme. Hence an early review of the publication on Appliance Testing Capabilities in South Asia, carried out under the SARI/E programmes is recommended.

13.0 RECOMMENDATIONS

The report dealt with many aspects of EEI&C and evaluated the challenges facing the region with a view to change the status quo to a more desirable state. The key challenges are posed by several aspects ranging from policy and regulatory aspects to financial aspects. The success of any attempt to change the status quo needs to be a comprehensive effort encompassing all such aspects at once, as many key interventions to change the status could fail due to the absence of minor, yet critical intervention in an often forgotten aspect. Hence the compilation of recommendations given below shall be taken in its entirety, not in isolation.

Scope and Limitations The programme must consider all energy services, including agricultural and transport sectors which are often left out from EEI&C programmes. It is strongly recommended to limit the programme to proven, well accepted technologies and solutions and provide a separate technology development platform for R&D on EEI&C technologies.

Existing Knowledge EEI&C efforts being in the mainstream for a long period has left many valuable knowledge elements in the region. Policy studies, surveys, research and case studies of best practices as well as bitter lessons are quite common in the region. SARI/E programme of the USAID has done a great deal of work especially in EEI&C area and has added to this knowledge base in no small measure. Similar programmes too may have contributed to EEI&C in the past and it is strongly recommended to accumulate such knowledge to a central entity and conduct an information clearing operation. Any new programme can begin from that point, reducing implementation time and repetition.

Learning from Success There are many successfully implemented EEI&C programmes in other parts of the world. Similar instances in the region are also common. Careful analysis of such programmes would be useful in formulating a new EEI&C programme. Special focus on international success stories such as the Top Runner programme of Japan is therefore recommended.

Choosing Champions The SEC is ideally positioned to drive a regional programme. However, each country in the SAARC region requires country programmes and more importantly a champion for the EEI&C cause. Early identification of an influential national level entity to drive the national programmes and to liaise with the regional programme is therefore necessary. Presentation of the findings of this study is proposed as a starting point for a regional programme and also as a good opportunity to appoint champions.

All national level agencies thus appointed as programme champions and the nodal agency – SEC require to be closely integrated as a Regional Task Force. The taskforce, whilst using all modern forms of communications to be in touch need regular interactions in member countries in rotation, as an

integrative measure and also to catalyse individual national programme. At least one meeting in a given country within a calendar year is recommended.

Understanding the Status Quo Given the urgency of the situation, some may argue that a programme can be designed without further studies which consume more time. However, after making a full use of the available knowledge an estimation of EEI&C potential, assessment of capabilities and understanding the circumstances, barriers and deficiencies in each country become essential prerequisites for a proper programme design. A region wide assessment is therefore recommended as a preparatory action. This action will highlight the opportunities for broad regional programmes as well as tailor made country specific projects.

Making Full Use of Available Capacity The study programme will identify the capabilities and deficiencies in each country. Every effort will have to be made to fully utilise the capacity within the region to address deficiencies thus identified. In this respect, idle capacity in member countries require to be mobilised and sufficient capacity in other countries in the region need to be developed. In the case of countries lagging far behind, initial support in developing EEI&C policies and providing basic knowledge in energy efficiency services to turn a core group of energy managers must receive top priority. Close association of energy management professionals will yield a common ground for and a better understanding of EEI&C programme implementation and these events must be nurtured to a regional accreditation process and a trade license to practice energy management in the region.

Taking EEI & C as a Marketing Challenge EEI&C efforts require a final decision of an end user to sway towards a more efficient technology, to deliver results. No amount of enforcement or no amount of persuasion alone will not influence that final decision. Hence like any other marketing problem, the buying decision requires not one but several pushes and pulls to work in unison. Hence identification of specific measures which drives the end user to make the better choice is vital.

Considering the large number of end use sectors and possible interventions, it is proposed to segment the EEI&C market by end use categories. This will allow a particular set of measures to be grouped and applied to a particular market segment. Hence a strong marketing approach in the proposed programme, where a chosen market is served by a package of measures is recommended. It is also recommended to use the market segmentation to identify regional programmes which can unfreeze large markets across borders and also to realise EEI&C benefits from low margin technologies which are unattractive for private sector through Public Private Partnerships.

Setting Priorities As stated earlier, the number of end use sectors and the large number of technologies available for improving efficiency pose a problem in implementation. Accordingly, the interventions which make the maximum impact with the least cost need to be implemented first.

Hence a detailed marginal cost analysis for each package of measures is proposed as a prerequisite for determining the implementation sequence.

Given the longer term and often unpredictable results of R&D efforts, it is recommended to treat these as a different group of interventions and to launch them through a different platform.

Market Development Since the region, when taken as a whole means a significant market for EEI&C technologies, the market segmentation must be seen in a regional perspective. Economics of scale and buying power of large markets could be effectively used to influence prices. Hence a strategy of a product homogenisation and possible harmonisation of standards and labels is recommended to be implemented. In this respect, priority must be given to simpler technologies for ease of implementation and better acceptance.

Assignment of a class of appliances to a particular country is recommended, following the footsteps of the Regional Centre for Lighting established in Sri Lanka. Establishment of such centres of excellence scattered across the region is strongly recommended to expedite the labelling programmes and harmonisation efforts.

Promoting EEI&C Winning the support of political authority and even other stakeholders is a necessary ingredient for programme success. Unfortunately, EEI&C programmes fail to impress most stakeholders as it has no physical output or visible elements as in the case of other development projects. Hence it is recommended to promote the national programmes as Efficiency Power Plants (EPP) comprising of capacity 'deductions' and energy 'savings' as opposed to capacity 'additions' and energy 'generation' in conventional power plants. Similar approaches for other sectors (e.g. transport, industrial thermal, etc.) too can be developed and the concepts must be promoted at national and regional level. Initial agreement and announcement of targets and milestones periodic announcement of achievements, preceded by appropriate countdowns are recommended as the core concepts of the promotion scheme. Government ownership of the promotion scheme is strongly recommended.

Finance as the Key Driver Keeping the important role played by funding in a programme, a strong focus on financing from the early conceptualisation stages to the post implementation phases is recommended. Appreciating the long gestation periods of multilateral funding programmes, early approach of the agencies is also recommended. Considering the keen interest in supporting EEI&C by developed countries in view of climate change, keeping green funds, carbon finances and other concessionary finance in the proper perspective from the programme design stage onwards would be desirable.

In the context of the deep technical knowledge required to develop implementable EEI&C projects and the level of expertise required, provision of funds for project development efforts made by consultants

is recommended. Other avenues of finances such as credit enhancement, revolving funds and debentures too are recommended to be considered as funding options.

Due concessions must also be given to tailor fund streams to suit individual packages of measures. This may involve rural credit schemes to large volume lending carried out by multi institute consortia. Hence the selection of fund sources which offer flexibility is of utmost importance. Overall, a large volume, long term financing package, sufficiently flexible to cater to regional needs is recommended to be developed at the earliest. It is also recommended to keep the options open to tap other sources of finances such as intra region funds, debentures and bonds along with multilateral and bilateral sources.

Sri Lankan Case Considering the great strides taken by Sri Lanka towards EEL&C in the recent past, few recommendations specific to Sri Lanka is made. Sri Lanka is now required to consolidate the gains, by taking measures to integrate the diverse interventions. An ideal opportunity exist in the regulatory sphere, since the electricity sector regulator, the PUCSL is now assembling its toolbox of regulatory measures for the electricity sector. This opportunity must be seized by the policy makers to enshrine EEL&C elements in the regulatory tools, acting as a policy umbrella for the many initiatives taken during the last few years.

The labelling programme of Sri Lanka can be easily expanded to cover other simpler appliances and this need to be done expeditiously. The labelling programme shall be taken to the general public with more vigour for speedy implementation. The scattered network of testing laboratories used for the Sri Lankan labelling programme may not be the appropriate approach in a context of large number of appliance labels. Hence, the development of a fully fledged appliance testing laboratory and gaining accreditation shall receive top priority of the implementers of the labelling programme. The import duty and taxation policies shall be aligned to reward efficient appliances, through a life cycle cost based taxation scheme.

Utility participation in EEL&C in both supply and demand sectors require to be reactivated through appropriate interventions. The success enjoyed by the utility driven CFL programme is a case in point, which should be expanded to other energy derived services sectors.

Enlarging the sector specific programmes to encompass other energy intense industries require a multi-pronged approach. The subsidies available to industrial sector shall be curtailed only to consumers which operate below the declared specific energy consumption benchmarks. Tariffs shall be used as a tool to encourage efficiency and punish waste. This effort must be supported by packaging all services, most importantly access to low cost finances as a single, easy to use instrument, encouraging all industries and building operators to get out of the punitive tariff regime.

14.0 CONCLUSION

The SAARC region which is the home of 20% of the global population is poised to be the next power house in global economic development. This vast geographical region and large community require modern energy services at affordable prices. Further, economic growth propelled by rapid industrialisation will drive demand for energy services to grow at unprecedented rates. In energy constrained world, the path to economic development taken by the developed countries is no longer available for developing country. Global warming among other environmental issues further limits available options for the region. In this context, a new path to economic development will have to be trodden by the region. This new path is laid on sustainability concepts where EEI&C and renewable energy development from the basis of meeting future energy needs and attaining regional energy security. Hence an urgent response by way of an action oriented programme for EEI&C is required from the SAARC region. A systematic approach providing an expeditious implementation, aided by intra region cooperation is recommended. The programme is 'Regional Cooperation on Energy Efficiency Improvement & Conservation' and an appropriate acronym for ease of branding is proposed for adaptation.

The proposed programme shall be formulated, based on the responsibility of the present generation to the future generations of not only humans but also other forms of life in protecting the environment. A sure path to an energy secure future for the region is to focus on energy sources independent of fossil fuel, due to the bleak outlook of fossil fuels today. However, the most important aspect of a sustainable energy future for the region remains the consumerism of the mankind. All our efforts to achieve sustainable development and our path towards a sustainable energy future is aligned to the defeat of consumerism, and this will not be a difficult choice for the South Asian region, where frugality is still considered a virtue.

15.0 REFERENCES

- [1] Freyssinier Jean Paul, Frering Daniel. Presentation on Energy Efficient Lighting Technologies. Lighting Education Programme for the South Asian Regional Centre of Excellence in Energy Efficient Lighting, 2009.
- [2] Sri Lanka Sustainable Energy Authority. Corporate Plan 2008-2010, 2007.
- [3] Siyambalapitiya Tilak (Managing Director – Resource Management Associates (Private) Limited). Presentation on Emerging Energy Crisis, 2006.
- [4] Siyambalapitiya Tilak (Managing Director – Resource Management Associates (Private) Limited). Interview and discussion, 2009.
- [5] Government of Sri Lanka. Energy Conservation Fund Act No.2 of 1985, 1985.
- [6] Daranagama Upali (Additional Secretary (Planning & Development) – Ministry of Power & Energy). Interview and discussion, 2009.
- [7] Ministry of Irrigation, Power & Energy. Report of the Committee Appointed by the Hon. General Anuruddha Ratwatte, Minister of Irrigation, Power & Energy to Formulate the Energy Policy of Sri Lanka, 1997.
- [8] Ministry of Power & Energy. Energy Efficiency, Conservation and Demand Side Management Strategies for Electricity Sector of Sri Lanka, 2002.
- [9] Working Group of Energy Efficiency, Conservation and Demand Side Management Strategy. Strategies to Improve the Delivery of Energy Efficiency Services in Sri Lanka, 2003.
- [10] Government of Sri Lanka. The Gazette of the Democratic Socialist Republic of Sri Lanka No.1553/10 of June 10, 2008 on National Energy Policy & Strategies of Sri Lanka, 2008.
- [11] Government of Sri Lanka. Sri Lanka Sustainable Energy Authority Act No.35 of 2007, 2007.
- [12] Government of Sri Lanka. Public Utilities Commission of Sri Lanka Act No.35 of 2002, 2002.
- [13] Government of Sri Lanka. Sri Lanka Electricity Act No.20 of 2009, 2009.
- [14] Lamasena LG (Project Coordinator, Integrated Development Association). Interview and Discussion, 2009.
- [15] Sri Lanka Sustainable Energy Authority. Consumer Survey on Domestic Energy Consumption, 2009.
- [16] Pieris Deepal (Project Consultant – Environmentally Friendly Solutions Fund (E Friends II) Project). Interview and Discussion, 2009.
- [17] Ceylon Chamber of Commerce. Final Report of the Promotion of Eco-efficient Productivity (PEP) Project, 2009.
- [18] Subasinghe Kaplia (Project Director – Renewable Energy for Rural Economic Development Project). Interview and Discussion, 2009.
- [19] Energy Conservation Fund. Operating Guideline – Sustainable Guarantee Facility, 2005.
- [20] Perera Vipul. (Engineering Manager, Access Energy plc.). Interview and Discussion, 2009.
- [21] Jayalath MS. Presentation on Utility Demand Side Management, 2004.
- [22] Ceylon Electricity Board. Energy Efficiency Building Code, 2000.

- [23] Sri Lanka Sustainable Energy Authority. Code of Practice for Energy Efficient Buildings – 2008, 2009.
- [24] Mohideen FK (Additional General Manager- Region 2, CEB). Interview and Discussion, 2009.
- [25] Gunasekera HN (Head of Operations, LECO. Interview and Discussion, 2009.
- [26] Wanniarachchi, Ramya (Chief Engineer-Energy Management, CEB). Interview and Discussion 2009.
- [27] Sri Lanka Sustainable Energy Authority. Report on National Energy Conservation Programme, 2007.
- [28] Government of Sri Lanka. The Gazette of the Democratic Socialist Republic of Sri Lanka No.1611/10 of July 22, 2008 on National Energy Policy & Strategies of Sri Lanka, 2009.
- [29] Nexant Inc.. USAID-SARI/E Publication on Review of Appliance Testing Capabilities in South Asia, 2003.
- [30] Nexant Inc.. USAID-SARI/E Publication on Roadmap for Harmonisation of Energy Efficiency Standards in South Asia, 2003.
- [31] Japan Bank for International Cooperation. JBIC Pilot Study on the Energy Efficiency Improvement Fund Project in Sri Lanka – Draft Final Report, 2004.

16.0 ACKNOWLEDGEMENT

I wish to thank Mr. M.M.C. Ferdinando, Secretary, Ministry of Power & Energy, Sri Lanka for the trust and confidence placed on me by appointing me as the country expert to compile this report. I would also like to express my gratitude to Dr. C.K.M. Deheragoda, Chairman, Sri Lanka Sustainable Energy Authority, who permitted me to undertake this task amidst other responsibilities.

My sincere thanks are due to Mr. Hilal A. Raza, Director, SAARC Energy Centre and Dr. Muhammad Pervaz and the team at SAARC Energy Centre for continuous guidance and encouragement given to me in preparing this document. I will be failing in my duty if I fail to acknowledge the cooperation I received from all the energy sector personnel who readily came forward to provide information and grant interviews thereby sharing the years of valuable experience in EEI&C with me.

Finally, I would like to thank the staff of the Sri Lanka Sustainable Energy Authority, especially the Energy Management Group lead by Mr. Ranjith Pathmasiri, Director (Energy Management) for their valuable contributions towards preparing this report. My thanks are also due to Pushpa, Inoka and Nimashi for having patience and the tolerance towards me throughout this assignment.

