A CRITICAL ANALYSIS OF ENVIRONMENTAL TAXATION FOR SRI LANKA IN A SUSTAINOMIC FRAMEWORK

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DECLARATION

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

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A Critical Analysis of Environmental Taxation for Sri Lanka in a Sustainomic Framework

Abstract

Sustainomics is to transform ongoing activities and planning of future developments more sustainable; balancing its key elements society, economy and the environment. Sri Lanka introduced environmental taxes by the Environmental Conservation Levy Act No. 26 of 2008 as another strategy to reach the sustainable development. A cess on polythene and plastic raw materials has been imposed previous to the said Act. The present study evaluates the effectiveness of the cess as a lesson for future taxation. When it was assumed that there were no other taxes imposed on importation of polythene and plastic raw materials, there was no a significant direct impact of the cess on the amount of polythene plastic raw materials imported into the country during the period from January 2008 to March 2009. The percentage of polythene and plastic waste amount recycled was 4.27% in 2008 and it was 3.05 % in 2007 compared to the total importation in respective years. The study recommends introducing a tax to be imposed on polythene bags which is a tax to the consumer as it has been successful in some other countries.

Another area studied was on the life cycle of mobile phones within Sri Lanka imported from 2006 to 2010. There is a rapid growth in use of mobile phones in Sri Lanka. The estimated stock of waste mobile phones generated in 2011 is 598 MT. The estimated value of the expected stock of recoverable metals from waste mobile phones in 2011 is Rs. 1094.695 million. Expected Gold stock has the highest value of Rs. 811 million. Calculated amount of waste mobile phones that would be generated in year 2012 is 284 MT and 342 MT in 2013, if the lifespan of a mobile phone is 5 years. Therefore the study recommends carrying out a feasibility study considering environmental, technical, economic as well as social factors to establish a material recovery plant in Sri Lanka.

The study finally proposes two options for disbursement of the fund generated by the taxes imposed under the Environmental Conservation Levy Act. It can be recommended a methodology based on a weighting system according to the importance of each sector that will utilize total amount of revenue for environmental management in the country.

Key words: Environmental taxes, polythene plastic cess, mobile phones, Environmental Conservation Levy Act.

Dedication

To

My Farther

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Description
BAN	Basel Action Network
PBT	Persistent Bioaccumulative Toxin
BFR	Brominated Flame Retardant
CEA	Central Environmental Authority
COD	Chemical Oxygen Demand
ECC	Environmental Conservation Council
ECL	Environmental Conservation Levy
E waste	Electrical and Electronic Waste
GDP	Gross Domestic Production
ITU	International Telecommunication Union
LCA	Life Cycle Assessment
LCD	Liquid Crystal Display
MBI	Market Based Instruments
MENR	Ministry of Environment & Natural Resources
MT	Metric Tonne
NOK	Norwegian Krone (Norwegian currency)
PCB	Printed Circuit Board
SD	Sustainable Development
TCLP	Toxicity Characteristic Leaching Procedure
TV	Television
UK	United Kingdom
ULSD	Ultra Low Sulphur Diesel
ULSP	Ultra Low Sulphur Petrol
VAT	Value Added Tax
WTP	Willingness to Pay

LIST OF APPENDICES

Chapter 1

SUSTAINOMICS AND ENVIRONMENTAL TAXATION

1.1. Introduction

The word 'sustainomics' was introduced into the lexicon by Prof. Mohan Munasinghe in 1994, who has long advocated for sustainable development and who recently mooted for Sustainable Consumption. Making the development more sustainable is by making existing development pattern more sustainable using the Sustainomics approach for balanced consideration of economic, environmental and social elements. In particular, maintaining and accumulating Manufactured, Natural and Human capital is vital. Sustainomics means "*meta-framework for making development more sustainable, which is transdisciplinary, integrative, comprehensive, balanced, heuristic and practical*" (Munasinghe, 1994).

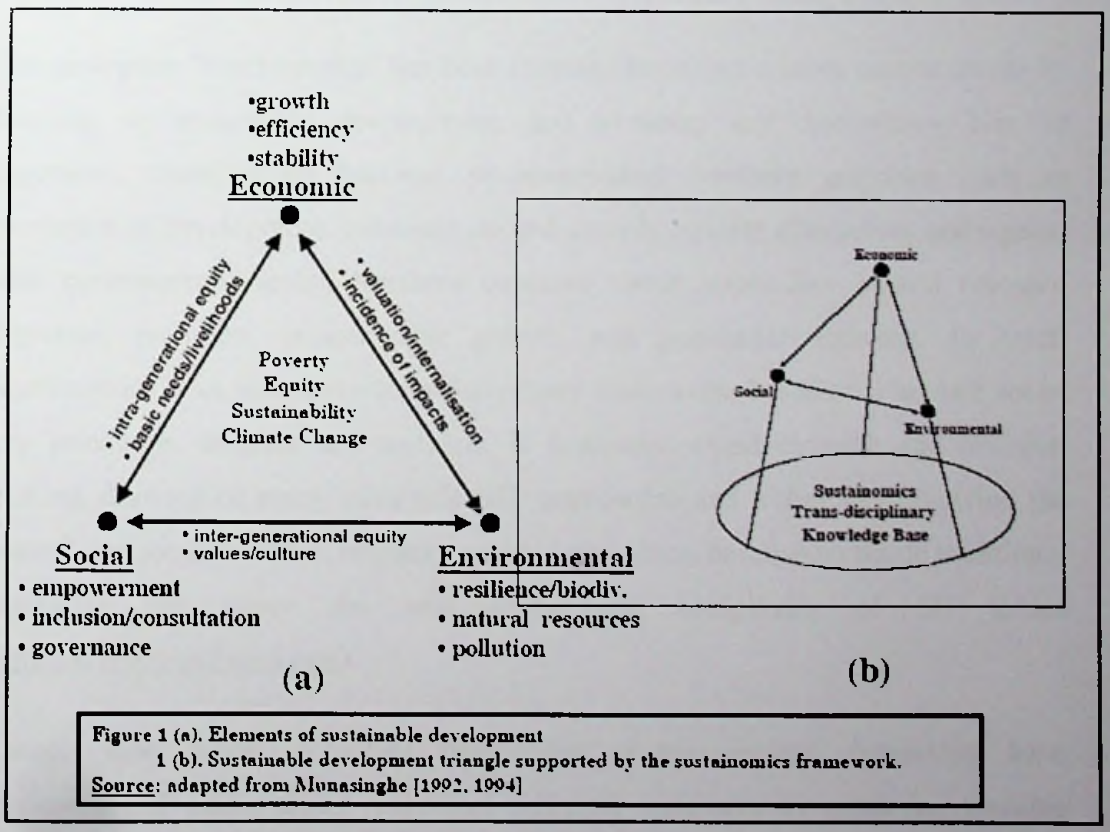


Figure 1.1: Elements of Sustainable Development

Source: Munasinghe (1994)

Unlike other traditional disciplines, it focuses absolutely on sustainable development. Therefore, the idea of the main principle of the framework is to transform ongoing and planning of future developments more sustainable in a practical way. Other key principles : (a) balanced and consistent consideration of the three dimensions of the sustainable development triangle (social, economic and environmental); (b) better integration by transcending conventional boundaries imposed by discipline, space, time, stakeholder viewpoints, and operational needs; and (c) practical application of innovative methods and tools throughout the full cycle from data gathering to policy implementation and feedback (http://www.mindlanka.org/ sustainomic.htm).

Prof. Munasinghe has outlined the earliest ideas about Sustainomics from 1990 onwards, concluding in a formal paper presentation at the 1992 Rio Earth Summit in Rio de Janeiro (http://www.mindlanka.org/). This was a more holistic and practical synthesis reach the sustainable development.

The neologism "Sustainomics" has been invented to project a more neutral image by focusing on sustainable development, and avoiding any disciplinary bias or hegemony. Sustainomics balances people-oriented Southern priorities such as promotion of development, consumption and growth, poverty alleviation, and equity, with environment-oriented Northern concerns about issues like natural resource depletion, pollution, unsustainable growth, and population increase. In brief, Sustainomics is an innovative transdisciplinary framework, based on a holistic set of key principles, theories and methods. It facilitates sound research and decision making, drawing on many other scientific approaches and techniques involving the natural and social sciences, engineering and humanities, because no single traditional discipline can cover the vast scope and complexity of SD issues (http://www.mindlanka.org/).

Usually most human activities, irrespective of any sectoral distinction, have environmental implications. Therefore adequate measures to minimize possible environmental damage in the course of development need to be incorporated in all components of the National Development Programme for the benefit of present and

future generations (Mahinda Chinthanaya, Ten year Development framework 2006-2016; Discussion paper).

Environmental Taxation in environmental policy has become more widespread in many countries during past several decades. The application of environmental taxes can provide long term economic, social and environmental gains. Environmental Taxes are a kind of Market Based Instruments (MBIs) which is more advantageous compared to the Command and Control Approach and aim to change behavior of the society/consumers while generating revenue which can be used for environmental investments (Speck, 2007). MBIs , in particular taxes and charges, have been introduced as one way to implement Polluter Pays Principle , which has been widely accepted as the general frame work for internalizing environmental externalities. Additionally economic instruments increase efficiency in resource use by decreasing total demand and reducing environmental damage (Markandya *et al*; 2002).

For more than twenty year period of time environmental management and protection in Sri Lanka have been carried out by the Ministry of Environment and Natural Resource Management, its' institutions and some other government bodies using traditional command and control approach. However with the current situation of the environment and past experiences it is obvious that it is less effective as a whole. For example though there are command and control mechanisms for the management of solid waste in Sri Lanka it has become a severe problem to the country today (CEA, 2008). Therefore Sri Lanka entered the process of introducing applications of Market Based Instruments in various forms for the protection and management of the environment.

1.2. Objectives

This study is carried out with the following objectives and in trying to understand the process of environmental taxation in Sri Lanka.

1. Study of the effectiveness of already implemented policy instruments
   (Case study on the effect of plastic cess on the behavioural change of the society).

2. Life Cycle Assessment (LCA) of mobile phones for the prediction of recycling cost of them.

3. Development of a strategy for fund management.

1.3. Justification

There had been no study on some of the pioneering efforts made in environmental taxation and this study hopes to fill a vacuum in this regard. Environmental taxation is best implemented if backed by well planned studies on their effectiveness and related issues. A case study on the effect of plastic cess on the behavioural change of the society could provide useful information on the effectiveness of the instrument and serve as a guide for the next cycle of MBIs. The fund raised by the Green Cess imposed on mobile phones in Sri Lanka is to be utilized for the waste management of mobile phones. Therefore it is necessary to carryout a life cycle analysis for identification of waste components of mobile phones and for the prediction of recycling cost for each component. Environmental Taxes raise funds that can be invested on environmental management. However a scientific strategy has to be developed for proper fund management. This study is an effort to fill the gap of the lack of studies regarding environmental taxation in Sri Lanka.

Chapter 2

LITERATURE REVIEW

2.1. Background

The way forward towards Sustainable Development is by making existing development patterns more sustainable using the Sustainomics approach for balanced consideration of economic, environmental and social elements (Munasinghe 1994). Purely focusing on growth has shown many ill effects and the world is today deeply aware of such approaches though appears to be in a fix as per getting out of such a mindset even with much visible negative impacts.

Environmental protection and management has become a main concern and a challenge in many countries especially with the development. Economic activity generates negative external effects that producers do not internalize. Taxes and standards are the common policy instruments to regulate the environmental quality. The traditional approach to discuss the optimal environmental policy has been to assume that polluters comply with the environmental regulation. However, firms' compliance is not guaranteed (Stadler et al., 2004).

An Environmental Tax can be defined as " any compulsory unrequited payment to the government , levied on tax bases deemed to be of particular environmental relevance", where the tax bases include energy products, motor vehicles, wastes, emissions, natural resources etc (OECD, 2006). On the other hand it can be defined as "a tax whose tax base is a physical unit or a proxy of it of something that has a proven, specific negative impact on the environment" (MENR, 2008). Therefore eenvironmental taxes have a broader field of applications. Such taxes may serve the dual functions of installing incentives and disincentives in order to correct harmful behaviour while being a source of fiscal revenue that can alleviate the tax burdens in other parts of the tax mix, and thereby pick up economic efficiency and contribute to economic growth (Sollund, 2007).

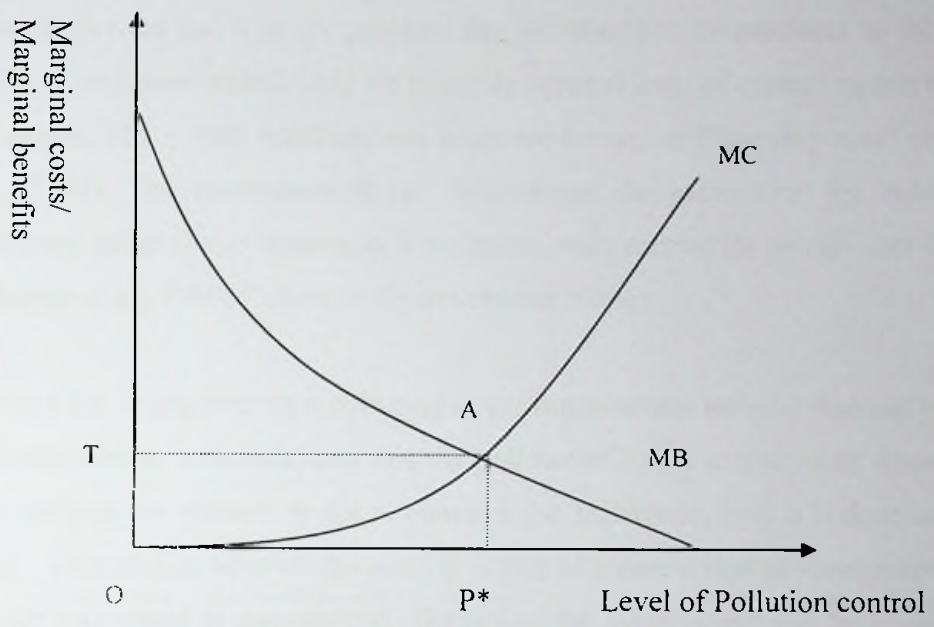


Figure 2.1. Determination of Pigouvian tax

Source: Gunawardena, 2010

"Marginal cost curve is upward sloping since each incremental unit of pollution control costs more and more to achieve the next incremental level of environmental quality. Marginal benefit curve is downward sloping since each incremental unit of control provides fewer and fewer incremental benefits to the society. The socially optimal level of control is where the marginal cost equals the marginal benefits of control (point A). Usually the producer has no incentive to invest in this optimal level of control since he is able to earn higher profits by setting the level of pollution control at zero. The producer's behaviour could be changed by imposing a pollution tax (a constant rate per unit emission) T = MB = MC.

Now the producer has two options:

1. to invest in pollution control where the total control cost is equal to area of OAP*
2. to pay the tax, where the total payment is equal to OTAP*

Up to the point A, it is more profitable for the producer to invest in pollution control than to pay the tax. The tax provides the incentive for the producer to increase his level of pollution control until his privately optimal level of control equals the social optimum, MC = MB. Such optimal taxes are known as Pigouvian taxes (Hanley *et al.*, 1997). The environmental tax 'internalizes the externality' by inducing the pollution generator to behave as if pollution costs entered its private cost functions (Perman *et al.*, 2003)." (Source: Gunawardena 2010).

Once a tax is imposed on a polluting or environmentally harmful material or action, it introduces an economic cost that the polluter will take into account when making the decision on whether or not to continue the activity or, how it is done or at what level. This applies whether the activity is part of a production process, consumption, or the way waste is disposed off. Damaging the environment can be considered as claiming a service from the environment. The producer or consumer should bear the full costs of their environmental damages so as to ensure that production and consumption is economically justifiable. In other words to guarantee that inherent or ensuing costs are not carried over to others. Introducing a well measured tax implies that the relevant external costs are internalised in the decision making (Sollund, 2007).

There are evidences in some other countries that they have successfully used the applications of Market Based Instruments, especially environmental taxation in order to regulate environmental pollution and also for the environmental protection. For example studies done in Sweden in the subject of environmental taxation has shown that the fuel taxes serve a very important role for the environment. The study says that they risk a backlash of increased emissions if those taxes are abolished.

Fuel taxes have restrained growth in fuel demand and associated carbon emissions. Although fuel demand is large and growing, the analysis shows that it would have been much higher in the absence of domestic fuel taxes. People often assert that fuel demand is inelastic but there is strong research evidence showing the opposite. The price elasticity is in fact quite high however only in the long-run: in the short run it

may be rather inelastic which has important implications for policy makers. Had Europe not followed a policy of high fuel taxation but had low taxes as in US, then fuel demand would have been twice as large. Hypothetical transport demand in the whole OECD area is calculated for various tax scenarios and the results show that fuel taxes are the single most powerful climate policy instrument implemented to date. Yet this fact is not usually given due attention in the debate for environmental taxes (Sterner, 2006).

Literature typically assumes that environmental quality is separable in utility, implying that changes in environmental quality will not affect the labor / leisure decision. Schwartz and Repetto (2000) relaxed this assumption, and found that if environmental quality is a leisure substitute, the welfare loss from the tax-interaction effect will be diminished or even reversed. Conversely, if environmental quality is a leisure complement, the welfare loss will be increased (Roberton, 2001).

It is evident that the health benefits of reduced pollution will increase labor supply. It concludes that in such cases, the optimal environmental tax will exceed that found by the prior literature, and may exceed marginal pollution damages. This is an important issue, as health effects represent the largest benefit from many environmental regulations. Burtraw and Toman (1998) noted that reductions in premature mortality alone typically account for 75 to 85 percent of economic estimates of the benefits of improved air quality. Reduced morbidity accounts for a much smaller, but still significant, fraction; for example, Burtraw et al. (1998) and USEPA (1996) both found that reduced morbidity accounted for roughly 5 percent of the benefit from reducing sulfur dioxide emissions. Thus, if the general equilibrium effects of lower mortality and morbidity differ substantially from what the prior literature has assumed, this indicate broad-reaching implications for the optimal regulation of a wide range of pollutants (Roberton, 2001).

There are implications of health effects from pollution. Rather than representing such effects implicitly in the utility function, it explicitly models two distinct channels through which health damages may affect labor supply — by changing medical

expenditures and/or by reducing the household time endowment. It is confirmed that health effects do indeed affect labor supply, and that this results in an additional impact, the *benefit-side tax-interaction effect* (Roberton, 2001).

To the extent that improved environmental quality causes households to spend less on medical care, households can consume more of other goods, including leisure. In contrast, when pollution causes increased time lost to illness, the sign of the benefit-side tax-interaction effect is ambiguous; both labor and leisure increase, and, while the increased labor leads to a welfare gain, the increased leisure creates an offsetting welfare loss.

2.2. Environmental Taxation in Sri Lanka

Sri Lanka as a tropical island in the Indian Ocean possesses diversified natural resources. Rich scenic beauty, clean water, minerals and biotic resources are outstanding resources. The island has a rich biodiversity and is considered as a Hotspot of Biodiversity in the world (Pushpakumara *et al.*, 2002). Furthermore Sri Lanka has a higher ecosystem diversity compared to the size of the island and it has resulted in a rich species diversity including both flora and fauna. However all those natural resources need favourable attention today. When considering the current status of the bio diversity in the country it has been identified that the island's bio diversity is being increasingly threatened by the increase in population and human activities. Therefore strengthening of environmental protection is an important matter with the development activities. On the other hand government's ten year development framework 2006 -2016 of Mahinda Chinthanaya expects to plan for an accelerating level of economic growth based on sustainability.

In Sri Lanka major issues identified in the environmental sector include inadequate funds for conservation and environmental management activities, lack of understanding of scientific management, undervaluation of bio diversity, climate change and increasing levels of pollution, undervaluation of pollution impacts, non – recognition of the contribution made by the natural resources like watersheds to the national economy, lack of awareness of economic impacts of air pollution, lack of

sustainable solid waste management systems etc (Mahinda Chinthanaya, Ten year development framework 2006 - 2016; Discussion paper).

For a twenty year period of time environmental management and protection have been carried out by the Ministry of Environment and Natural Resource, its' institutions and some other government bodies using traditional command and control approach which mostly relies on command and control instruments (CEA, 2008). Here regulatory institutions command for required behaviour typically by standards for emissions and discharges to the environment and enforce to be compliance with the standards (Markandya, 2002). However with the current situation of the environment and past experiences it is obvious that it is less effective as a whole. For example though there are command and control mechanisms for the management of solid waste in Sri Lanka it has become a severe problem to the country today (CEA, 2008). Various instruments may be used to induce consumers and manufacturers to undertake a level of activity that coincides with the level that maximizes social welfare.

In managing natural resources regulatory approaches were to be complemented by the introduction of market instruments that move individual decisions closer to what benefits society as a whole (Mahinda Chinthanaya, Ten year development framework 2006 - 2016; Discussion paper). Afterward His Excellency the President in his capacity as the Finance Minister proposed to introduce Environmental Levies through an Environmental Conservation Levy Act for the purpose of Conservation of Environment in his budget speech for 2008. Subsequently the proposed Environmental Conservation Levy Bill was passed in April 2008 by Resolution of the Parliament (CEA, 2008).

The Environmental Conservation Levy (ECL) Act No.26 of 2008 introduced Environmental Conservation Levies to be imposed on specified items owned by a consumer, specified items imported into or manufactured in Sri Lanka and on specified services provided within Sri Lanka which are likely to have a harmful impact on the Environment. The Minister of Finance shall submit regulations to the

Parliament for approval in consultation with the Minister of Environment. The CEA drafts the regulations and orders on behalf of the Minister of Environment and moreover the CEA has been empowered to substantiate defaults under the ECL Act and to recover the penalties and to instruct the Institutions specified in the Act.

All Levies collected are to be remitted to the "Environmental Conservation Levy Account" of the consolidated fund and under the provisions of the Act. An Environmental Conservation Council (ECC) will be established for the responsibility of disbursement of raised Fund. The ECC will consist of stakeholders of the Environmental Conservation of the country including the Minister of Environment and Natural Resources. The Secretary of the Ministry of Environment and Natural Resources is to be the Chairman of the ECC and the CEA is to be the Secretariat to the proposed ECC.

2.2.1. Environmental Conservation Levy Act No. 26 of 2008

2.2.1.1. Introduction

His Excellency the President in his capacity as the Finance Minister proposed to introduce environmental taxes to conserve the environment in his Budget Speech for 2008. He has proposed to vest the Central Environmental Authority (CEA) with the necessary powers to impose and collect taxes in various forms. He has further proposed to introduce a new Act in the Parliament for this purpose. It is significant that the CEA will be in a capacity to impose taxes which was an exclusive function of the Minister of Finance. The CEA can then use taxes as an environment conservation tool, in addition to already existing tools, namely, law enforcement, education, consultancy and encouragements (Gammanpila, 2008). Consequently the proposed Environmental Conservation Levy Bill was passed in April 2008 by a Resolution of the Parliament.

The basis of the Levy Act is 16th principle of the Rio Declaration on Environment and Development of The United Nations Conference on Environment and Development, at Rio de Janeiro held from 3 to 14 June 1992. The Principle says that "National authorities should endeavour to promote the internalization of

environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment".

2.2.1.2. Objectives of the Act

1. Minimization of Environmental Pollution

Through

i) Development of a Proper Hazardous Waste Management system with government sector, private sector and community participation

ii) Discouragement of the consumption of environmental unfriendly products

iii) Promotion of consumption of environmental friendly products

iv) Encouraging the pollution control programmes by financial aids

v) Research activities.

2. Expansion of the contribution for Environmental Conservation

Through,

i) Providing grants and incentives for Environmental Investments

ii) Public awareness programmes on Sustainable Development

iii) Incorporating affordable people to Environmental Conservation.

iv) Promotion of efficient /sustainable utilization of natural resources

3. Raising a Local Adaptation Fund enabling Sri Lanka to adapt impacts of Global Warming.

2.2.1.3. Types of Levies which can be proposed under the Levy Act

The following types of Levies will be introduced on specified items owned by consumers, on specified items imported into or manufactured in Sri Lanka or specified services provided in Sri Lanka, which are likely to have a harmful impact on the environment.

(a) Green Cess

Green Cess is to be imposed on products which require specialized disposal or recycling methods. Hence the consumer of the product pays for the cost of recycling or disposal by way of a Cess. The collected Cess will be utilized for financing disposal and /or recycling of the product.

A Cess was imposed on plastic and polythene products in Sri Lanka in 2005. It is proposed to impose such a cess on some of the following products which require specialized disposal methods.

- Electrical equipments
- Electronic equipments
- Batteries of all forms
- Tyres

(Gammanpila, 2008)

(II) Green Surcharge

The Green Surcharge will be imposed on environment unfriendly products which have environment friendly alternatives. By addition of the surcharge, it is expected to make the product less attractive in the market. The consumers will then shift to the environment friendly product from environmental unfriendly products.

Example: Both reed bags and plastic bags are used to carry goods. Reed bags are environmental friendly considering the fact reed bags biodegradable in comparison to plastic bags. However the price of reed bags may be comparatively high. Hence consumers are compelled to purchase more plastic bags. If a surcharge is to be imposed on plastic bags, consumers would be encouraged to purchase relatively cheap reed bags instead of expensive plastic bags. This is the principle of green surcharge.

(III) Environmental Conservation Contribution (ECC)

It is expected to make society environmentally sensitive by incorporating them directly to environmental conservation. In this context people who posses a particular level of assets or a level of income should financially contribute to environmental conservation process monthly or annually (Gammanpila, 2008).

(IV) Green Conservation Levy

It is expected to compel people for the sustainable utilization of Natural Resources. The imposition of Green Levy will manage exploitation of limited Natural Resources which is an essential component of sustainable development (Gammanpila, 2008)

2.2.1.4. General collection modes

The collection mode depends on the type of the levy and the type of the commodity or the service which is levied under the Levy Act. For example if vehicles were levied, the collection mode would be applied along with the issuance of Vehicle Revenue Licenses or the Vehicle Emission Test Certification procedure. However the following may be general collection modes of Levy Act.

1. The Director General of Customs
2. The Director General of Excise
3. Provincial Commissioners of Motor Traffic
4. Commissioner General of Inland Revenue

(Gammanpila, 2008)

2.2.1.6. Orders made under the Environmental Conservation Levy Act No.26 of 2008

According to the Levy Act the Environmental Conservation Levy was imposed on four selected commodities by following orders for the Environmental conservation, management and pollution control in Sri Lanka.

1. The order No. 01 of 2008 imposing specified taxes on specified vehicles with internal combustion engines published by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1559/8 dated 22.07.2008.

The tax specified in Column II of the following schedule was to be imposed and charged on the items specified in the Column II of the schedule

Table 2.1. : Tax rates imposed on vehicle categories

SCHEDULE

Item *I*	*Tax (Rs.)* *II*
Motor Cycle	100
Motor Car- Unladen Weight	
(a) (i) Up to 762 kgs. (Petrol)	200
(ii) Up to 762 kgs. (Diesel)	300
(b) (i) Exceeding 762 kgs. up to 1016 kgs. (Petrol)	300
(ii) Exceeding 762 kgs. up to 1016 kgs. (Diesel)	400
(c) (i) Exceeding 1016 kgs. up to 1270 kgs. (Petrol)	400
(ii) Exceeding 1016 kgs. up to 1270 kgs. (Diesel)	600
(d) (i) Exceeding 1270 kgs. .(Petrol)	500
(ii) Exceeding 1270 kgs. (Diesel)	800

The tax collecting authority was the Commissioner of Motor Traffic of the each Provincial Council. The owners of the vehicles with internal combustion engines had to pay the tax when they obtain the annual revenue license or when it is renewed. The order came to effect from 01.08.2008. The reason for the tax was causing air pollution by vehicles with internal combustion engines and the basis for the selection of categories was based on per capita emissions.

2. The order No. 02 of 2008 imposing a levy of Rs. 3.00 per bulb exceeding 40 W except Compact Fluorescent Lamps was published by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1559/9 dated 22.07.2008.

The collection of the Levy at the importation of bulbs liable for the levy was to be made by the Director General of Customs in accordance with the provisions laid down in the Customs Ordinance and where such bulbs are manufactured locally the relevant levy was to be collected by the Director General of Excise (Special Provisions) Act No. 13 of 1989. The order came to effect from 01.08.2008. The justification behind this tax was, a huge amount of electricity generation of the country was based on air polluting fossil fuel combustion and bulbs exceeding 40 W were consumed largely while energy saving options being available in the market.

3. The order No.03 of 2008 imposing a levy of 2% calculated on the value of the services supplied and to be supplied by the licensed cellular phone operators (for the use of a mobile phone) published by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1559/10 dated 22.07.2008.

The authority of the collection of the levy was entrusted to the Chairman, Sri Lanka Telecommunication Regulatory Authority Commission. The order came to effect from 15.08.2008. The rationale behind this tax was, at the end of the life of a mobile phone it becomes an electrical and electronic waste which belongs to the category of hazardous waste. On the other hand there was a rapid growth in usage of mobile phones in Sri Lanka whilst the market price of a mobile phone significantly decreases from the time of introduction to the market. This Order was amended by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1568/01 dated 22.09.2008 to avoid an error, 'tax on tax".

4. The order No. 04 of 2008 imposing a levy of Rs. 50.000.00 per tower on

(a) Television transmitting towers

(b) Broadcasting transmitting towers

(c) Telephone transmitting towers

When a single transmitting tower is shared by several companies, each company had to pay a levy of Rs.25, 000.00 per tower. The Order was published by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1559/11 dated 22.07.2008. The Chairman of the Central Environmental Authority was empowered for the collection of the Levy. The reason for imposing this tax was the visual pollution and caused by transmission towers and environmental damages during the erection of them especially at hilltops. On the other hand there was a higher rate of erecting new towers all over the island and the CEA did not have any instrument to control it effectively (CEA, 2008).

2.2.1.7. Issues arisen in the process of environmental taxation in Sri Lanka

At the preliminary phase of the introduction of legal provisions to facilitate environmental taxation in the country some parties like one or two non governmental

agencies (NGOs), political parties that represented the opposition to the Government of Sri Lanka in the year 2008, opposed the Environmental Conservation Levy Act (CEA, 2008).

a). Supreme Court cases

In the middle of the year 2008 four Fundamental Right cases bearing numbers 336/2008, 345/2008, 346/2008 and 347/2008 against aforementioned orders were filed in the Supreme Court of Sri Lanka making the Secretary of Ministry of Finance and Planning, Minister of Finance and Planning, Central Environmental Authority, Chairman of the Central Environmental Authority, Secretary of Ministry of Environment and Natural Resources, Minister of the Ministry of Environment and Natural Resources, Attorney General's Department, Telecommunication Regulatory Commission as the respondents. Considering the objections filed by the Central Environmental Authority, The Supreme Court decided to continue the Levy on Mobile phones and order No. 01, No.02 and No. 04 of 2008 were rescinded (CEA, 2008).

b). Canceling tax on mobile phones

The order No.03 of 2008 was in operation till 2010. By the Budget speech for the year 2011 it has been proposed that the taxes applicable to Telecommunication sector was complex and to combine all such taxes and impose a Telecommunications Levy of 20 percent (Budget speech 2011). According to that decision, the Gazette No. 1559/10 dated 22.07.2008 was rescinded by the Extraordinary Gazette Notification No. 1680/28 dated 2010.11.29 and thereby Levy on Mobile phones was cancelled.

There is no any Environmental Conservation Levy imposed under the provisions of ECL Act No.26 of 2008 in operation at this moment in Sri Lanka (CEA, September 2011).

2.2.2. Fund disbursement

At the introduction of the ECL Act No.26 of 2008, it was expected to disburse fund for the environmental conservation and management activities that is for environmental investments including following objectives.

- Raising funds for Local Adaptation Fund to mitigate adverse impacts of Global Warming
- Funding "Pilisaru" project for a proper municipal Solid Waste Management in the country.
- Acceptable Environmental conservation / management activities

(Gammanpila, 2008)

2.2.2.1. Proposed fund disbursement mechanism

An Environmental Conservation Council (ECC) which will be answerable to the Parliament is to be formed to be responsible for the fund disbursement. The Government agencies which work on following areas will be members of the ECC. Therefore those areas would be selected for the fund facilitation for environmental management and conservation activities in the future. It is expected to call proposals for specific objectives from interested parties through the respective government institutions.

i) Subject areas coming under the purview of Ministry of Environment
ii) Sustainable Energy
iii) Forest Conservation and Management
iv) Wildlife Conservation
v) Geological Survey and Mines Bureau
vi) Marine Pollution Prevention Authority
vi) Areas coming under the purview of Meteorological Department
vii) Coast conservation
viii) Subject areas coming under the purview of CEA
ix) Subject areas coming under the purview of Ministry of Land

(CEA, 2009)

Fundamentally environmental project funding falls into two distinct categories:

A) Funding within programmes: - Where project proponents will be required to meet specific and pre-set criteria and to design projects to assist in the delivery of the aims and objectives of the programme (European Commission, 2005).

B) Open calls for proposals: - Where project proponents have freedom to design projects that meet objectives set with the context of an environmental need appropriate to the funding call. Environmental research, education and technological innovation are often funded in this way (European Commission, 2005).

2.2.2.2. Identified environmental challenges that need to be addressed in Sri Lanka

Sri Lanka is one of the twenty-five bio-diversity hotspots of the world. However Sri Lanka faces problems of natural resource degradation as well as environmental pollution with human activities. On the other hand population density of Sri Lanka is around 280 persons per square kilometer, which is one of the highest in the world (AECEN, 2006).

Studies have identified that deforestation and unsustainable land use practices cause loss of an estimated 5-10 mm of topsoil every year to soil erosion. This is most acute in the up country, where the significant watersheds are located (AECEN, 2006). Land degradation has been recorded as one critical issue among most significant environmental issues in Sri Lanka. It affects environment, economy as well as the living standards of the people. Land resources are fragile, finite and non-renewable (Semasinge, 2010). Solid waste was a severe environmental problem in Sri Lanka being a major cause of water pollution, air pollution as well as soil degradation and many environmental and social implications (CEA, 2008). In addition wetland management correlated with National Land Use Plan is necessary to protect remained wetlands to maintain the ecological balance in the country (Jayasundera, 2010).

Water pollution is caused mainly by agrochemicals, fertilizers, industrial pollution and urban pollution, including domestic waste and sewage. A lot of industries do not have proper waste treatment facilities. A pilot study in the Kelani River Basin has

discovered that out of a select sample of 57 industries, less than half had partial or complete water treatment facilities (AECEN, 2006). Kelani river is an environmentally sensitive site. Rivers and on a number of lakes in urban areas have been badly affected by the surface drainage of pollutants from urban environments and direct discharges. Air pollution is increasing, according to the air quality monitoring data in urban areas, particularly in Colombo. The sources of air pollutions are both mobile and stationary sources. However the most significant air pollution is from mobile sources (AECEN, 2006).

2.2.3. Polythene plastic cess

2.2.3.1. History

During the early periods of the 1st decade after the millennium it has been calculated that about 160,000 tones of plastic raw materials and products had been imported under the HS 39 annually. Out of this amount 30% had been exported back as finished products and the rest has been come to the local market. This amount was haphazardly disposed to the natural environment.

Due to non- degradable nature of plastic and polythene and environmental unfriendly practices of the society in disposing them as post consumer waste severe environmental problems had been occurring. Therefore considering environmental problems as well as human welfare, the Sri Lankan government had taken several attempts to control manufacturing and use of polythene within the country. However all such efforts have been ineffective as a result of economic and social implications.

Afterward under the provisions of Export Development Act No. 40 of 1979, a Cess has been imposed on the plastic and polythene raw materials and products imported under the HS 39 code by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1382/01 dated 28.02.2005. The fundamental objective of introducing this Polythene – Plastic Cess has been raising funds for establishing a post consumer plastic – polythene waste management system in the country. Initially it has been imposed 1% Cess on Plastic and polythene materials imported under HS 39 code and

then the amount of Cess was gradually increased by the Government as 2%, 5% and finally 10%.

In addition to that for the control of utilization of polythene or polythene products, the Government of Sri Lanka prohibited manufacturing polythene or polythene commodity for local consumption which is 20 μ or less than 20 μ in thickness and selling or utilization of polythene product which is 20 μ or less than 20 μ in thickness by the extra ordinary Gazette notification No. 1466/5 dated 10.10.2006. The Gazette came to effect from 01 January 2007.

2.2.2.2. Utilization of the revenue

The Ministry of Environment & Natural Resources has obtained approval of the Cabinet of Ministers to implement a post consumer plastic waste management project through a public-private partnership in year 2004 by utilizing the revenue generated by the Polythene Plastic Cess for the purpose of proper management of polythene-plastic waste and for creating public awareness for the same reason. The revenue collected by the Cess was to be remitted to a special plastic account and the account was to be managed according to a guideline for the management of Special Plastic Account (CEA, 2005).

2.2.2.3. National Post Consumer Plastic Waste Management Project (NPCPWMP)

National post consumer plastic waste management project has been established on 21.05.2007 as a project attached to the Central Environmental Authority. The objective of the project was creating a behavioural change among the Sri Lankan community to ensure a proper disposal of plastic – polythene waste in a manner that does not harm the environment and to put in place necessary logistics enabling collection and recycling of post consumer plastic waste in the country. The steering committee responsible for the fund management and project monitoring was known as Plastic Partnership Committee (PPC). Public parties such as the Central Environmental Authority, the Treasury and private parties were members of the PPC (CEA, 2005).

The project has been implemented within Colombo and Gampaha districts at the beginning. Then it has been extended to Kandy, Galle, Anuradhapura and Nuwara Eliya districts and from 01 January 2009 it has been further extended to the rest of the island (Pers. Com. Bandula, 2011).

2.2.4. Other environmental taxes and charges operated in the country

There were some other applications of environmental taxes functioned in Sri Lanka with different forms of objectives. Such taxes were in operation in energy sector, transport, water consumption and etc. Taxes on fuel, kerosene could be seen in energy sector. Import and excise taxes on vehicles, luxury motor vehicle tax, and annual vehicle revenue license fee were the taxes and charges that had been applied in transport sector. The revenue from those taxes imposed on transport and energy sectors was around 10 percent of total tax revenue and therefore played a big role in taxation in Sri Lanka (MENR, 2008).

In addition there are tariffs levied on electricity and water consumption. There were proposals for implementing wastewater user charges and user fees for solid waste collection and proper disposal. Applications of environmental taxation in some sectors such as fisheries, tourism, agriculture and waste management, where such taxes could be applied fruitfully, have been restricted in Sri Lanka (MENR, 2008).

2.3. Applications of Environmental Levies in other countries

The magnitude of environmental taxation is one of the highest in the OECD countries. According to the OECD 2006 Report there had been 375 environmentally related taxes in OECD member countries, plus some 250 environmentally related fees and charges in those countries. Out of these taxes, the largest number was levied on energy products (150), on motor vehicles (125), and various forms of waste (50).There was a wide range of environmentally related taxes currently levied in the OECD-countries, among others: water pollution tax, batteries tax, logging tax, tyres tax, beverage container tax, toxic waste levy, tax on plastic bags, aircraft noise tax,

tax on groundwater extraction, tax on pesticides, and artificial fertilisers, landfill tax, ozone depletion tax etc (Sollund, 2007).

In OECD countries revenues raised from environmentally related taxes represented on average about 2-2.5% of GDP. However this figure varied significantly among countries, from more than 3% in Scandinavian countries, the United Kingdom, Turkey and the Netherlands, to less than 1% in the United States. As well the share of environment tax as percent of total tax revenue varied significantly, being in the order of 6-7% on average in the OECD countries. This figure was, of course not only resulting from the tax mixes but was also influenced by the level of traditional taxes like income tax and VAT in each country (Sollund, 2007).

European Law stated about the recovery of costs of water services in Article 9; that "Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis conducted according to the conditions given in annexure and in accordance in particular with the polluter pays principle" (http://eurlex.euripoa.eu, 2000). In China there has been levied a tax on wooden chop sticks and it has been increased in 2007 in order to protect forests. According to a news report, Chinese consumers consume and dispose of 45 billion pairs of wooden chopsticks annually, requiring logging of 25 million trees (Sollund, 2007). Thailand is still in the preliminary stage of introducing applications of environmental taxes for the purpose of environmental management in the country (Bunyagidj, 2011).

2.3.1. Green taxes in Norway

Norway had practiced Environmental Taxation for long period of time in order to reduce environmentally harmful emissions to air and water, and to reduce the amount of waste generated. In 1931 Norway has introduced a petrol tax. The first tax that had an explicit environmental purpose was levied on sulphur in mineral oil in 1971. However, a wide-spread use of environmental taxes is not observed until the late 1980s and early 1990s (Sollund, 2007).

Since the early 1990s revenues of environmental taxes had been used in providing incentives for cleaner production and consumption patterns, even though regulation had been the main policy instrument for environmental protection. Introduction of environment tax on beverage packaging has been done in 1994 and tax on final waste disposal has been done in 2000 and both differentiated according to environmental impacts of them. After only two years in operation low Sulphur tax on coal, coke and refineries have been removed at the end of 2001. According to the estimates made in 2006 budget, 4.2 percent of central government tax revenue is due to environmental and energy taxes, equivalent to 1.6 per cent of GDP in Norway. The highest contribution of the tax revenue is from taxes on energy consumption. Environmental taxes, such as Carbon dioxide and Sulphur taxes refer to taxes with a precise environmental purpose.

Table 2.2 : A summary of Environmental taxes operated in Norway

Year /Period	Form of tax
1971	Sulphur tax on mineral oil
1974-1993	Tax on non-refillable beverage containers (replaced by broader taxation of beverage packaging)
1986-	Petrol tax differentiated according to lead content
1988-1998	Tax on nitrogen and phosphor in mineral fertilisers
1998-	Tax on pesticides, tax on lubricating oil
1990-1991	Tax on environment damaging batteries (replaced by regulation)
1991-	CO_2 tax on petrol, auto diesel oil, mineral oil (excl. fisheries etc.), and petroleum sector (only offshore activities)
1992-2002	CO_2 tax on coal and coke, except most industrial processes
1994-	Environment tax on beverage packaging differentiated according to return rate
1999-2001	Sulphur tax on coal, coke and oil refineries at a low rate

	(replaced by voluntary agreement)
1999-	Tax on final waste treatment. CO_2 tax includes domestic sea transport of goods (formerly only passenger transport) and the supply fleet
2000-	Tax on environment and health damaging chemical products (only two products so far), beverage packaging tax differentiated according to materials, auto diesel oil tax differentiated according to sulphur content, annual weight-based tax on heavy vehicles differentiated according to emission standards (EUROI–EUROIII)
2003-	Taxes on HFCs and PFCs

(Source: Ministry of Finance, Norway.)

Times to time several committees have been appointed to make environmental taxation system more efficient and effective in Norway. A Green Tax Commission has been appointed late in the year 1994, and assessed how to change the Green tax system as an instrument for both improving the environment and increasing employment and the Commission recommended a large number of changes and increases over a broad range of environmental and energy taxes.

As an adjustment towards more rigid state aid rules, the CO_2 tax on coal and coke was abolished from 1 January 2003. Subsequently the CO_2 tax only covered the use of petrol, auto diesel oil and mineral oil (except fisheries), and CO_2 emissions from offshore petroleum activities.

On 1 January 2003 taxes on the greenhouse gases HFCs (hydrofluorcarbons) and PFCs (perfluorcarbons) were introduced. The tax rates were around 180 NOK per tonne CO_2 equivalents.

Annual vehicle tax (weight-based) for vehicles more than 20 tonne in weight has been to be included in EU emission requirements to be introduced in 2005 and 2008. The change has expected to increase revenue by about NOK 15 million. Hydrogen cars

that are free of CO2 emissions were to be exempted from vehicle registration tax and annual vehicle tax.

2.3.2. Environmental Levies operated in the United States of America

According to the National Center for Environmental Economics of the United States several types of pollution fees, charges and taxes were being implemented in the United States. A pollution charge is defined as a fee based on the quantity and/or content of pollutants discharged into the environment and a user charge is a fee paid in exchange for use of natural resources or collection or disposal of pollutants. The other type of environmental levy is product charges and they were imposed on products that were considered to have detrimental impacts on the environment. According to the federal law, a tax is a purely revenue-raising instrument, whereas charges or fees are intended to offset costs to government.

Table 2.3: A summary of fees, charges and taxes in Environmental policy in USA

Type of Levy	Description	Examples
Pollution fee	Charge based on quantity and/or content of pollutants discharged into the environment	i. Air emission permit fee ii. Effluent permit fee iii. Solid waste disposal fee
User fee	Fee for consumption of resources	i. Water use fee ii. Road congestion fee iii. Grazing fee
Product charge	Charge on a product that believed to have harmful impacts on the environment	i. Gas guzzler tax ii. CFC tax iii. State taxes on fertilizers iv. State advance disposal fees on tires, motor oil, packaging & other goods
Other fees on environmentally	Different mechanisms	i. Wetland development fees

damaging activities		ii. Storm water runoff fee

(Source: National Center for Environmental Economics, 2011)

2.3.3. Environmental levies in the United Kingdom

The Government of the United Kingdom promotes sustainable development and believes that it is to be achieved via a stable socio economic development and environmental protection. They practice the strategy of using economic instruments along with other policies to reach this objective. The United Kingdom's environmental taxation programs main objective is increasing incentives to reduce damages to the environment (Lin & Francis, 2004).

The Government of the United Kingdom considered many environmental taxes as 'revenue neutral' since the impact of new taxes is offset by reductions in a different way. The Government of the United Kingdom utilized revenues of green taxes for specific environmental management activities such as investment in cleaner technologies or to reward better performers in environmental management (Lin & Francis, 2004).

Environmental taxes operated in United Kingdom could be classified into following categories as, taxes on,

a) Energy products
   - Duty on hydrocarbon oil (eg: petrol, diesel)
   - Fossil fuel levy
   - Climate change levy

b) Transport
   - Vehicle excise duty
   - Air passenger duty

c) Pollution
   - Landfill tax

d) Resources
   - Aggregates levy

The major environmental tax type has been the tax on energy products which raised around 80 percent of all environmental tax returns (Lin & Francis, 2004).

Climate Change Levy

Developed countries have agreed a legitimate commitment to reduce greenhouse gas emissions by 5.2% below 1990 levels over the period 2008-2012 at Kyoto in 1997. The European Union Member States as a group decided to reach an 8 percent reduction at Kyoto. In addition the UK had set itself an internal target to go beyond their legally-binding Kyoto goal - to trim down emissions of carbon dioxide by 20 per cent on 1990 levels by 2010 (HM Revenue & Customs, 2011).

Therefore the Government of the UK aiming reducing greenhouse gas emissions of all sectors in the country, a climate change levy has been proposed in 1999 and was introduced on 01 April 2001 excluding taxable commodities used by consumers or charities for non- business. The levy was imposed at the time of supply of taxable commodities such as electricity, coal, gas, and so on to industrial and commercial consumers (HM Revenue & Customs, 2011).

Duty on hydrocarbon oils

A range of types of duties on different energy products were coming under this category. Eg: ultra low Sulphur diesel (ULSD) and ultra low Sulphur petrol (ULSP), fuel oils and gas oils.

The duties rate in 2001 on ULSP and ULSD:

Table 2.4.: Duties on ULSP and ULSD in 2001 in the UK

(Source: HM Customs and Excise)

Fuel	Rate (per litre)
ULSP	45.82 pence
ULSD	45.82 pence

The Aggregates Levy

The Aggregates Levy has been introduced in April 2002 and was a tax on the extraction of aggregates for commercial purposes. The rate of the Levy was £ 2.0 per tonne and applied to commercial extractors such as quarrying operators, mobile crusher operators, and operators of dredgers. If anybody expected to exploit aggregate in the UK for commercial reasons he or she needed to register for the levy. Government of the UK defined aggregate as rock, gravel or sand and whatever occurs or is mixed with it as well as, in certain circumstances, spoil, off cuts and by-products. If anybody extracted following resources he or she did not require registering for taxation but required to inform the government (HM Revenue & Customs, 2011).

- coal, lignite, slate or shale
- spoil resulting from the separation of coal, lignite, slate or shale after extraction
- spoil resulting from the separation of specified minerals after extraction
- china clay, ball clay and spoil or waste arising from its extraction
- other types of clay (HM Revenue & Customs, 2011).

Landfill Tax

Landfill Tax was a tax on the disposal of waste which was to encourage waste producers to reduce waste, recover more value from waste, for example through recycling or composting and also to practice more environmentally friendly waste disposal methods.

Landfill Tax applied to all waste:

- disposed of by way of landfill
- at a licensed landfill site
- on or after 1 October 1996
- unless the waste is specifically exempt

The tax was charged by weight and there were two rates of the Landfill Tax. Inert or inactive waste was subjected to the lower rate. People needed to register if they were

landfill operators making or intending to make taxable disposals. VAT applied to the full amount charged on a waste disposal, including the Landfill Tax.

The Government of the UK has received £41.4 billion from environmental taxes in 2010. It has been 8% of total tax revenue of the United Kingdom in the same year. This was £1.9 billion more than in 2009 and more than double the amount received in 1993. Returns of environmental taxes were equivalent to 2.8 per cent of Gross Domestic Production (GDP) in 2010, unchanged from 2009.

Energy tax revenue has shown a distinct increase by £1.3 billion in 2009 to £ 32.2 billion in the year 2010, primarily due to an increase in duty on hydrocarbon oils.

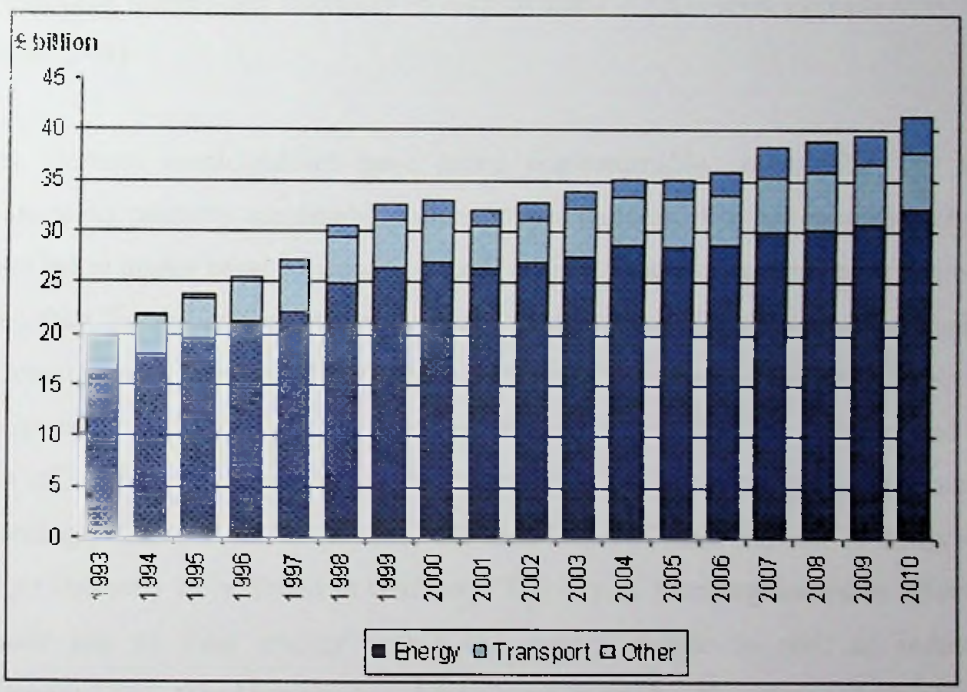


Figure 2.2: Receipts of Environmental taxes to the Government of UK from 1993 to 2010
(Source: Office for National Statistics)

2.3.4. Environmental taxes in Germany

There were a few "classic" local taxes and fees in Germany and were effective in influencing positively sustainable behaviour of the society. The local water tax, waste and wastewater fees might be considered as the oldest environmental taxes

which had been tremendous applications of polluter pays principle effectively (Böhm, 2008).

People had to pay for waste or for wastewater when they required disposing them and the fee should recover all the costs necessary for providing the local services. The principle of recovery is fundamental for all local fees. All estimated costs for waste disposal and sewage discharges were charged by tax is the principle of cost coverage practiced in Germany. These costs include general operating costs, which are labour cost, cost of equipments, cost of collection, transport cost and the dealing and disposal of waste. In some German municipalities higher fees was charged when the industrial wastewater chemical oxygen demand (COD) level exceeds 600 mg/l[1] (Böhm, 2008).

Many German municipalities have taxed non-returnable commodities by local ordinance to promote sustainable consumption patterns. For an example, city of Kassel led to higher costs by imposing local taxes for the plastic cups, plates, spoons, knifes than for the consumed goods itself. However private entrepreneurs such as McDonald's have prosecuted at German Supreme Court against the local authorities and thereafter German Supreme Court has made a much criticised decision and as a result of it all local taxes and fees for sustainable consumption habits had ceased. Accordingly there are no local taxes for land use, soil consumption or congestion charges currently to be found in Germany. The city of Marburg has made efforts to promote use of solar energy within the general public as well as industrial community and the Municipality have been sued by the state administration complaining that Municipalities are not permitted to set local statutes and ordinances to protect the global climate (Böhm, 2008).

Many efforts by local authorities to use of environmental taxes had been ended by the German Supreme Court and Municipalities had been restricted to impose taxes or setting laws to address local or general environmental problems (Böhm, 2008).

2.3.5. Taxes on polythene plastic control in other countries

2.3.5.1. Behavioural response to Plastic bag tax in Botswana

Extensive use of lightweight disposable plastic shopping bags (at free of charge) in Botswana started in around 1975 with the fast economic development after discovery of diamonds. Then plastic bag litter had been a scourge in the country. Agriculture and tourism sectors which were major items of local economy had been affected severely. It has been a hazard to the environment especially to the wildlife. Then the government decided to reduce plastic bag litter, encourage recycling and safe disposal rather than eliminating use of them as plastic bag use was a consequence of the economic growth (Dikgang *et al*, 2009).

The Government of Botswana prohibited manufacturing and import of plastic bags thinner than 24 micron and a levy was imposed on other permitted plastic bags in 2007. The tax was a direct tax intended consumers' behavioural change to reduce the demand for plastic bags. The tax has not been a Pigouvian because it has not been the optimal level of the tax by identifying the marginal external cost. Taxing plastic bags had reduced purchases of them significantly in both the luxury and poor segments of the market (Dikgang *et al*, 2009).

2.3.5.2. The success story of plastic bag levy in Ireland

In Ireland the plastic bags has not been most widespread litter item and it was 5% of the national litter composition, according to the National Litter Pollution Monitoring System. Nevertheless waste plastic bags had been an observable and persistent element of litter pollution, throughout the countryside and along the coastline and had become an environmental problem in the country. Then the Irish government has imposed a levy of € 0.15 per plastic bag at the point of sale in March 2002. The tax was not Pigouvian and has intended to change behaviour of the consumer. Therefore the tax has been fixed to be sufficiently higher rate to compel consumers to avoid paying for a new bag (Convery *et al*, 2007).

Because of the introduction of the levy, annual consumption of plastic bags had been reduced by approximately 94%. The 5% plastic bag waste composition of national

litter before the introduction of the levy had bee reduced to 0.32% in 2002, in 2003 to 0.25% and to 0.22% in 2004 (Convery *et al*, 2007).

2.3.5.3. Plastic bag levy in South Africa

Annual consumption of thin – filmed plastic carrier bags was approximately 8 billion in South Africa. Plastic bags has been available free of charge. It had been a huge environmental problem in the country and has been known as the 'National flower' because of extensive availability on streets as litter. Therefore the government has planned to solve the problem. A 3 rand cents levy was imposed on a plastic bag in May 2003 and increased up to 4 rand cents in March 2009. A nominal fixed price of 46 rand cents per bag was set in 2003. At the same time 30 micron was fixed as the minimum gauge from May 2003 with a five-year allowance for bags with a gauge of 24 micron.

The South African Levy on plastic bags has reduced its consumption of plastic bags for a short term. There has been a steady increase in demand for plastic bags proving that the Levy was not successful. The reason was the level of levy charged was too small and has not been sufficient to reduce the demand.

2.4. Life Cycle Assessment

2.4.1. Introduction to LCA

Life Cycle Assessment (LCA) is a tool for evaluation of effects that a product or a service has on the environment over the entire period of its functional life; from raw material extraction and processing of them, through the manufacturing, packaging and marketing process and the use, reuse and maintenance of the product and on its eventual recycling or disposal as waste at the end of its functional life (Chithrage, 2008).

LCA studies the environmental impacts throughout a product's life that is from the point of raw material extraction through production, use, recycling to final disposal. Therefore LCA is useful to,

- Identify stages where environmental improvements are required or where more environmental improvements can be incorporated.
- Inform decision makers for strategic planning, redesigning and etc.
- Select relevant indicators of environmental performance including measurement techniques
- Use for the purpose of marketing (ISO 14040:1997(E))

The scope, boundaries and level of details of a LCA depend on the type and objectives of the study. However in all cases the principles and framework should comply with International Standards.

LCA assess the environmental aspects and potential impacts associated with a product or a service. Several steps are followed to complete the assessment as, assembling an inventory of relevant inputs and outputs of a product system, evaluating potential environmental impacts of those inputs and outputs and finally interpretation of the results of the inventory analysis and impact assessment (ISO 14040:1997(E)).

2.4.2. Phases of a LCA

Life Cycle Assessment includes several stages as definition of goal and scope, inventory analysis, impact assessment and interpretation of results (Figure 2.2.).

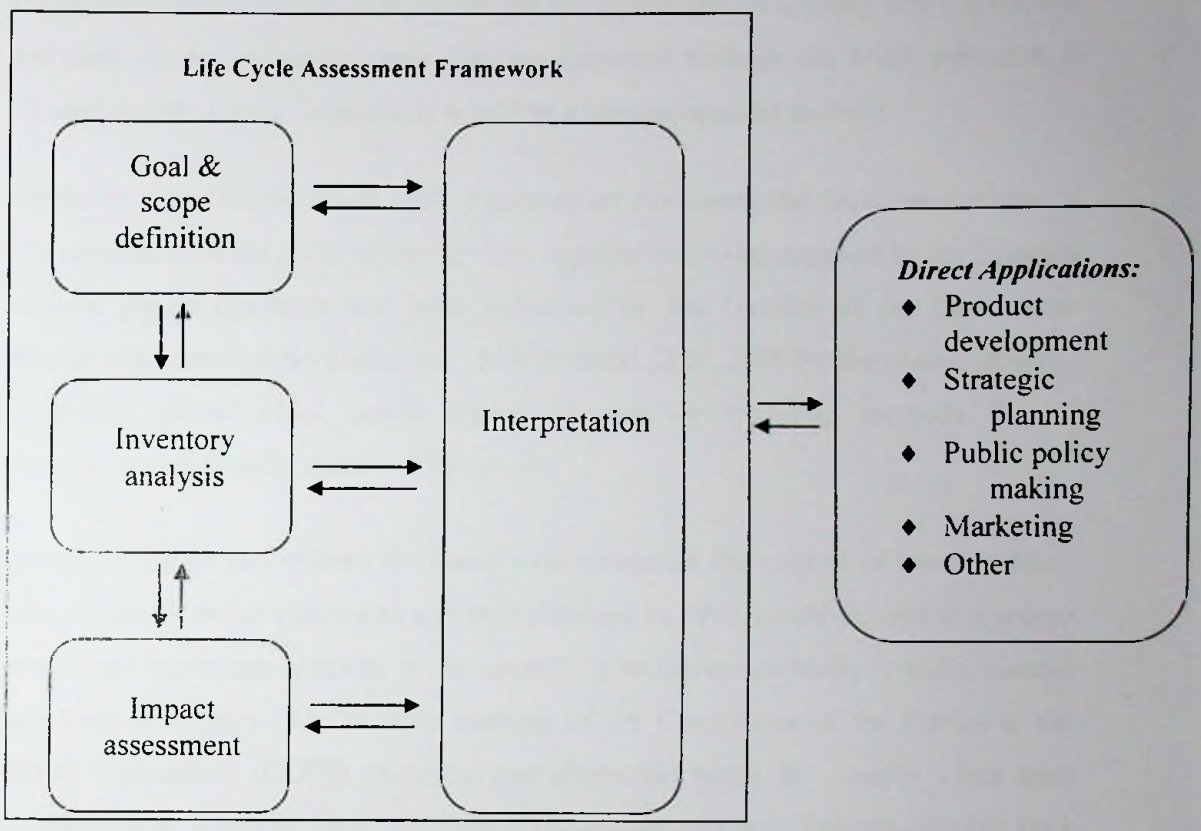


Figure 2.3: Phases of a LCA

The international standard ISO 14040 presents principle, framework and a few methodological requirements to carry out a LCA. Further facts are available in the complementary international standards ISO 14041, ISO 14042, and ISO 14043 concerning different phases of LCA study (ISO 14040:1997 (E)).

2.5. Environmental Taxation on Mobile phones in Sri Lanka

For the implementation of provisions of the Environmental Conservation Levy Act No.26 of 2008, commodities which with negative impacts on the Environment were identified by the Central Environmental Authority (CEA) after many internal discussions and then expert consultations, mobile phone (cellular phone) which requires special disposal or recycling methods for an environmental friendly disposal, had been selected for the imposition of a Green Cess (CEA, 2008). The CEA proposed to impose the tax at the point of importation of mobile phones into the country. However according to the Ministry of Finance and Planning, Sri Lanka, a

considerable amount of mobile phones are smuggled into the country and if a tax was imposed on the cellular phones that are imported through the legal path that is through the Sri Lanka Customs, it would be a discouragement to them.

Therefore the order No.03 of 2008, imposing an environmental conservation levy of 2% calculated on the value of the services supplied and to be supplied by the licensed cellular phone operators had been published by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1559/10 dated 22.07.2008 for the reason of using a mobile phone which needs special disposal or recycling methods for an environmental friendly end of its life cycle.

Since Sri Lanka has ratified the Basel Convention on the control of transboundary movements of hazardous waste and their disposal in 1992, establishment of a proper hazardous waste management in the country in an environmentally friendly manner has been obligatory. At the sixth meeting of the Conference of the Parties to the Basel Convention (COP6) electrical and electronic waste (e – waste) has been recognized as a priority issue which required urgent attention. The requirement for e waste management had been considered especially important to the Asia – Pacific region. In addition to that due to its hazardous nature, Sri Lanka has identified e waste as a scheduled waste type which needs special handling methods and license for handling of them under the National Environmental regulation No. 01 of 2008 published by the gazette of the Democratic Socialist Republic of Sri Lanka No. 1543/18 dated 01.02.2008.

Besides that the Ministry of Environment and Natural Resources in collaboration with the Central Environmental Authority (CEA) has conducted a study aiming at preparation of a detailed inventory for selected e products in 2007 and had investigated that electronic equipment market grows annually by 7 – 10 % (MENR, 2008) . Since consumption rate of electronic and electrical items was at a considerable level and well regularized e waste management activities were not practiced at that time in Sri Lanka, it has been essential to launch an e waste management project to avoid adverse impacts of improper electronic waste

management in the country. Therefore as a solution, the Minister in charge of the subject of Environment and Natural Resources was able to bring out the concept of imposing a Green Cess on use of a Mobile phone under the provisions of the Environmental Conservation Levy Act. The mobile phone was selected among many other electrical and electronic equipments widely utilized in the country, for the imposition of a Green Cess, considering scientific factors, economic factors and also social aspects (CEA, 2008). Potential environmental impact of cellular phones had been previously studied by researchers from various viewpoints. From the life cycle point of view, ecological footprint analysis and life cycle energy modeling had shown that the raw material acquisition and the manufacturing stages of a mobile phone required a large amount of land area and energy (Lim *et al.*, 2010). However the ultimate objective of imposing a Green Cess on use of a mobile phone in Sri Lanka has been raising funds to implement a proper e waste management programme in the country (Gammanpila, 2008).

2.6. Global Trend in the use of Mobile phones

Since the 1990s, the telecommunications industry has changed dramatically with the wide diffusion of mobile telecommunications (Iimi, 2004). Mobile phone has become one of the most ubiquitous electronic products on the earth. Cellular phones have been essential instruments for telecommunication and information technology and are also regarded as fashion icons to identify and express personal character. Therefore, community continuously desire new and fashionable cellular phones with higher functionality. This consumer attitude has effectively shortened the useful life span of cellular phones, and was causing accelerated resource consumption for manufacturing due to the high content of rare and precious minerals in cellular phones and increased negative impacts on the environment largely from waste cellular phones (Lim *et al.*, 2010).

The number of cellular phone users has been amounted to more than 900 million in the world at the end of 2001 and has been increasing at an annual rate of 10.4% (ITU, 2002). It has been estimated that there were 4.7 billion mobile phone subscriptions around the world, most of which were in developing countries in the

year 2009 (ITU, 2010). According to the Ministry of Industry and Information Technology of China, global mobile phone out put has been 1.18 billion units in 2008 (Yu *et al.*, 2010). In the United Kingdom, it has been estimated that 18 million handsets are replaced every year (Ongongo, 2011).

The rapid introduction of new sophisticated technologies into mobile phones, increasing functionality such as cameras, music players as well as increasing per capita income were the major reasons for mobile phones' relatively short lifecycles (CEA, 2008).

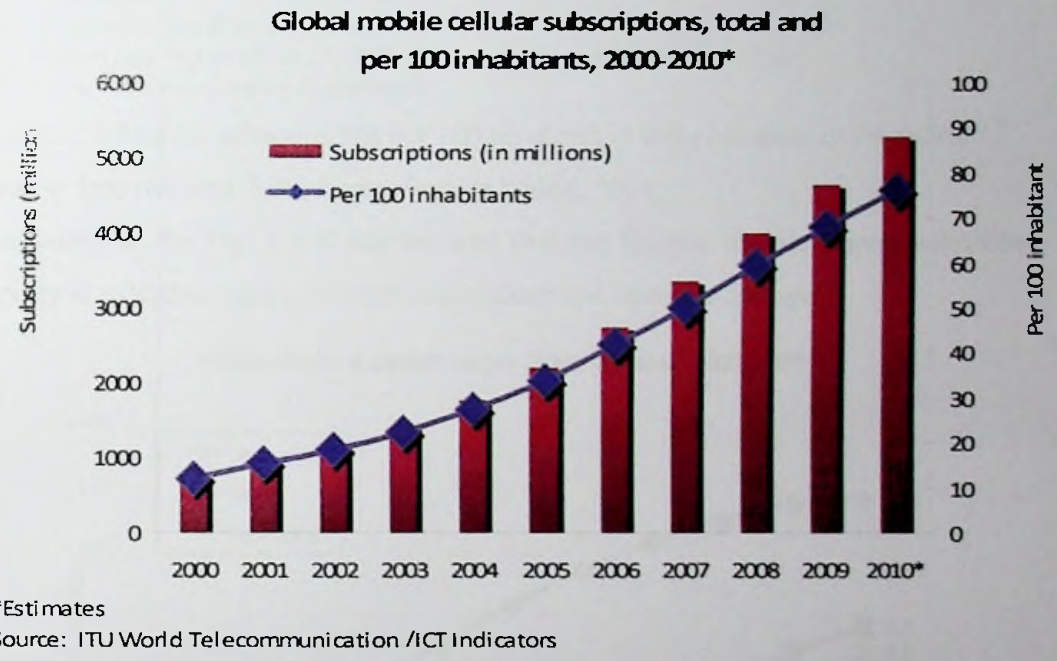


Figure 2.4: Global mobile cellular subscribers, total and per 100 residents from 2000 to 2010
(Source: International Telecommunication Union)

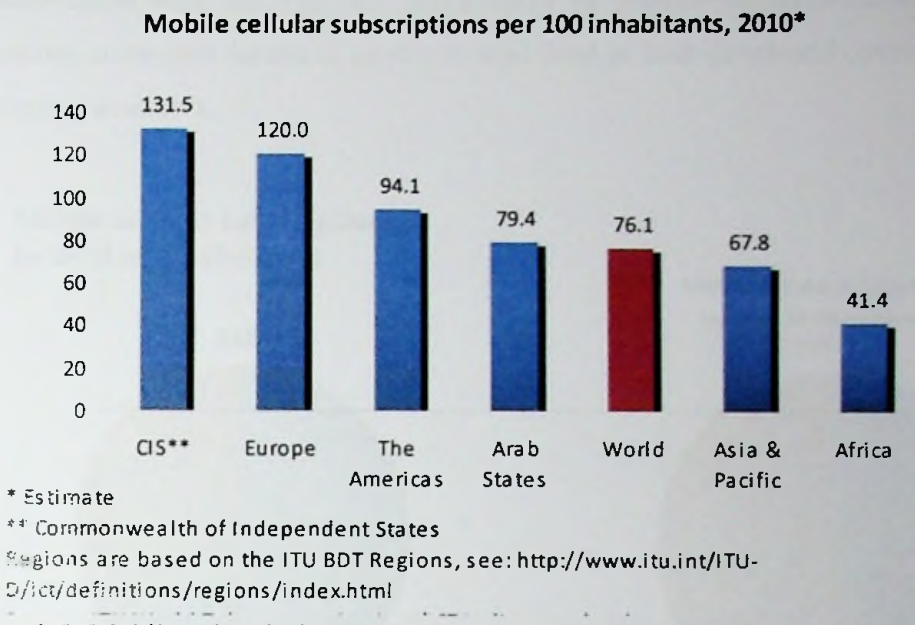


Figure 2.5: Mobile subscriptions per 100 residents in deferent areas in the world

Source: International Telecommunication Union, 2011

According to the Fig. 2.4 it can be seen that the highest mobile phone subscriber density is recorded from commonwealth states and from the Europe.

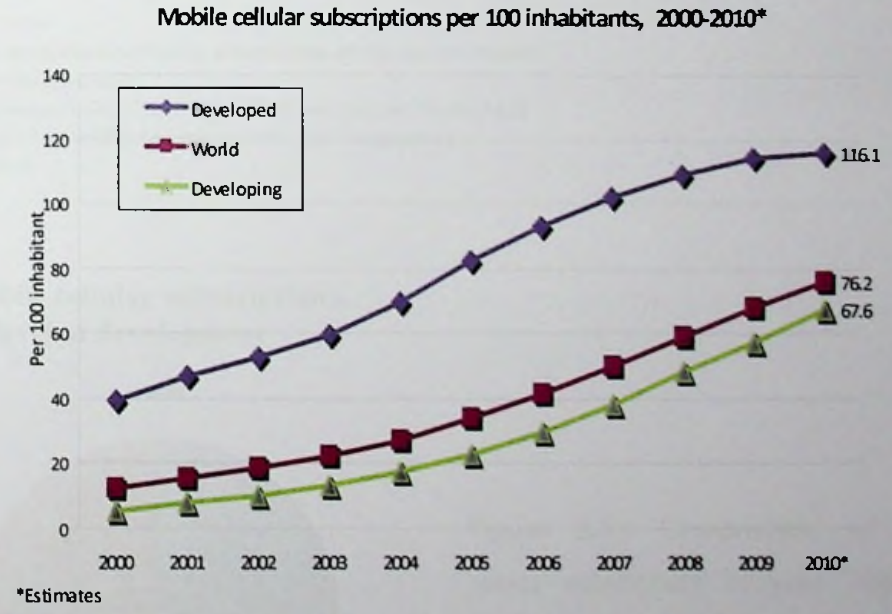
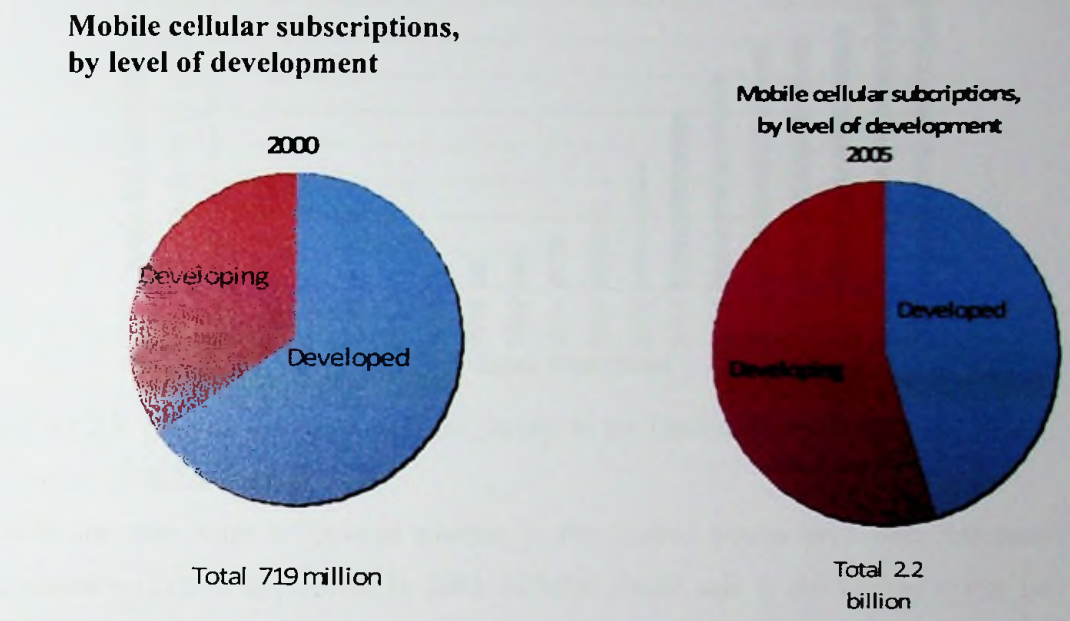


Figure 2.6.: Transformation of Mobile cellular subscribers per 100 residents in developed countries, developing countries and in the world. From 2000 to 2010

Source: International Telecommunication Union, 2011

In accordance with the Fig. 2.5 the number of mobile subscription has been increasing in the past decade at an accelerated level in both developed countries and developing countries.



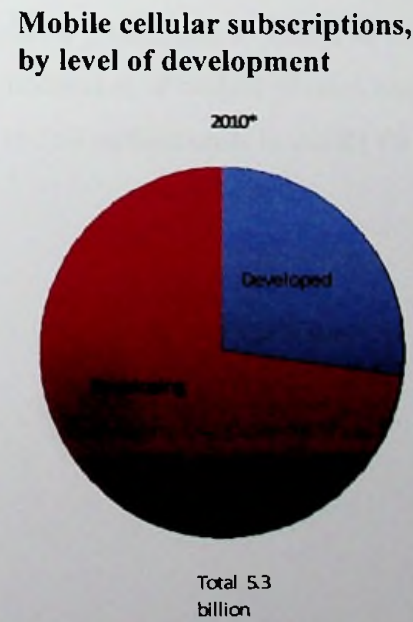


Figure 2.7.: Composition of mobile phone subscribers in year 2000, year 2005 and year 2010
(Source: ITU, 2011)

Contribution of developing countries to the composition of global mobile phone subscribers has been increased drastically.

Figure 2.8. : Sales volume of cellular phones in the United States.

Source: US EPA (2008a)

With the time sales of cellular phones in the United States have been increased drastically (Lim *et al.*, 2010). In 2003, cellular phone sale in the United States has exceeded 140 million units.

China has been the largest manufacturer and exporter as well as the largest consumer of mobile phones in the year 2010. Mobile phone plays a key role in the information industry in Chinese society. During the last few years, the Chinese mobile phone industry has increased at a rapid growth rate (Yu *et al.*, 2010). The ratio of mobile phone production in China to export has increased greatly since 2000. The Chinese production of mobile phones has also increased from 52.48 million units in 2000 to 560.50 million units in 2008 (Yu *et al.*, 2010).

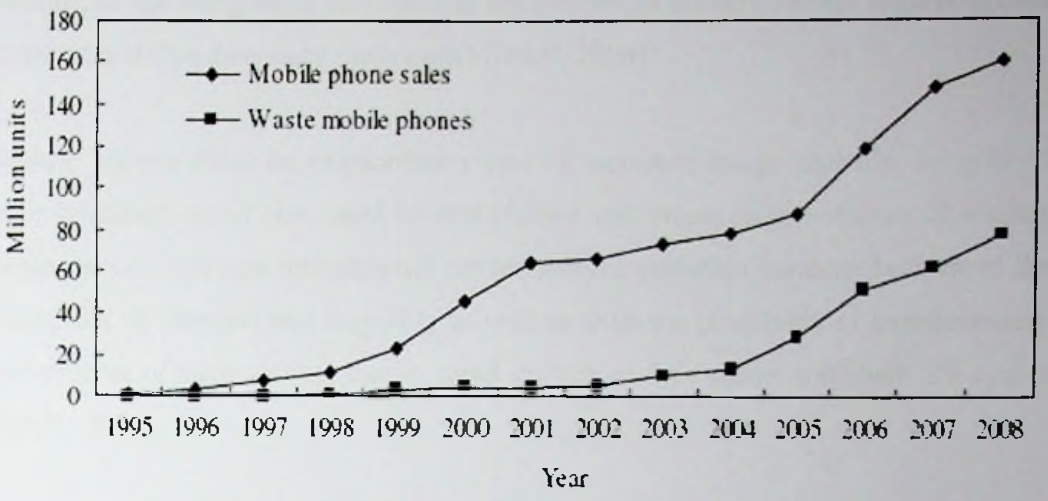


Figure 2.9.: Mobile phone sales and generation of waste mobile phones per year in China

It has been noted that the collection rate of waste mobile phones in China is comparatively low. Some surveys carried out in year 2008 has found out that approximately 40% of Chinese users stockpile their used mobile phones at home. 31% offer them to relations and friends , 23% sell them to curbside peddlers. 3% discard them as ordinary waste, and only 1% hand them over to formal collection agencies without payment. This survey results implied that between 20 and 30 million mobile phones are stored at home or work, unused in China (Yu *et al.*, 2010).

2.7. Hazardous Nature of Waste Mobile phones

Cellular phones have high detrimental environmental & health impact potentials basically because of their heavy metal content and consumer attitudes toward purchasing new phones with higher functionality and neglecting to return waste phones into proper take-back systems (Lim et al., 2010).

The Basel Convention defines hazardous waste as 'wastes that are enumerated in Annex I of the Convention, unless they do not possess a hazardous characteristic found on Annex III'. According to the Basel Convention cell-phones, even without the batteries are classified under hazardous waste. (The Basel Convention is the world's foremost only legally binding global tool for hazardous wastes on their

definition, and the general and specific obligations of country Parties regarding their disposal and transboundary movement) (BAN, 2004).

Mobile phones show an extraordinary rate of increased usage globally. In spite of their relatively small size, used mobile phones will create huge volumes of wastes, posing a very serious international environmental pollution concern both from the viewpoint of disposal and recycling as well as from the possibility of transboundary movements of such wastes, due to rapid growth of their usage and short life cycles (BAN, 2004).

It has been revealed that the Europeans and consumers in other developed countries typically replace their mobile phones at intervals of between 12 and 18 months. This is mostly because of frequent introduction of new sophisticated technologies and features into mobile phones, such as cameras and music players and therefore many users compel to replace their mobile phones though those are perfectly functional (Ongondo *et al.*, 2011). In the United States by themselves, experts had estimated that 130 million cell phones would be discarded, resulting in 65,000 tons of cell phone waste at the end of the year 2005 (BAN, 2004). The widely used determiner of hazardousness is the tendency to leach dangerous substances into the environment and it has been recognized in the Basel Convention as one method of defining hazardous characteristics.

2.7.1. Toxic components of a mobile phone

Mobile phones, especially older models, typically can contain following potentially harmful substances in each part.

- 1 & 2 - Cover and key pad - Chromium, Poly Vinyl Chloride, brominated flame retardants
- 3 - LCD screen - liquid crystals

- 4 - Circuit board - lead, brominated flame retardants (PBB, PBDE), mercury
- 5 - Battery - cadmium, nickel, lithium

Figure 2.10.: Parts of a typical mobile phone
(Source: http://news.bbc.co.uk, November, 2008)

As a study conducted by the University of Florida testing mobile phones on toxicity characterization of them, following details have been disclosed. The average composition of the cellular phones tested contain 45% plastics, 40% printed wiring (or circuit) board, 4% liquid crystal display (LCD), 0% solar cell, 3% magnesium plate, and 8% metals. These figures do not include cell phone batteries. As toxic substances lead, brominated flame-retardants, beryllium, hexavalent chromium, arsenic, cadmium, and antimony have been found there (BAN, 2004).

Cellular phone batteries are rechargeable batteries and rechargeable batteries contain toxic components such as cadmium, as well as brominated flame-retardants. Total environmental impact of cell phone batteries depends on both material composition of the battery and function of the length of time cell phones are used before they are discarded. Majority of cellular phone users replace the battery at least once before disposal of the phone (BAN, 2004).

2.7.2. Tendency to leach hazardous substances of disposed cellular phones into the environment at improper disposal

The Toxicity Characteristic Leaching Procedure (TCLP) test is an internationally accepted test to determine hazardousness from leachate sources of solid wastes. TCLP is a standard used to determine whether wastes possess the hazardous characteristic of being able to leach harmful substances from soil to groundwater resources that concludes the waste belongs to hazardous waste category (BAN, 2004).

The University of Florida has carried out a study using the standard TCLP to assess levels of eight metals they have found in the leachate from cell phones. Results of

only lead, iron, copper and zinc results are listed below. Using the standard TCLP, the University of Florida Study has tested cell phones without batteries (BAN, 2004).

Table 2.5.: University of Florida's TCLP Test Results for Cell Phones

Sample No.	Make	Model/year	Method	pH	Metal concentration in lechate (mg/l)			
					Cu	Fe	Pb	Zn
1	Motorola	SWF4018DF J 160017B	(M.S.)	4.9	0.01	43	141	6
2	Motorola	80148WNBEA	(M.S.)	5.0	0.11	87	115	0.4
3	Sprint	QCP-2700	(M.S.)	5.0	0.00	5	1.5	0.4
4	Motorola	SWF2049A H7 41843A4C	(M.S.)	4.9	0.01	6	1.6	3.0
5	Texas Inst	TI-36X Calculator	(M.S.)	5.0	0.04	11	0.8	1.0
6	Ericson	CR768	(M.S.)	5.0	1.16	44	115	19.0
7	Nokia	2120	(M.S.)	6.3	0.00	2	0.1	12.0
8	Nokia (b)	5160	(M.S.)	4.9	0.03	9	11	20.3
9	Nokia (p)	5160	(M.S.)	5.0	0.01	2	2	18.3
10	Motorola	Piper 34106NNDPA/1996	(M.S.)	4.9	0.00	107	14	4.5
11	Motorola	Piper 34106NNDPA/1996	(M.S.)	4.9	0.00	93	15	4.0
12	Motorola	piper 34106NNDPA/1996	(M.S.)	4.9	0.00	119	17	4.1
13	Motorola	Piper 34106NNDPA/1996	(M.S.)	4.9	0.00	113	17	2.7
14	Motorola	Piper 34106NNDPA/1996	(M.S.)	4.9	0.00	125	15	3.1
15	Motorola	Piper 34106NNDPA/1996	(M.S.)	4.9	0.00	111	16	0.3
16	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.00	109	20	3.5
17	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.01	109	21	4.1
18	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.01	97	16	3.1
19	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.01	94	17	3.1
20	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.00	105	20	3.3
21	Motorola	Piper 34106NNDPA/1996	(True)	4.9	0.00	83	18	2.5
22	Ericsson	DF688/1997	(True)	5.5	0.01	7	4	4.0
23	NEC	MP5G1A-1A/1996	(True)	5.4	0.02	4	3	7.0
24	Nokia	2160 EFR	(True)	8.8	0.00	0.1	0	0.2
25	Ericsson	KH668(2)/1997	(True)	5.6	0.08	14	16	7.7
26	Nokia	3390	(True)	5.0	0.82	56	60	18.9
27	NEC	DM2100MP5G1B1-1A	(True)	8.4	0.01	0.1	0.0	0.0
28	Nokia	5120i	(True)	5.0	0.08	56	16	16.0
29	Motorola	Piper 76362NNDBA/1995	(True)	5.1	0.00	121	30	3.1
30	Mitsubishi	G100e/1996	(True)	5.1	0.00	20	21	15.4
31	Qualcomm	QCP-820(2)	(True)	5.2	0.03	147	12	25.1

32	Ericsson	KH668(2)/1997	(True)	5.4	0.01	17	1.1	7.3
33	Qualcomm	QCP-820(1)	(True)	5.0	0.00	0.6	1.5	20.5
34	Nokia	6160/1997	(True)	5.0	0.22	0.3	32	12.8
35	Nokia	2180/1995	(True)	9.0	0.00	0	0	0.1
36	NEC	TR5E800-26B Portable	(True)	5.0	0.00	0.1	65	2.4
37	Motorola	FR50/2001	(True)	5.0	0.01	0.3	6	85.0
38	Nokia	918+	(True)	8.4	0.00	0	0	0.1
39	LGIC	LGP-2300W	(True)	5.0	0.13	0.2	23	5.4
40	Nokia	6160i	(True)	5.0	0.17	0.3	31	13.4
41	Nokia	6160(2)/1997	(True)	5.0	0.06	0.4	16	19.6
42	NEC	MP5AF4-1APortable/1995	(True)	5.0	0.10	0.1	61	15.1
43	Motorola	Micro Elite TAC Lite II	(True)	5.0	0.00	21	21	8.3
44	Motorola	Ultra Classic	(True)	5.0	0.00	0.1	24	1.6
45	Motorola	Profile 300	(True)	5.0	0.09	69	35	0.7
46	Motorola	76254NNFDA/1991	(True)	4.9	0.35	6	47	1.5
47	Motorola	Micro AC Elite (2)	(True)	5.0	0.03	59	13	6.8
48	Motorola	Micro TAC Elite	(True)	5.0	0.05	78	18	5.8
49	Qualcomm	QCP-820(3)	(True)	5.0	0.00	74	1.4	10.7
50	Motorola	F09HLD8415BG/1991	(True)	5.0	0.00	23	48	15.7
51	Motorola	F09HGD8467CG/1989	(True)	5.0	0.06	20	40	1.5
52	Motorola	34106NNRSA/1995	(True)	5.0	0.01	66	19	6.0
53	Nokia	2160EFR(2)/1994	(True)	4.9	0.00	1.7	0.3	7.8

2.7.3. Detrimental impacts of hazardous constituents of mobile phones

Persistent Bioaccumulative Toxins (PBTs)

The danger of the Persistent Bioaccumulative Toxins (PBTs) is that they do not degrade in the environment over long periods of time, and are able to easily spread and move between air, water, and soil. It results bioaccumulation of toxins far away from the original point source of pollution. PBTs accumulate in fatty tissue of humans and animals and the toxins are gradually concentrated through food chains, putting those at the top of the food chain at the maximum risk. Many materials found in cell phones belong to the category of PBTs (BAN, 2004).

As stated by the United States Environmental Protection Agency (EPA), "PBTs are associated with a range of adverse human health effects, including damage to the nervous system, reproductive and developmental problems, cancer and genetic

impacts." Children are a particularly sensitive population adversely impacted by PBTs (BAN, 2004).

Lead

Lead (Pb) is a widely used metal in electronics. It is a highly dangerous PBT which is a common contaminant and extremely toxic to human health as well as to the environment resulting very high chronic and acute effects on microorganisms, plants, animals and on humans. As adverse impacts of Lead accumulation in human body, affecting the central nervous system, immune and vascular systems, kidneys, and the endocrine system, with serious effects on the development of children's brains and resulting intelligence quotients have been suggested. In addition Lead is a carcinogenic substance (BAN, 2004).

Brominated Flame Retardants (BFRs)

Brominated flame retardants (BFRs) are used in mobile phones to prevent flammability and BFRs are mainly included in the plastic housing and printed wiring boards of cellular phones. Some BFRs have been proven to be affecting human health and the environment. The rest is still being tested for their negative impacts (BAN, 2004).

There are various types of brominated flame retardants used in electronics.

1. Hexabromocyclododecane (HBCD)
2. Polybrominated biphenyls (PBBs)
3. Polybrominated diphenyl ethers (PBDEs)
    - Decabromodiphenyl ether (Deca-BDE)
    - Octabromodiphenyl ether (Octa-a - BDE)
4. Tetrabromobisphenol (TBBP-A)

It has been revealed that BFRs belong to the category of persistent bioaccumulative toxins (PBTs) and can leach from landfills to the environment. Polybrominated diphenyl ethers (PBDEs) are associated with cancer, liver damage, neurological and immune system problems, thyroid dysfunction and endocrine disruption (BAN, 2004).

If copper was present during incineration, (as it is in printed wiring boards), it would increase the risk that BFRs will create highly toxic brominated dioxins and furans. If the incineration occurred at low temperatures, as is commonly found in e-waste recycling operations in developing nations, the incomplete combustion would generate even higher amounts of dioxins and furans. A number of studies carried out have found that BFRs were included in human breast milk and levels of PBDEs in the breast milk of North American women that were forty times higher than the highest levels found in Sweden (BAN, 2004).

Beryllium

Beryllium is an extremely toxic metal if inhaled and is generally used in beryllium-copper alloys to increase flexibility and strength in components that need to be flexible. Mostly labourers at mobile phone manufacturing factories and recycling facilities are affected by exposing to Berillium dust or fumes and entering the body through respiratory system. Beryllicosis can cause a permanent scarring of the lungs, sometimes years after initial exposure, and can be fatal (BAN, 2004).

2.8. Extractable Constituents of Waste Mobile Phones

Generally major components of a mobile phone are case/plastic housing, liquid-crystal-display (LCD) panel, keypad, printed circuit board (PCB), frame/plate, antenna, battery, speaker, and microphone (Wu et al., 2007). Mobile phones vary from each other depending on their design, manufacturer, brand name and production year. However, all phones have the same general structure and composition (Yu et al., 2010).

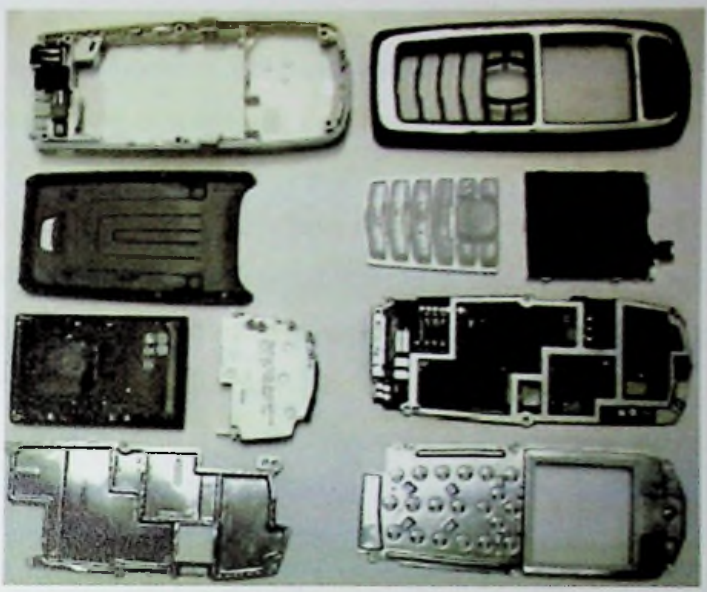


Figure 2.11. : A Mobile Phone dismantled in to its main components.
(Source: Wu *et al.*, 2007)

Figure 2.12. : A Mobile Phone dismantled in to its main components. 'Original in Colour' (Source: photograph taken by the author)

Many valuable and sensitive materials are included in waste cellular phones. Therefore, it is important to illustrate the economic value of precious metals associated with the flow of waste mobile phones (Yu *et al.*, 2010).

Plastics (not including epoxy based) have the highest contribution in the total weight of a cellular phone, followed by metals, ceramics, and epoxies. The main materials used for the housing, key pad, many components and connectors are plastics (Wu *et al.*, 2007). Even though plastic, glass, and other materials comprise a large part of a mobile phone, value of them is much lower compared to metals and can be neglected from economic viewpoint (Yu *et al.*, 2010).

A variety of metals are used in the printed circuit board (PCB) components, frames, plates, screws, and other parts. The ceramics includes the glasses in the LCD and PCB as well as the ceramics in the components. Epoxy resin is a dominant substance in the PCB. Other constituents such as organic solutions in the battery and the polycyclic aromatic hydrocarbon of the LCD are estimated to be 2%–3%. Both the plastics and PCB are likely to contain bromine in organic compounds which was used as a flame retardants, which may pose the threat of forming dioxins and furans in poor combustion and controlled exhaust gas streams. Metal components, more than 20 elements, contributed to 35% – 40% of the total mass. In accordance with a comparative analysis of materials in cellular phones, it has been found that although various cellular phones were quite different in model and production year, the type of elements and their relative ratio did not change (Wu *et al.*, 2007).

More precious metals such as copper, gold, and silver and toxic metals such as Pb, Cd, Hg, As, Ni, and Cr were contained in mobile phones. If the average weight of a mobile phone was 125 g, the economic gain of recycling one ton of waste mobile phones in China would be US$ 10,860 according to the metal prices in 2008. If all the waste mobile phones generated in 2008 in China were formally recycled, more than 1250 t Cu, 480 t Fe, 13 t Ag, 3 t Au, and 2t Pd would be recovered for an economic benefit of US $ 105 million (Yu *et al.*, 2010).

Analyzed detailed composition of metallic contents (24 elements) of two selected mobile phones is presented in the following table. Some trace elements were not included there because their presence has been less than mg/L level. Those two mobile phones (E & N) have been collected from a recycler. The sample E has been launched in to the market in 1998 and the sample N has been available in the market in 2003. The total weight of metal components of sample E has been more than twice of total weight of metal of sample N (Wu *et al.*, 2007).

Table 2.6. : Metal contents of two mobile phones

Source: Wu *et al.*, 2007

Element	Metallic content (g)	
	Sample E	Sample N
Al	17.1636	9.6814
Fe	16.3912	5.1121
Cu	13.1702	7.0213
Co	9.6921	4.1331
Zn	1.4492	0.0770
Ni	1.3070	0.6652
Sn	0.7665	0.4778
Cr	0.5714	0.5432
Pb	0.4328	0.1250
Mg	0.1919	0.0013
Ag	0.1052	0.0712
Mn	0.0855	0.0478
Ba	0.0658	0.0826
Nd	0.0628	0.1167
Sb	0.0478	0.0070
Au	0.0265	0.0133
Pd	0.0099	0.0039
Ti	0.0089	0.0283
Be	0.0070	0.0020
W	0.0056	0.0006
Bi	0.0032	0.0008
As	0.0026	0.0031
Cd	0.0004	0.0002
Hg	0.00008	0.00001
Total	61.5672	28.2149

Total weight of sample mobile phone 'E' = 153.38 g

Total weight of sample mobile phone 'N' = 80.25 g

2.9. Energy Consumption of a Mobile phone during its Lifecycle

Mobile phone industry had a demand for raw materials and a huge amount of energy requirement for the process of raw material extraction. The overall energy consumption for mobile phone production in China has rapidly increased during the period from 1995 to 2008. The total energy requirement for manufacturing of total mobile phone production in China has been 9.8 x 10^{10} MJ in 2008 (Yu *et al.*, 2010).

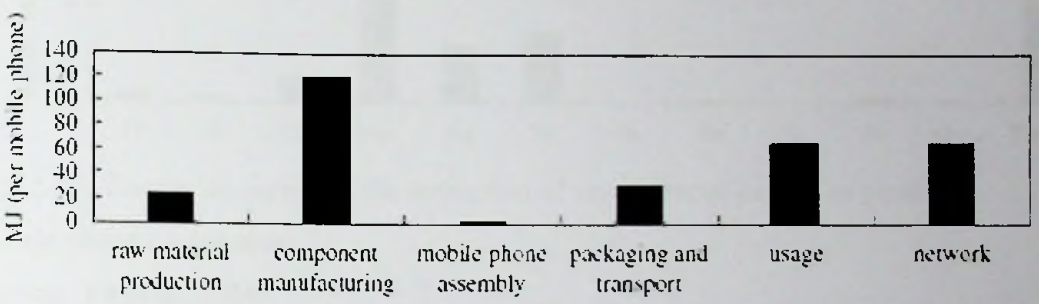


Figure 2.13.: Energy consumption of a mobile phone during its life cycle

Source: (Jinglei Yu, EricWilliams, MeitingJu, 2010)

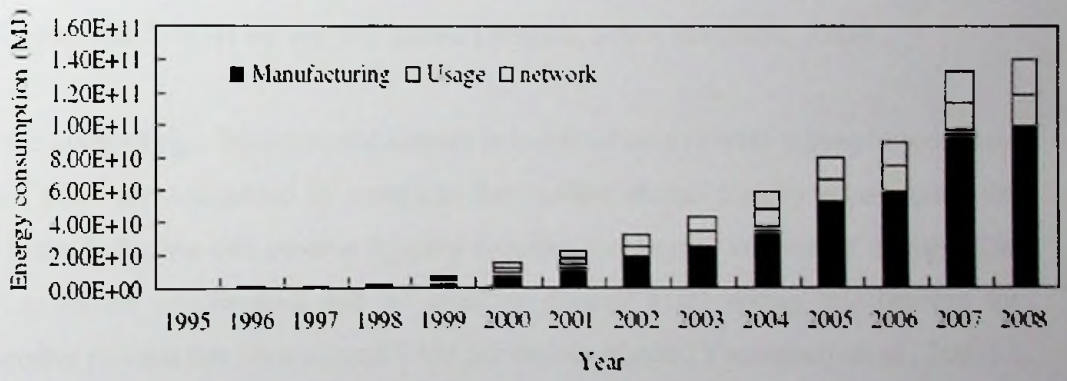


Figure 2.14.: Total energy consumption of mobile phone manaufacturing ,usage and network infrastructure.

Source: (Jinglei Yu, EricWilliams, MeitingJu, 2010)

2.9.1. Energy consumption during manufacturing of a mobile phone

It has been estimated that overall energy requirement for a production of a mobile phone was 175 MJ (Yu *et al.*, 2010). Raw material extraction and processing of them consumed 23 MJ for one cellular phone. Precious metals occur in smaller

percentages in a mobile phone. However amount of energy consumed to extract and process them has been very high compared to other materials (Yu *et al.*, 2010).

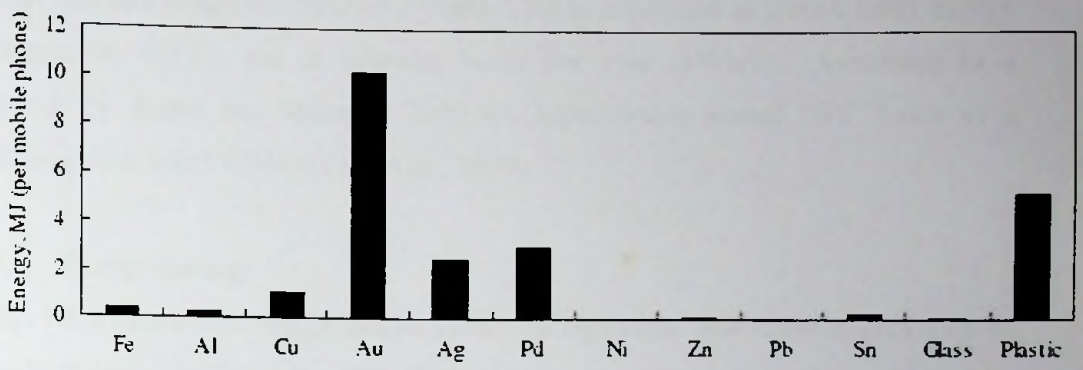


Fig. 2.15.: Energy consumed in the extraction of raw material needed to produce mobile phone components.

Source: Yu et al., 2010

The manufacturing phase of printed wiring board on which are mounted active components such as ICs and passive components such as capacitors and resistors has showed the highest energy requirement of a life cycle of a mobile phone. It has been estimated that 120 MJ for one cell phone (Singhal, 2005; Hoffman, 2003).

At the assembling a liquid crystal display is installed on a printed wiring board. Then other parts are assembled to complete the mobile phone. Finally adjustments are performed. During this process lighting requires the largest amount of energy. The rest is for air conditioning and for machine power. Total energy requirement for assembly process has been around 2 MJ per mobile phone (Yamaguchi et al., 2003).

Energy requirement for the phase of packaging and transportation differs from each other depending on factors such as packaging design and weight, transportation distance and so on. However energy utilization of this phase could be shown to be in the range from10 to 60 MJ (Singhal, 2005).

2.9.2. Energy consumption during use phase

Energy consumption during the use phase includes energy use for charging the battery for an average life time of 2 years. This is expressed as annual unity energy consumption (UEC) and in kilowatt hours per year (kWh/yr). According to a research by Rosen and Meier in 2000 the approximate annual UEC value of a cellular phone was 9 kWh/yr (Yu *et al.*, 2010).

2.9.3. Energy savings

It has been found that energy can be saved through reuse and material recycling of mobile phones. The following table illustrates energy savings that can be achieved by use of recycled materials instead of virgin raw materials extracted for manufacturing of mobile phones.

Table 2.7. : Energy savings of using recycled rather than virgin materials.
Source: Cui and Forsberg (2003).

Material	Energy savings (%)
Aluminum	95
Copper	85
Iron and steel	74
Lead	65
Zinc	60
Paper	64
Plastic	>80

Chapter 3

METHODOLOGY

3.1. Study of the Effectiveness of Already Implemented Policy Instruments

3.1.1. Selection of polythene plastic cess for the case study

The study was carried out as a lesson for the proper implementation of environmental conservation levy. Following criteria were considered for the selection of Polythene plastic cess for the case study

(i) Being a tax imposed considering environmental matter

(ii) Being an income source that is utilized for addressing the particular environmental issue.

3.1.2. Data and information collection

Primary data collection was done basically by personnel communication with the former Director and the present Director of the Post Consumer Plastic Waste Management Project. Other information was gathered by secondary information sources.

3.1.3. Analysis

For the analysis to determine the relationship between imported quantities of polythene and plastic raw materials and rate of import Cess on them, SPSS version 16 software was used.

Variable 1; imported quantities of plastic and polythene raw materials

Variable 2; tax rate of import Cess on polythene and plastic raw materials

3.2. Life Cycle Assessment (LCA) of Mobile phones for the Prediction of Recycling Cost of them.

Life Cycle Assessment (LCA) assesses the environmental aspects and potential impacts associated with a product or a service. Several steps are followed to complete the assessment as, assembling an inventory of relevant inputs and outputs of a product system, evaluating potential environmental impacts of those inputs and

outputs and finally interpretation of the results of the inventory analysis and impact assessment (ISO 14040:1997(E)).

3.2.1. Phases of a LCA

Life Cycle Assessment includes several stages as definition of goal and scope, inventory analysis, impact assessment and interpretation of results.

The international standard ISO 14040 presents principle, framework and a few methodological requirements to carry out a LCA. Further facts are available in the complementary international standards ISO 14041, ISO 14042, and ISO 14043 concerning different phases of LCA study (ISO 14040:1997 (E)).

Definition of Goal and Scope

The goal and scope of the LCA is clearly defined here. The goal of the study states the intended applications, the rationale for conducting the study and expected addressees.

The following matters should be clearly illustrated in defining the scope of the study.

- The functions of the product system
- The functional unit
- The product system
- The system boundaries
- Allocation procedures
- Impacts and method of impact assessment
- Data requirement
- Assumptions
- Type of critical review
- Type and format of the reporting

Function and the functional unit

The scope of the study includes functions of the system. A functional unit provides a reference to which the input and outputs are related and provides the ability to compare LCA results.

Quantities of mobile phones consumed from year 2006 to 2010 were selected for the study because of the availability of data. According to the Central Environmental Authority and relevant private parties the average life span of a mobile phone in Sri Lanka was 5 years.

System boundaries

The system boundary determines which unit processes are included in the assessment. Sri Lanka imports manufactured mobile phones to the country. Therefore it was selected the process from importation up to the disposal that are occurred within the country.

Data and Information Collection

Information collection for determination of system boundaries and identification of life cycle stages was done basically through personal communication with the relevant organizations in the country.

Data collection for determination of quantities of mobile phones consumed within the country, for the predictions of future consumptions, prediction of waste generation, prediction of possible amounts that could be recovered from the waste and their values, was done through personal communication with relevant institutions and secondary data collection.

3.2.2. Selection of mobile phones used in Sri Lanka for LCA

Mobile phone was selected for the LCA to determine recycling cost based on following reasons.

Mobile phone had been selected by the Central Environmental Authority considering environmental factors, social factors as well as economic factors, for the imposition of environmental conservation levy under the provisions of Environmental

Conservation Levy Act No. 26 of 2008 for the reason of generation electrical and electronic waste (e waste) that would create detrimental impacts on the environment. It was expected to invest the revenue for e waste management in the country and however Sri Lanka does not practice material recovery or recycling of waste mobile phones within the country.

3.2.3. Estimation of quantities of waste mobile phones and recoverable materials

It was assumed that total number of mobile phone connections was similar to the actual number of mobile phones. Number of phones containing duel sim was considered as negligible.

For the prediction of waste quantities of mobile phones it was assumed that the lifespan of a mobile phone within Sri Lanka was 5 years based on data obtained from two responsible institutions in e waste management in the country.

Values of recoverable materials were calculated for selected metals that have high values in the market and for the metals that the data was available. For the prediction of the values market price method was followed.

3. 3. Fund Disbursement

3.3.1. Option 1

Identification of the sectors to be financially facilitated by the environmental taxation system in Sri Lanka was based on the sectors which represented the proposed Environmental Council for the environmental taxation programme and fund disbursement.

However the following sectors were selected for the development of a methodology for fund disbursement for the purpose of environmental conservation and management in the country.

Raising a fund for adaptation for impacts of climate change was an objective of the Central Environmental Authority when the environmental taxation procedure was introduced. Therefore it was added here. Since there is a global power crisis it is beneficial to develop innovative methods and renewable energy practices.

Meteorological department's subjects and subjects coming under the Ministry of Land were deleted from the list because environmental concerns of those sectors are covered by other sectors that directly deal with the environment.

Small and medium scale enterprises were specially mentioned for the pollution control sector. Aquatic resources were added because there are separate institutions that handle the subject and it was not included in the proposed list.

i. Adaptation fund for impacts of climate change
ii. Sustainable Energy (for innovations, renewable energy projects)
iii. Forest Conservation and Management /Flora Diversity Conservation, Protected area management
iv. Wildlife Conservation/Fauna Diversity
v. Natural Resource Management (Geological mines, minerals, water management, other aquatic resource management
vi. Marine Pollution Prevention
vii. Coast conservation
viii. Areas coming under the purview of Meteorological Department
ix. Pollution Control (eg: subsidies to small and medium scale enterprises)
x. Solid waste management (eg; funding Pilisaru project)
xi. Eco System enrichment/management

The proposed methodology for the fund disbursement is a kind of Multi Criteria Decision Making.

3.3.2. Option 2

Identified environmental challenges pointed out in section 2.2.2.2. were based for the identification of areas that need to be financially facilitated to carry out required activities for environmental management and conservation in the country.

Following sectors have been highlighted in the section:

1) Rich bio diversity of Sri Lanka being a biodiversity hotspot of the world
2) higher population density of the country

3) Negative impacts of deforestation and irregular land use practices on the environment including watersheds
4) Issues of land degradation
5) Solid waste problem
6) Necessity of wetland management
7) Water pollution by agrochemicals
8) Industrial pollution due to lack of treatment facilities
9) Direct discharges to water bodies
10) Increasing air pollution in urban areas
11) Severe air pollution by mobile sources

Therefore following measures were identified to address above mentioned facts.

1. Prevent avoidable air pollution by mobile sources
2. Incentive or loan scheme for small and medium scale enterprises for pollution control
3. Identification and elimination of direct discharges to water bodies
4. Introduction and implementation of innovative or indigenous practices instead of polluting agrochemicals
5. Solid waste management
6. Enrichment of environmental sensitive areas
7. Protecting watersheds
8. Community based projects wetland conservation
9. Forest Management
10. Economic incentives for Wildlife conservation
11. Conservation of threatened and vulnerable species

According to the Central Environmental Authority a tax is imposed to address a particular issue and mostly funds raised by the taxes would be required to address that particular issue. In addition to that there are problems that arise in some time periods and such problems also required to be addressed. For example; power crisis in Sri Lanka needs innovations for uses of renewable energy sources. Adaptation programmes for impacts of climate change fall into this category.

In addition decision makers of a country should have a good understanding on environmental issues and requirements of the environment. Therefore following 3 factors were added in addition to the above mentioned facts.

1. Identified specific objectives at the imposition of taxes
2. Timely environmental problems in the country during the respective year
3. Awareness for politicians and decision making officers of the government

Then total number of measures identified totaled up to 14.

The proposed ECC could finalize the fund disbursement mode according to the received project proposals after a thorough review.

Chapter 4

RESULTS AND DISCUSSION

This chapter presents results of qualitative and quantitative analysis of the study.

4.1. Study of the effectiveness of already implemented policy instruments

(Case study on the effect of plastic Cess on the behavioural change of the society)

4.1.1. Background information of the plastic polythene cess

During the early periods of the 1st decade after the millennium it has been calculated that about 160,000 tones of plastic raw materials and products had been imported under the HS 39 annually. Out of this amount 30% had been exported back as finished products and the rest has been come to the local market. This amount was haphazardly disposed to the natural environment as post consumer plastic waste.

Plastic and polythene waste do not degrade naturally and environmental unfriendly practices of the society in disposing them as post consumer waste had been occurring severe environmental problems in the country. Therefore considering environmental problems as well as human welfare, the Sri Lanka had taken several attempts to control manufacturing and use of polythene materials within the country. However all such efforts had been ineffective as a result of various economic and social implications arisen (CEA, 2004).

Afterward under the provisions of Export Development Act No. 40 of 1979, a Cess has been imposed on the plastic and polythene raw materials and products imported under the HS 39 code by the Gazette of the Democratic Socialist Republic of Sri Lanka no. 1382/01 dated 28.02.2005. The fundamental objective of introducing this Polythene – Plastic Cess has been raising funds for establishing a post consumer plastic – polythene waste management system in the country (CEA, 2004). Initially it has been imposed 1% Cess on Plastic and polythene materials imported under HS 39 code in 2006 and then the amount of Cess was gradually increased by the Government as 3%, 5% and finally 10% (Custom, 2009).

4.1.2. Effects of the polythene plastic cess on polythene and plastic in the country

4.1.2.1. Impact of the Cess on importation of polythene and plastic

i) Behaviour of imports under HS 39 (polythene & plastics) with the changes of import Cess.

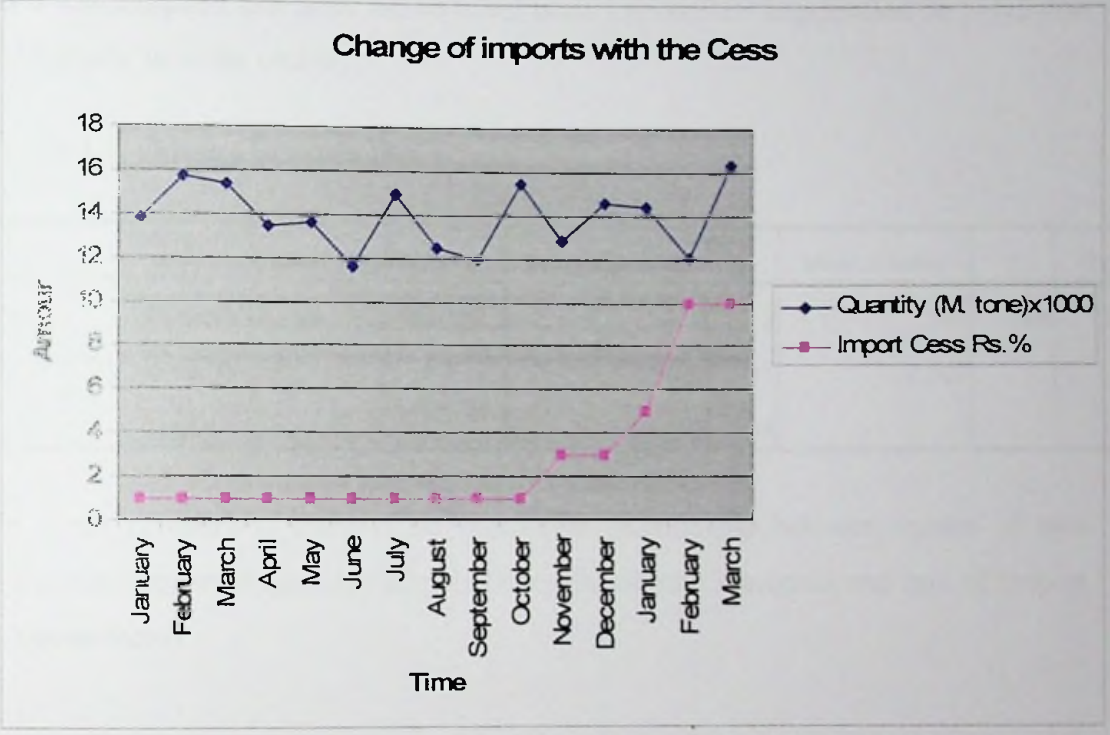


Figure 4.1.: Relationship between increases of Polythene Cess rate and imported amount of polythene and plastics, from January 2008 to March 2009

From the introduction of the Cess on polythene and plastics in February 2005 under the provisions of the Export Development Act No. 40 of 1979 the rate has been 1% until October 2008. The rate of the Cess was increased as follows;

October 2008 to December 2008 :- 3%

December 2009 to January 2009 :- 5%

February 2009 up to date :- 10%

There are several other taxes imposed on materials imported under HS 39 as customs duty, excise duty, etc. Therefore it is quite difficult to decide the exact behavioural pattern of importation of polythene and plastics with the changes of import cess on them without keeping other taxes constant.

The Government's prohibition of manufacturing polythene or polythene products which is 20μ or less than 20μ in thickness was prevailing during the considered time period. Therefore it was assumed that the impact of this law on the amount of polythene raw materials imported was constant.

If it was assumed that there are no other taxes imposed on importation of polythene and plastic in to the country,

Table 4.1. : Mean Comparison

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Imported quantity * Import Cess	Between Groups	(Combined)	.570	3	.190	.068	.976
	Within Groups		30.820	11	2.802		
	Total		31.390	14			

In mean comparison there is no significant relationship between means of two variables (imported amounts of polythene, plastic raw materials and rate of import Cess on them).

Linear Regression Analysis

Linear regression is used to specify the nature of the relationship between two selected variables.

Table 4.2. : Correlations

		Import Cess	Imported quantity
Import Cess	Pearson Correlation	1	.097
	Sig. (2-tailed)		.732
	N	15	15
Imported quantity	Pearson Correlation	.097	1
	Sig. (2-tailed)	.732	
	N	15	15

Pearson correlation shows that there is no any significant relationship between two tested variables. Here level of significance is 0.097 that is > 0.05.

According to results of the mean comparison and linear regression analysis, it can be decided that there is no direct impact of import Cess on importation of polythene and plastic raw materials into the country.

ii) Changes of the revenue collection and the pattern of the importation

According to the graph it is obvious that the revenue of the cess on polythene and plastic importation has been increased with the increase of the rate of the Cess, however there is no distinct change in the pattern of the amount of polythene and plastics imported with the changes of the Cess.

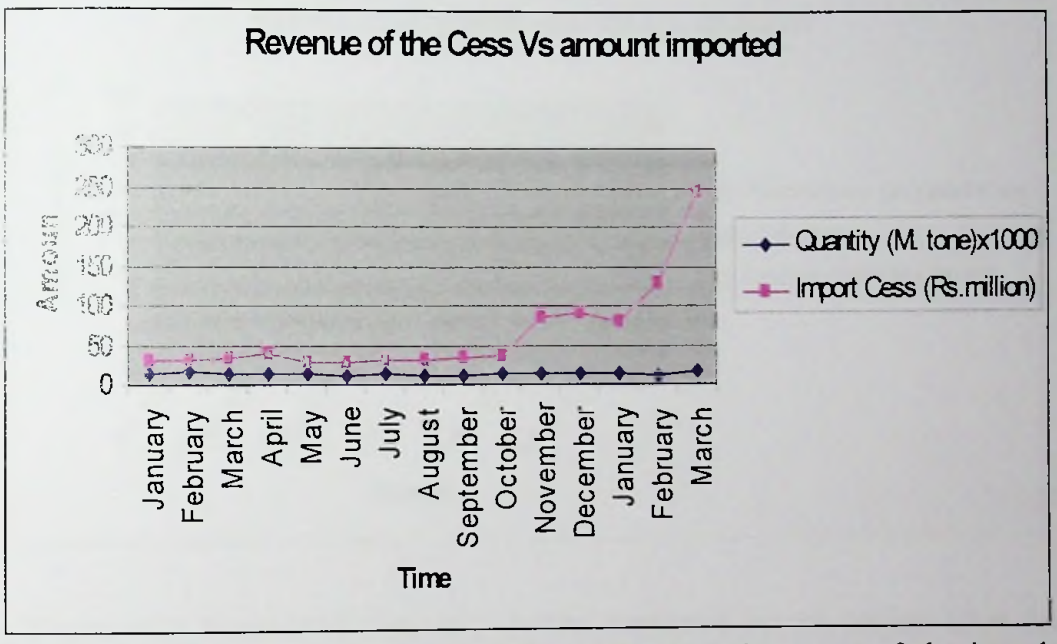


Figure 4.2.: Changes of the revenue of Polythene Cess and amounts of plastic and polythene imported from January 2008 to March 2009.

4.1.2.1. Post consumer plastic waste management

A project funded by the revenue generated by import cess on polythene and plastic was commenced in May 2007 for the purpose of creating a behavioural change among the Sri Lankan community to ensure a proper disposal of plastic – polythene waste in a manner that does not harm the environment and to put in place necessary logistics enabling collection and recycling of post consumer plastic waste in the

country. The project is being implemented up to date and have been extended island wide.

It conducts following activities for regularizing of post consumer polythene – plastic waste management in the country.

(i) Conducting awareness programmes and environmental camping for students

Target groups: School children, Dhamma school students and teachers. government officers, non government organizations, community based organizations

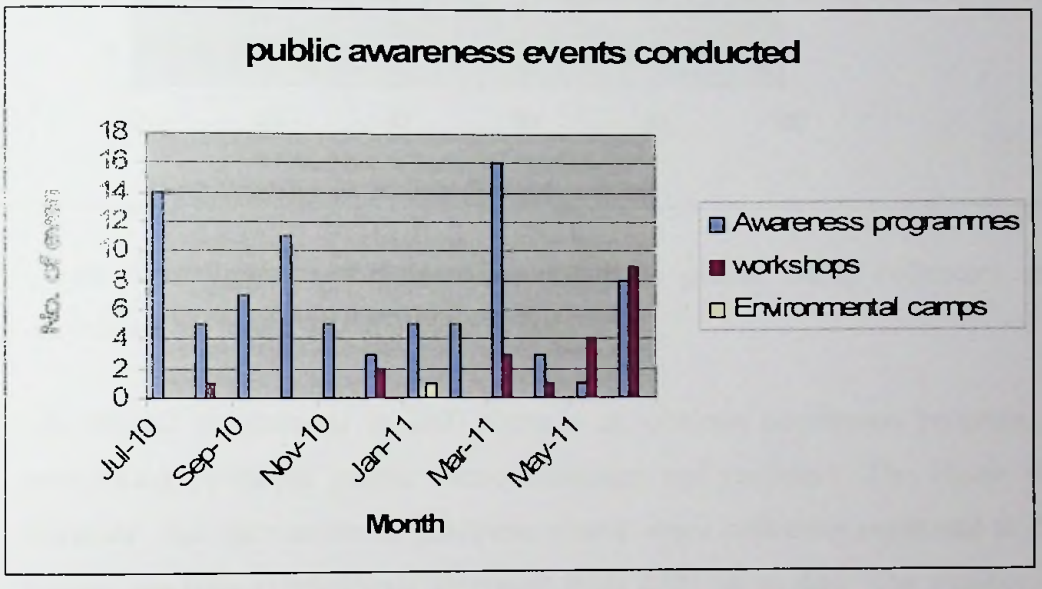


Figure 4.3.: Number of awareness events conducted by the project from July 2010 to June 2011

i) Development of a recycling network in the country.

a) Providing infrastructure facilities to local authorities for waste management

Distribution of waste disposal bags (95,000 bags in 2010)

Providing waste disposal bins (300 bins in 2010)

Providing waste disposal tractors (05 in 2010)

Providing waste disposal trailers (07 in 2010)

Permanent waste disposal tanks (25 in 2010)

b) Coordinating and facilitating polythene plastic waste collectors and recyclers

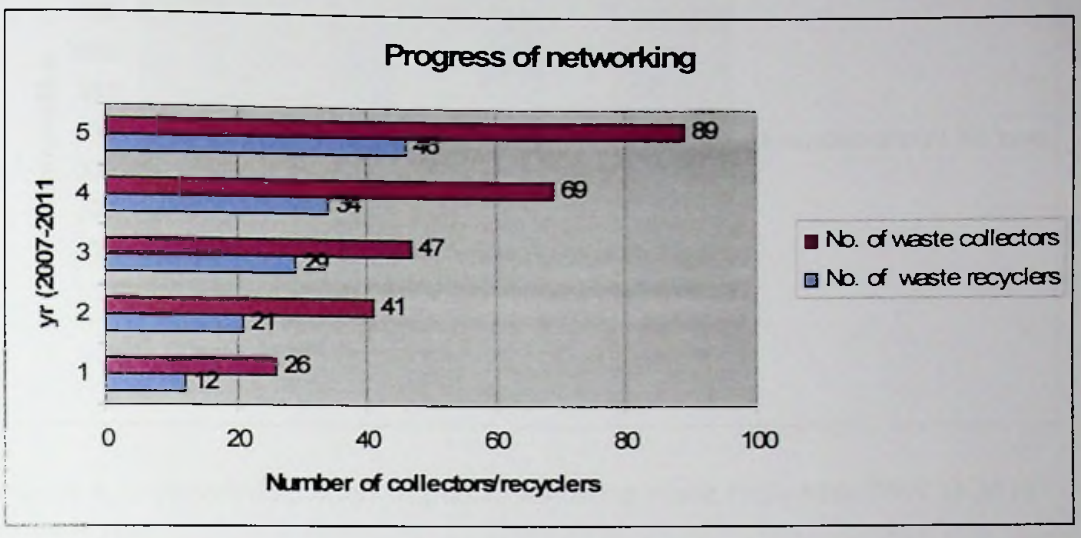


Figure 4.4.: Progress of networking polythene plastic waste collectors and recyclers from May 2007 to middle of 2011.

The project commenced in 2007 there is an obvious continuous progress in networking polythene plastic waste collectors and recyclers. The figure 4.4 illustrates that the number of polythene plastic waste collectors registered at the project has been continuously increased from 2007 up to date. The number of polythene plastic waste recyclers has also been increased from the beginning of the project up to now.

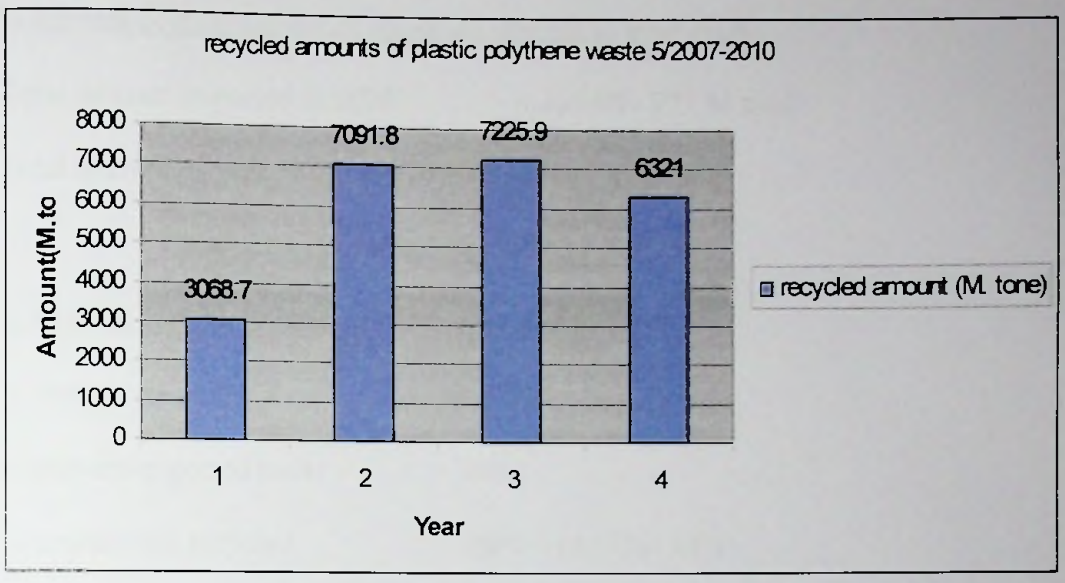


Figure 4.5.: recycled amounts of plastic polythene waste from May 2007 to 2010 in each year

As illustrated by the figure 4.5., the highest amount of polythene plastic waste recycled has been recorded in year 2009.

As the Post Consumer Plastic Waste Management project commenced its operations in May 2007, the progress of the year 2007 was for around 7 months.

Assuming that imported plastic – polythene materials within a year, are subjected to be recycled in the same year,

% amount of recycled out of imported amount in year 2007

Total amount imported in 2007 = 172,124.773 MT

Total amount of waste recycled in 2007 = 3068.7 MT

% amount recycled in 2007 (7months) = 1.78%

If it was calculated for the entire year, assuming project started in January 2007;

% amount recycled in 2007 $= \frac{1.78\%}{7} \times 12$

% amount recycled in 2007 = 3.05%

% amount of recycled out of imported amount in year 2008

Total amount imported in 2008 = 165,989.977 M tone

Total amount of waste recycled in 2008 = 7091.8 M tone

% amount recycled in 2008 = 4.27 %

% amount that might have not been recycled in 2008

% amount recycled = 4.27%

% amount exported back = 30%

% amount not recycled = 100% – (4.27%+30%)

= 65.73%

Weight of materials not recycled = 165,989.977 M tone x 65.73%

= 109105.21 Metric tone

In year 2008 efficiency of waste recycling has been 4.27%. Amount that was not recycled has been 65.73%. This amount might be included in commodities/utensils manufactured by polythene or plastics being used or being disposed improperly in the environment.

% amount recycled against amount of waste collected

Average amount of waste recycled per month = total amount recycled / No. of months (May 2007 -2009)

= 17386.4 metric ton / 7+12+12 months

= 560.85 metric ton per month

Amount of waste collected by the local authorities per day was 2,838,455 kg and composition of waste polythene and plastic was 5.91% (MENR, 2005). If there are 30 days for a month;

% waste polythene plastic recycled against Collected waste polythene plastic = amount recycled / Amount collected X 100

$$= \frac{560.85 \text{ MT per month}}{5032.58 \text{ MT per month}} \times 100$$

$$= 11.14\%$$

The real value of the percentage of waste recycled against waste collected might be lower than the calculated value because data used to calculation for the recycled amount was data from the period of 2007 to 2009 and data of collected waste polythene and plastic was quoted from a publication in 2005 and therefore it must be before 2005.

ii) Promotional programmes

National level and local level promotional activities, participating at national exhibitions, sponsoring "Derana" monthly environmental TV programme, sponsoring "Sobaketha" environmental TV programme, production and telecasting 'Mr. Green' TV programme and other types of sponsoring and media coverage

iii) "Polypto" Lanka Private Limited

The "Polypto" Lanka Private Limited was a project for recycling waste polythene and plastic into a combustible liquid fuel using an innovative technology identical to them. The project has been commenced on 19.02.2009 as an activity (public – private partnership) attached to the Post Consumer Plastic Waste Management Project of the Central Environmental Authority under the Ministry of Environment and Natural Resources.

The project has been conducted until 14.09.2010 as a pilot project to test the economic viability, environmental feasibility and chemical stability of the production process and the product. Then the "Polypto" project has been recommended to start its operation commercially and has been attached to the Ministry of Power and Energy since 13 August 2010. The project design has been completed to commence the commercial production with a capacity of 2

metric tones of waste polythene and plastics per day (pers.com. Gunawardena, 2011)

Data is not available to assess the production efficiency of the Polypto Lanka Private Limited and its impact on polythene plastic waste generated in the country since the project has been conducted as a pilot project to test its viability from the economic point view and technically as well.

4.1.3. Review of the results and suggestions

According to the figure 4.1.which illustrates the relationship between increases of import tax rate and imported amounts of polythene and plastic, from January 2008 to March 2009, it is clear that not only the import cess but also all taxes imposed at the point of importation have not resulted an average reduction in importation of polythene and plastic materials into the country. Though the Cess has been increased from 1% up to 10% within the period from January 2008 to March 2008 it has not reduced the polythene plastic importation into the country. That is the tax increase has not been higher enough for a behavioural change in the society. However by this assessment it cannot decide whether the tax did affect the demand for imported polythene plastic materials. If there were not any tax imposed at the point of importation, figures of importation of polythene plastic materials into the country would change.

The average composition of non degradable polythene plastic waste of municipal solid waste collected by Local Authorities has been 5.91% (MENR, 2005). However all solid waste generated throughout the country is not collected by Local Authorities in Sri Lanka yet and therefore the figure 5.91% did not represent all polythene plastic waste generated in the country. Therefore the actual composition of polythene and plastic waste must be higher than 5.91%. In addition to that lack of data on collected waste during 2007 to 2009 is one of issues arisen in calculating the exact value of percentage amount of recycled polythene and plastics.

This case is somewhat similar to the imposition of a levy on plastic bags in South Africa to reduce the demand for plastic bags. The level of the levy charged has been undoubtedly too small and therefore, it has been only successful in the short term in reducing plastic-bag demand. There has been a steady increase in the demand for plastic bags which has proved that the policy had failed partially. The rate of the levy should have been fixed adequately higher to reach sustained reduction in the consumption of plastic bags (Dikgang *et al*, 2010).

According to the Fig. 4.2., revenue of the import tax on polythene and plastics has been noticeably increased with the increases of tax rates. Figure 4.4 shows that progress of networking polythene plastic waste collectors and recyclers which was one of objectives of the post consumer plastic waste management project which is funded by the cess, has clearly increased from May 2007 to middle of 2011. However the percentage of recycled amount against the imported amount in 2007 was 3.05% and 4.27 % in 2008. The percentage of waste polythene and plastic amount recycled against collected amount of plastic and polythene waste was 11.14%. That means 88.86% of waste polythene and plastics generated in the country are not recycled. This figure must be higher than 88.86% since total amount of polythene and plastic waste generated in the country was not taken into account in the estimations due to unavailability of data. Therefore PCPWM project has not been efficient in achieving its major objectives. The project should immediately evaluate its action plan to further expand recyclers and collectors network throughout the country and to accelerate the efficiency of recycling.

It is obvious that a small quantity of polythene plastic waste generated is directed to recycle in Sri Lanka and there is no significant impact of the import cess on reduction of importation of plastic and polythene into the country. Therefore the import Cess has a less impact on polythene and plastic waste generation in the country. In considering the problem of waste polythene and plastic, many countries have identified waste polythene plastic bags as the main cause of environmental problems of polythene and plastic waste. Therefore various countries all over the world had taken a range of steps to trim down the consumption of plastic bags. The

Republic of Ireland was the first country to tax plastic shopping bags and has resulted a dramatic reduction in use of them and a significant increase of using reusable bags. New Zealand, Taiwan, Denmark, Germany, Israel, Italy, South Africa and Canada are among the countries that have imposed a tax or a charge on plastic bags. South Africa and Italy have been failed to reach their targets because of minimal rates of taxes imposed. Some countries like Bangladesh, Mexico have banned use of plastic bags (www.marrickville.nsw.gov.au, 2011).

According to the Central Environmental Authority "Sili Sili" bags and lunch sheets have been a major problem in the waste recycling process in Sri Lanka. Since a huge number of polythene bags are required to make up 1 kg, people and collectors have been discouraged to collect them from the financial point of view. Therefore one of options that could be practiced in Sri Lanka is discouraging the use of problematic 'Sili Sili' bags and lunch sheets.

Sri Lanka is able to impose a tax on non degradable plastic polythene bags under the provisions of Environmental Conservation Levy Act No.26 of 2008 which provide legal facilities to impose a tax on commodities or services that have negative impacts on the environment. To impose a theoretical Pigouvian tax it is required to recognize the marginal external cost and to determine the optimal level of tax. However to plan for a behavioural change of the consumers it is required to compel them not to buy a new plastic bag instead of reusing a bag. Therefore it is required to set a tax rate sufficiently higher to stimulate consumers not to purchase a new bag (Convery *et al* 2007). The tax on plastic bags in Botswana has also not been a Pigouvian, where the taxing plastic bags had reduced purchases of them significantly (Dikgang *et al*, 2009). The Irish Government has surveyed the consumers' willingness to pay (WTP) for a plastic bag and has set the tax rate at a value that equals to six times of average WTP (Convery *et al* 2007). By following this methodology Sri Lanka would be able to introduce a tax on plastic polythene bags at an effective rate to change the behaviour of consumers aiming reduction of plastic bag consumption in the country.

4.1.4. Environmental Conservation Levy Act No.26 of 2008

The Act provides provisions to impose Environmental Conservation Levies on specified items imported into or manufactured in Sri Lanka or specified services provided in Sri Lanka, which are likely to have a harmful impact on the environment. Since the objective of the Act is environmental management and conservation it does not provide provisions to cover the total requirement of the country. Though the Act provides provisions for environmental pollution control, it does not provide enough legal provisions for natural resource management. For example if it was required to control sand mining from river beds, it does not have a provision to impose a tax on unit sand extraction.

4.2. Life Cycle Assessment (LCA) of mobile phones for the prediction of recycling cost of them

4.2.1. Goal and scope of the LCA

The ultimate goal of this Life Cycle Assessment of mobile phones in Sri Lanka is assessment of recycling cost of waste mobile phones in Sri Lanka. As in many countries in Sri Lanka there is a high demand for mobile phones and the use of mobile phones is increasing drastically. This phenomenon is an example of arising an e waste problem in the country. Meanwhile the government of Sri Lanka intended to control the increase of use of mobile phones and manage their waste by imposition of an Environmental Conservation Levy. However the imposition of the levy is not in operation at present and there is a necessity of controlling massive use of mobile phones from the environmental perspective.

This study tries to assess the real quantities of waste mobile phones that would be generated in the country and potential amounts of recoverable materials that could be extracted from waste stocks that may be useful for the Sri Lankan government in their future endeavors in planning electrical and electronic waste management in the country.

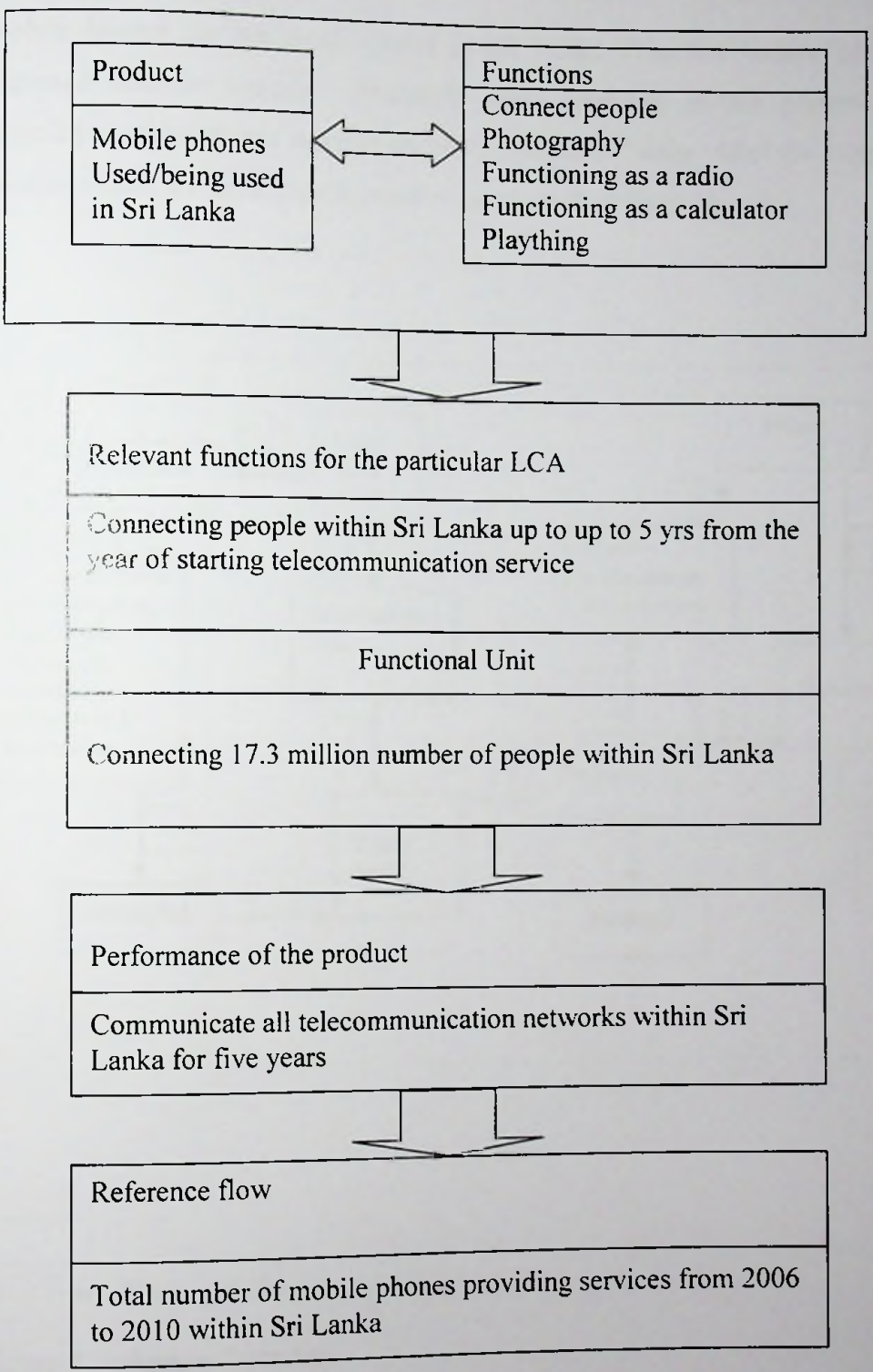


Figure 4.6. : Functions, functional unit and reference flow

4.2.2. System boundary

Mobile phones are not manufactured in Sri Lanka Therefore mobile phones are imported into the country. Electronic waste including mobile phones are not recycled or directed into material recovery within Sri Lanka. After the importation, mobile phones are used, reused, repaired, stockpiled or disposed.

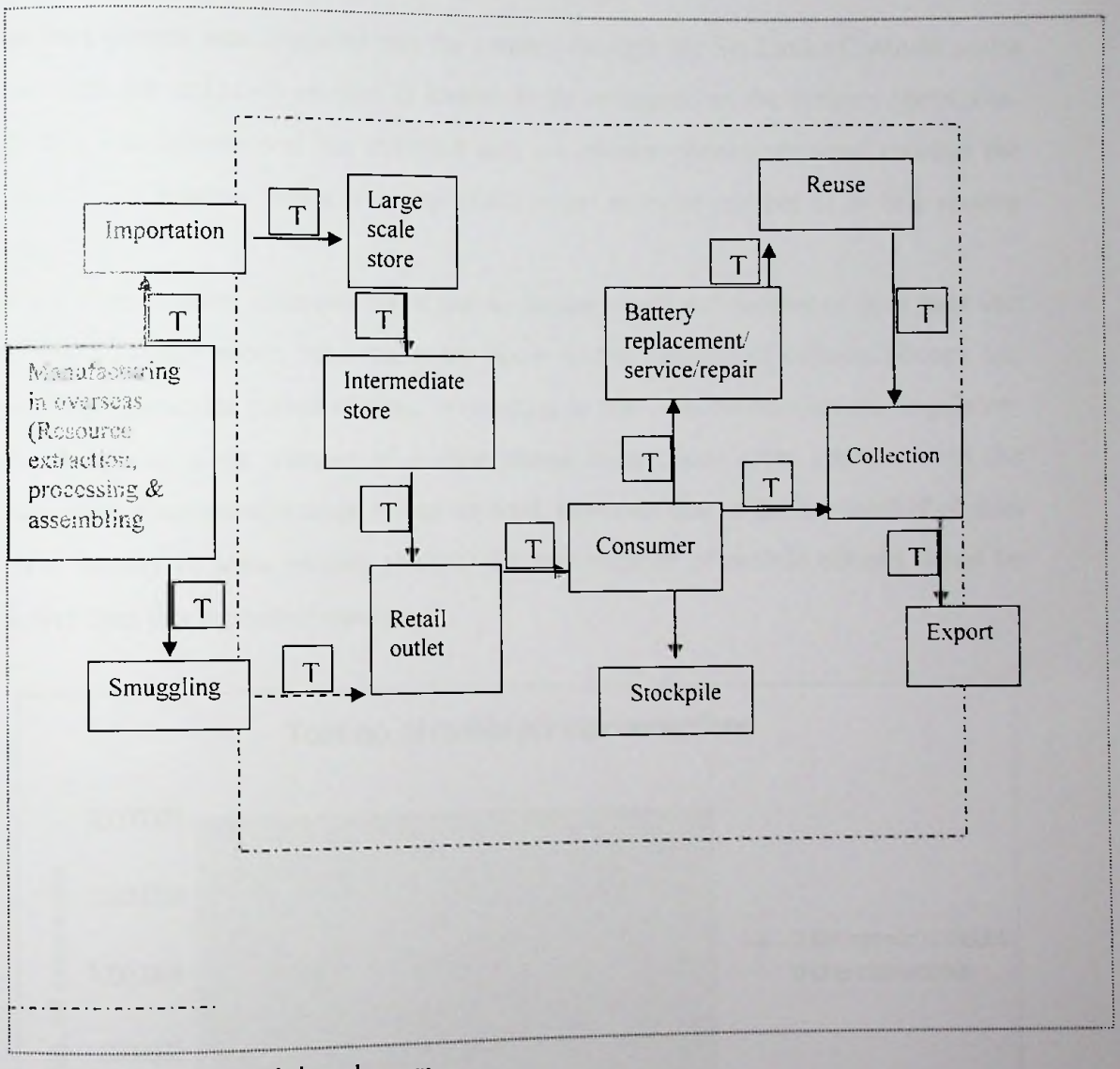


Figure 4.7.: System Boundary

4.2.3. Transportation, storage and trade

Mobile phones are not manufactured in Sri Lanka (Ministry of Finance, 2008) and imported from manufacturing countries. From the port imported cellular phones are

transported to large-scale stores. Then they are transported to the stores at the head office/intermediate stores of the company and then to retail outlets and stored/displayed. This route would change with different backgrounds of the business.

4.2.4. Mobile phone use in Sri Lanka

Mobile phones area imported into the country through the Sri Lanka Customs and a considerable unknown amount is known to be smuggled in the country (pers.com. 2008). The Government has statistics only on cellular phones imported through the Sri Lanka Customs. Hence it is impossible to get an exact number of mobile phones imported.

Therefore as many countries do, it had to assume that total number of post paid and prepaid mobile phone subscribers are equal to the number of cellular phones use within a particular period of time. According to the Telecommunication Regulatory Commission, given number of mobile phone connections were active within the particular three months when it was counted. However due to the availability of dual SIM facility in some mobile phones, the real number of mobile phones could be lower than this estimated number.

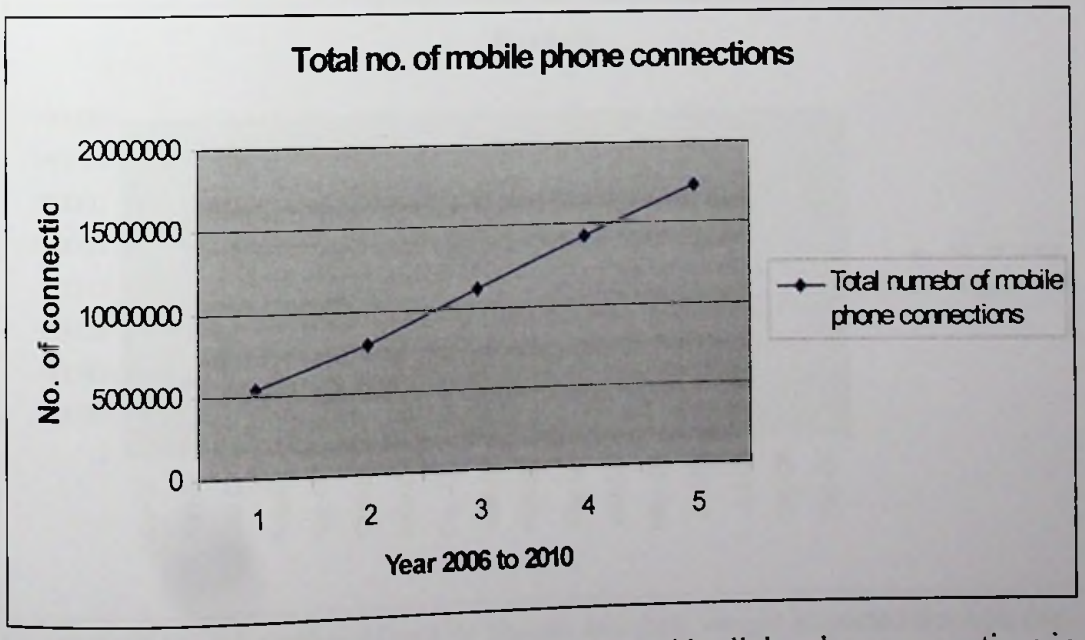


Figure 4.8.: Increase of number of prepaid & post paid cellular phone connections in Sri Lanka from 2006 to 2010

According to the graph there is a continuous rapid growth in mobile phone usage in Sri Lanka from the year 2006 to year 2010.

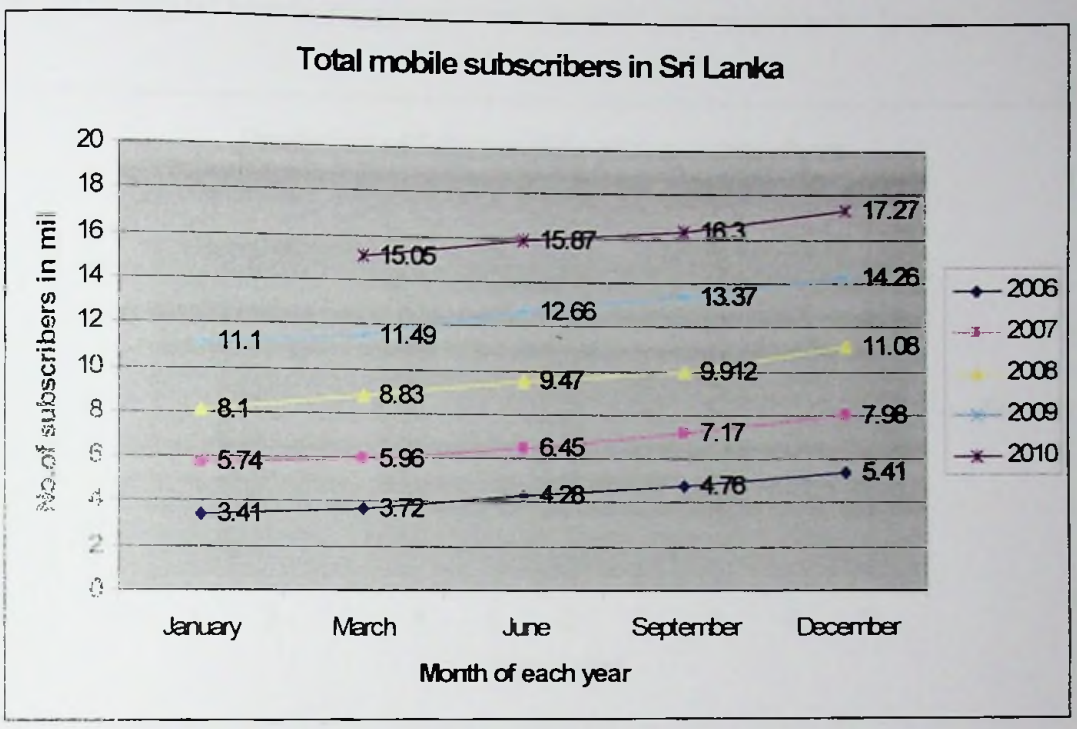


Figure 4.9.: Increase of total number of mobile phone subscribers in each year from 2006 to 2010.

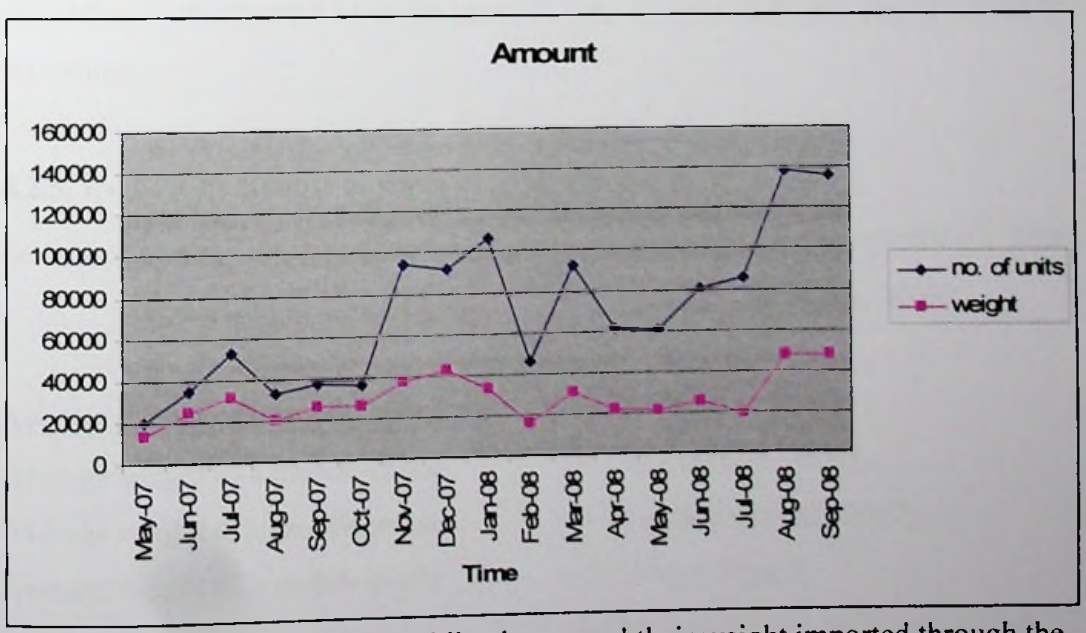


Figure 4.10.: Total number of mobile phones and their weight imported through the legal channel into Sri Lanka from May 2007 to September 2008 respectively

By comparing the Fig. 4.8, Fig. 4.9 and Fig. 4.10 it is clearly seen that a considerable amount of mobile phones have entered the country by another way that would be illegal (smuggle) Mobile phones are used, repaired, and reused in Sri Lanka.

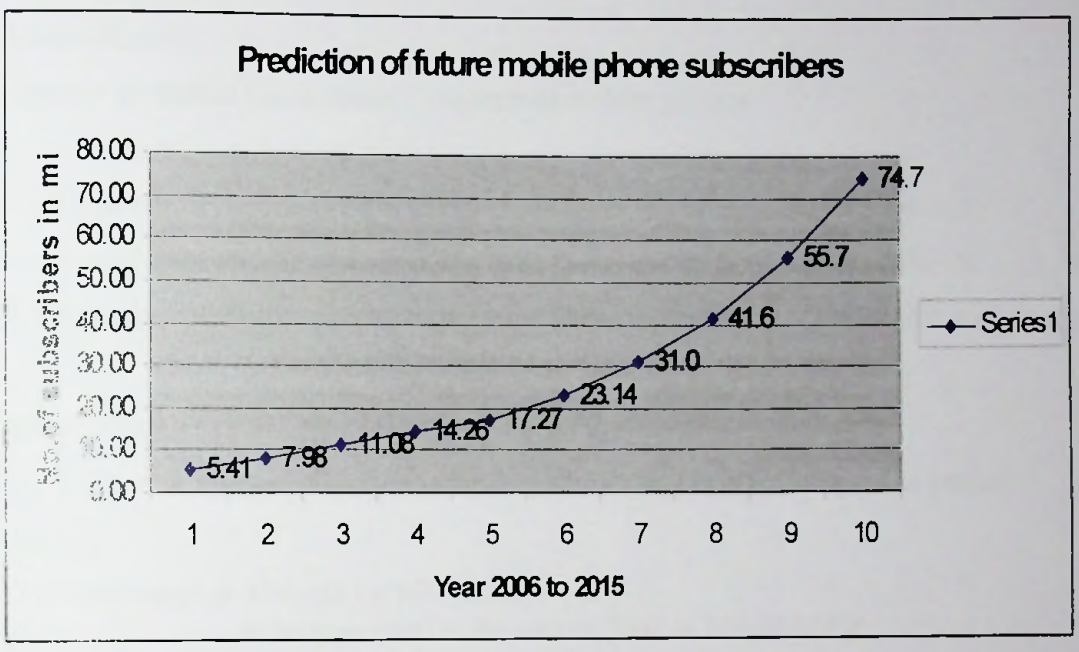


Figure 4.11 : Prediction of number of mobile phone subscribers from 2011 to 2015; (Note: Data from 2006 to 2010 are from TRC, 2010)

According to the figure 4.11 in the year 2011 the number of mobile phones exceeds 20 million.

4.2.5. Expected amounts of waste cellular phones in Sri Lanka

Estimated average lifespan of a mobile phone in Sri Lanka = 5 yrs (Softlogic, 2009) & (CEA, 2009)

Average weight of a mobile phone

Average weight of a mobile phone = 130 g (Nokia, 2009)

Average weight of a mobile phone = 91 g (Socolf et al., 2007)

Average weight of a mobile phone = (130 g + 91g)/ 2

= 110.5g

Total number of mobile phone connections being used in 2006 = 5412496

Total number of mobile phone connections being used in 2007 = 7983489

Total number of mobile phone connections being used in 2008 = 11082508

(TRC, 2009)

Assumption 1;

Number of mobile connections = number of mobile phones

Total number of mobile phones being used at the end of 2006 = 5412496 = X

Total number of mobile phones being used at the end of 2007 = 7983489 = Y

Total number of mobile phones being used at the end of 2008 = 11082508 = Z

Assumption 2;

All cellular phones are disposed at the end of life, that is after 5yrs to the proper channel;

Therefore number of waste mobile phones
to be generated at the end of 2011 = X = 5412496

a) Estimated waste mobile phone mass at the end of 2011 = (5412496 x 0.1105) Kg
= 598080.808 Kg
= 598 metric tone

b) Expected mass of waste mobile phones at the end of 2012= (Y-X) 0.1105 kg
= 2570993 x 0.1105 Kg
= 284094.7265 Kg
= 284 metric tone

c) Expected mass of waste mobile phones at the end of 2013= (Z-Y) 0.1105 Kg
= 3099019 x 0.1105 kg
= 342441.5995 Kg
= 342 metric tone

As Sri Lanka has been using mobile phones since 1990s, the real stock of mobile phones available must be higher than the estimated amount.

If a recycling plant is operated in Sri Lanka;

d) Number of waste mobile phones available for recycling per day in 2011 = 5412496/365
= 14828.75 per day
= 14830 per day

e) Number of waste mobile phones available for recycling per day in 2012 = 2570993/366
= 7024.57 per day
= 7025 per day

f) Number of waste mobile phones available for recycling per day in 2013 = 3099019/365
= 8490.46
= 8490 per day

Number of waste mobile phones expected in 2011 is much higher than that of 2012 and 2013 though the consumptions are higher in 2012 and 2013; because estimations of waste mobile phones have not been carried out for the previous years.

However there is a huge gap between the collected numbers of waste mobile phones during past three years (2008, 2009, and 2010) and expected numbers of waste mobile phones in next three years (2011, 2012 and 2013). The reason behind this is the poor collection of mobile phones. In Sri Lanka there are no incentives operated for take back service. Usually people do not handover their waste mobile phones to collection centers. They prefer to keep waste mobile phones with them or donate to a family member or to a friend (pers.com. Thilekerathne, 2011).

4.2.6. Possible amounts of metals to extract

Table 4.1. : Metal contents of two selected mobile phones

Source: Wu *et al.*, 2007

Element	Metallic content (g)	
	Sample E	Sample N
Al	17.1636	9.6814
Fe	16.3912	5.1121
Cu	13.1702	7.0213
Co	9.6921	4.1331
Zn	1.4492	0.0770
Ni	1.3070	0.6652
Sn	0.7665	0.4778
Cr	0.5714	0.5432
Pb	0.4328	0.1250
Mg	0.1919	0.0013
Ag	0.1052	0.0712
Mn	0.0855	0.0478
Ba	0.0658	0.0826
Nd	0.0628	0.1167
Sb	0.0478	0.0070
Au	0.0265	0.0133
Pd	0.0099	0.0039
Ti	0.0089	0.0283
Be	0.0070	0.0020
W	0.0056	0.0006
Bi	0.0032	0.0008
As	0.0026	0.0031
Cd	0.0004	0.0002
Hg	0.00008	0.00001
Total	61.5672	28.2149

Above two mobile phone samples E and N have been collected from a recycler in China. Sample E have been introduced in to the market in 1998 and sample N have been introduced in 2003. The weight of cellular phone E has been about double of the weight of cellular phone N (Wu *et al.*, 2007).

Table 4.2.: Average metal content of a typical mobile phone

Source : Yu *et al.*, 2010

Element	Cu	Al	Fe	Ni	Pb	Sn	Ag	Au	Pd
Content %	13	2	5	0.1	0.3	0.5	0.14	0.035	0.02

Based on the details given in the table 4.2 calculated weight of each element included in a typical mobile phone with an average weight of 110.5 g is given in table 4.3. below.

Table 4.3. : Metal content of a mobile phone

Element	Cu	Al	Fe	Ni	Pb	Sn	Ag	Au	Pd
Content %	13	2	5	0.1	0.3	0.5	0.14	0.035	0.02
Actual weight, (g)	14.37	2.21	5.525	0.111	0.332	0.553	0.155	0.039	0.022

4.2.6.1 Estimation of amounts of selected metals that could be recovered from waste mobile phone stock available in 2011.

i) Al - Aluminium

Average amount of Al included in a cell phone = (17.1636g + 9.6814g + 2.21g)/3

Amount available in all waste cell phones in 2011 = 9.685g x 5412496

= 52420023.76 g

= 52420 kg

ii) Fe - Iron

Average amount of Fe in one cell phone = (16.3912g + 5.1121g +5.525g)/3

= 9.0094 g

Amount available in cell phones in 2011 = 9.0094 g x 5412496

= 48763521.8789 g

= 48763.5 kg

iii) Cu - Copper

Average amount of Cu included in a cell phone = (13.1702+7.0213+14.365)g/3

= 11.5188g

Amount available in total no. of cell phones in 2011 = 11.5188 g x 5412496

= 62345639.34 g

= 62345.6 kg

Table: 4.4. Recoverable amounts of metals expected in 2011

Metal	Weight 1(g)	Weight 2(g)	Weight 3(g)	Average weight included in a cell phone (g)	Estimated no.of waste cell phones in 2011	Recoverable amount in 2011 (g)	Recoverable amount in kg
Al	17.1636	9.6814	2.21	9.685	5412496	52420023.76	52420.02376
Fe	16.3912	5.1121	5.525	9.00943333	5412496	48763521.88	48763.52188
Cu	13.1702	7.0213	14.365	11.5188333	5412496	62345639.34	62345.63934
Ni	1.307	0.6652	0.1105	0.69423333	5412496	3757535.14	3757.53514
Sn	0.7665	0.4778	0.5525	0.59893333	5412496	3241724.271	3241.724271
Pb	0.4328	0.125	0.3315	0.29643333	5412496	1604444.231	1604.444231
Ag	0.1052	0.0712	0.1547	0.11036667	5412496	597359.1419	597.3591419
Au	0.0265	0.0133	0.039	0.02626667	5412496	142168.2283	142.1682283
Pd	0.0099	0.0039	0.022	0.01193333	5412496	64589.11893	64.58911893
Zn	1.4492	0.077	-	0.7631	5412496	4130275.698	4130.275698
Cr	0.5714	0.5432	-	0.5573	5412496	3016384.021	3016.384021
Ba	0.0658	0.0826	-	0.0742	5412496	401607.2032	401.6072032
Cd	0.0004	0.0002	-	0.0003	5412496	1623.7488	1.6237488

iv) Zn – Zinc

Amount available in total no. of cell phones in 2011 = 4130.27kg

v) Ni – Nickel

Amount available in total no. of cell phones in 2011 = 3757.5 kg

vi) Sn (Tin)

Amount available in total no. of cell phones in 2011 = 3241.72 kg

vii) Pb (Lead)

Amount available in total no. of cell phones in 2011 = 1604.44 kg

viii) Ag (Silver)

Amount available in total no. of cell phones in 2011 = 597.36 kg

ix) Au (Gold)

Average amount of Sn included in one cell phone = 142.168 kg

x) Pd (Palladium)

Average amount of Sn included in one cell phone = 64.589 kg

Largest amount that could be extracted is from Copper.

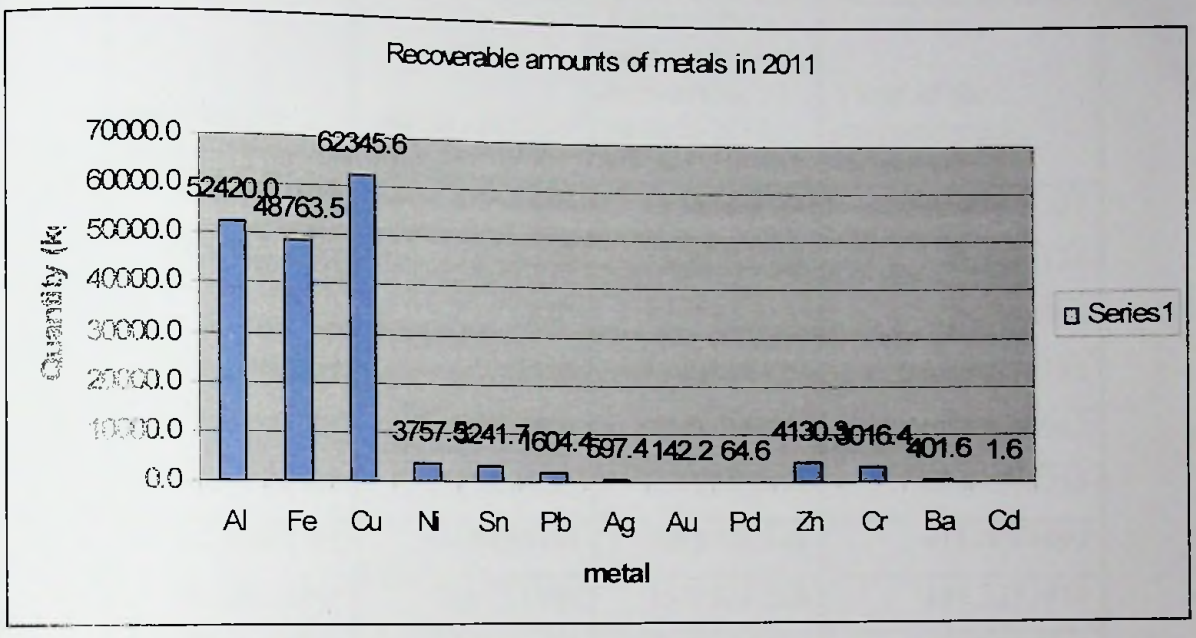


Figure 4.12.: Estimated amounts (in Kg) of selected metals that could be recovered from the expected stock of waste mobile phones in 2011

4.2.7. Estimation of value of selected recoverable metals expected in 2011

World market values of some selected metals are as follows

i. Aluminum = US $ 2.206 per kg
ii. Copper = US $ 7.261 per kg
iii. Nickel = US $ 18.050 per kg
iv. Lead = US $ 2.023 per kg
v. Tin = US $ 19.005 per kg
vi. Zinc = US $ 1.956 per kg
vii. Gold = US $ 52654.08481per kg
viii. Silver = US $ 967.7844581 per kg
ix. Palladium = US $ 20612.1596 per kg

(Source: www.metalprices.com)

Currency rate

1US $ = Rs. 108.34 (Bank of Ceylon, 11.09.2011)

Table 4.5.: Estimated financial value of recoverable metals in 2011

Metal	Recoverable amount in kg	market price US $ per kg	Value of the estimated recoverable stock in 2011, US $	Value of the expected stock, Rs.million
Al	52420.02376	2.206	115638.5724	12.52828294
Cu	62345.63934	7.261	452691.6873	49.0446174
Ni	3757.53514	18.05	67823.50927	7.347998995
Sn	3241.724271	19.005	61608.96977	6.674715785
Pb	1604.444231	2.023	3245.790679	0.351648962
Ag	597.3591419	967.7844581	578114.8934	62.63296755
Au	142.1682283	52654.08481	7485737.948	811.0048493
Pd	64.58911893	20612.1596	1331321.228	144.2353418
Zn	4130.275698	1.956	8078.819265	0.875259279

(Market Price method was followed for valuation)

According to the calculations total estimated income from the recovery of selected metals in 2011 = Rs. 1094.695 million

On the other hand by the recovery of metals, raw material production energy for recycled metals, labour cost, environmental costs and social costs would be saved.

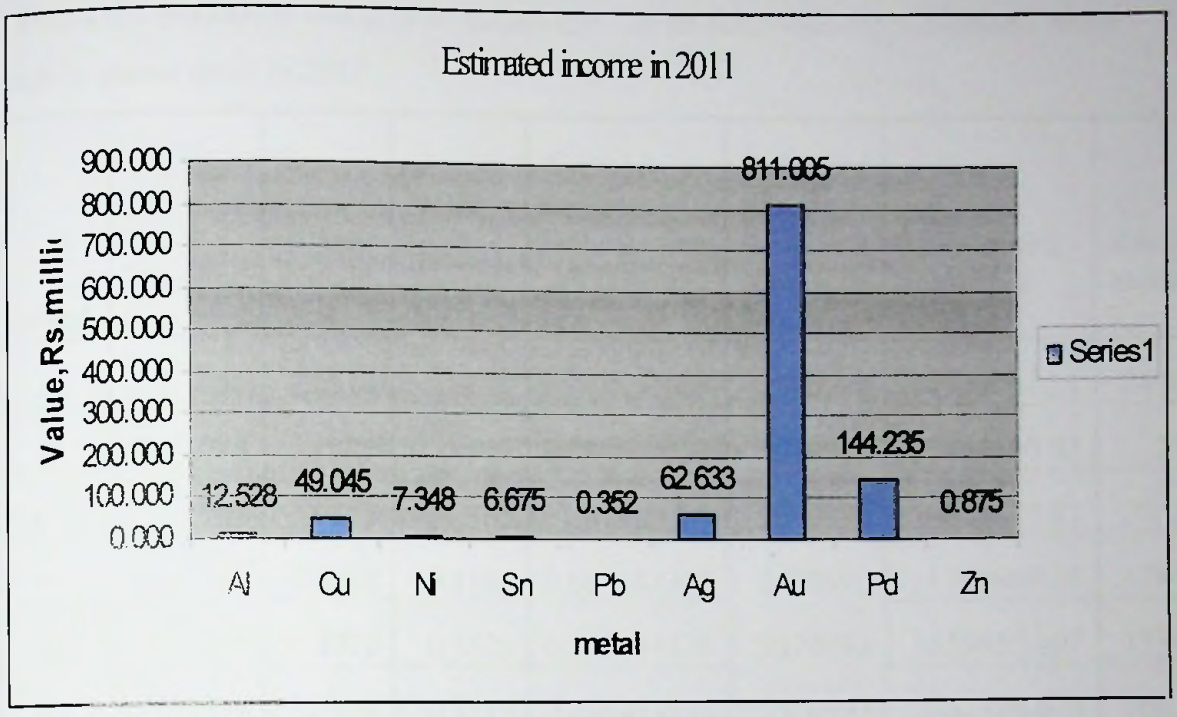


Figure 4.13. : Estimated income expected in 2011 from recoverable metals from waste mobile phones

Highest income can be expected from the recovery of Gold.

4.2.8. Estimation of amounts of selected metals that could be recovered from waste mobile phone stock available in 2012.

It was assumed that the contents of each metal would not be deviated from the calculated average value of content for year 2011. However models and metal contents change with the time and therefore the real values would be fairly different from the predicted values.

Table 4.6. : Estimated amounts of metals that can be recovered from expected waste mobile phone stock in 2012

Metal	Weight 1(g)	Weight 2(g)	Weight 3(g)	Average weight included in a cell phone (g)	Estimated no. of waste cell phones in 2012	Recoverable amount in 2012 (g)	Recoverable amount in kg
Al	17.1636	9.6814	2.21	9.685	2570993	24900067.21	24900.0672
Fe	16.3912	5.1121	5.525	9.009433333	2570993	23163190.03	23163.19
Cu	13.1702	7.0213	14.365	11.51883333	2570993	29614839.87	29614.8399
Ni	1.307	0.6652	0.1105	0.694233333	2570993	1784869.04	1784.86904
Sn	0.7665	0.4778	0.5525	0.598933333	2570993	1539853.407	1539.85341
Pb	0.4328	0.125	0.3315	0.296433333	2570993	762128.025	762.128025
Ag	0.1052	0.0712	0.1547	0.110366667	2570993	283751.9274	283.751927
Au	0.0265	0.0133	0.039	0.026266667	2570993	67531.41613	67.5314161
Pd	0.0099	0.0039	0.022	0.011933333	2570993	30680.51647	30.6805165
Zn	1.4492	0.077		0.7631	2570993	1961924.758	1961.92476
Cr	0.5714	0.5432		0.5573	2570993	1432814.399	1432.8144
Ba	0.0658	0.0826		0.0742	2570993	190767.6806	190.767681
Cd	0.0004	0.0002		0.0003	2570993	771.2979	0.7712979

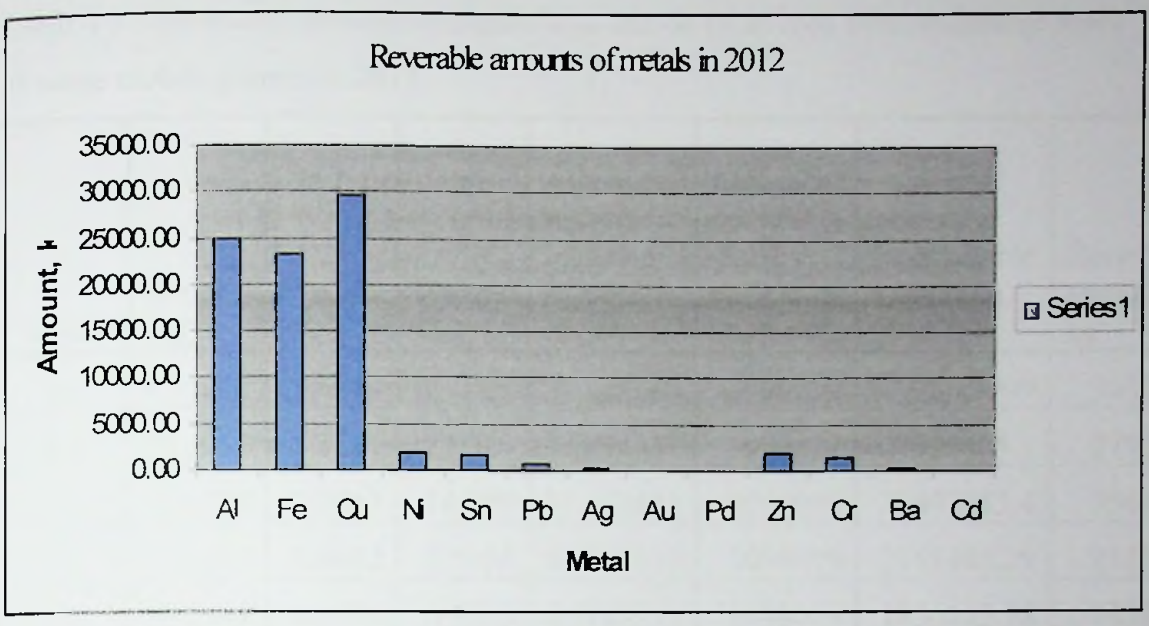


Figure 4.14. : Estimated amounts of recoverable metals that could be recovered from expected amount of waste mobile phones in 2012

Highest amount of metal that would be possible to extract will be from 'Cu'.

4.2.9. Estimation of amounts of selected metals that could be recovered from available waste mobile phone stock in 2013.

It was assumed that the contents of each metal would not be deviated from the calculated average value of content for year 2011. However models and metal contents change with the time and therefore the real values would be somewhat different from the predicted values.

Table 4.7.: Estimated amounts of metals that can be recovered from estimated stock of waste mobile phones in 2013

Metal	Weight 1(g)	Weight 2(g)	Weight 3(g)	Average weight included in a cell phone (g)	Estimated no. of waste cell phones in 2013	Recoverable amount in 2013 (g)	Recoverable amount in kg
Al	17.1636	9.6814	2.21	9.685	3099019	30013999	30013.999
Fe	16.3912	5.1121	5.525	9.0094333	3099019	27920405.1	27920.405
Cu	13.1702	7.0213	14.365	11.518833	3099019	35697083.4	35697.083
Ni	1.307	0.6652	0.1105	0.6942333	3099019	2151442.29	2151.4423
Sn	0.7665	0.4778	0.5525	0.5989333	3099019	1856105.78	1856.1058
Pb	0.4328	0.125	0.3315	0.2964333	3099019	918652.532	918.65253
Ag	0.1052	0.0712	0.1547	0.1103667	3099019	342028.397	342.0284
Au	0.0265	0.0133	0.039	0.0262667	3099019	81400.8991	81.400899
Pd	0.0099	0.0039	0.022	0.0119333	3099019	36981.6267	36.981627
Zn	1.4492	0.077		0.7631	3099019	2364861.4	2364.8614
Cr	0.5714	0.5432		0.5573	3099019	1727083.29	1727.0833
Ba	0.0658	0.0826		0.0742	3099019	229947.21	229.94721
Cd	0.0004	0.0002		0.0003	3099019	929.7057	0.9297057

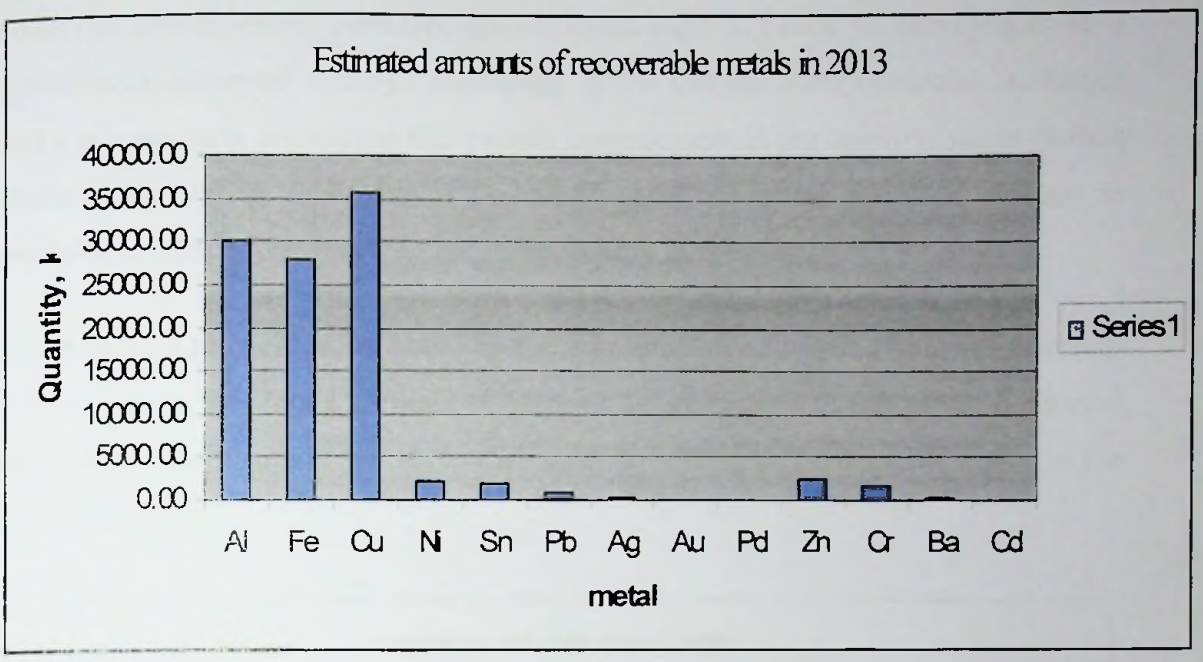


Figure 4.15. : Estimated amounts of recoverable metals that could be recovered from expected amount of waste mobile phones in 2013

4.2.10. Practice of cellular phone waste management in Sri Lanka

Waste cellular phones belong to the category of electronic and electrical waste (e waste). Sri Lanka has ratified the Basal convention which regulates trasboundary movements of hazardous waste. Hazardous waste includes e waste, clinical waste, waste oil and industrial waste (CEA, 2008). The Central Environmental Authority (CEA) regulates e waste management in Sri Lanka by the regulation with regard to hazardous waste management published by the extraordinary gazette No.924/13 dated 23.05.1996. The regulation standardizes collection, storage, transportation, recycling and disposal of hazardous waste within the country. The regulation has been amended in 2008 with an addition of a prescribed list.

The CEA has signed a Memorandum of Understanding (MOU) with a private party to develop an existing network for waste mobile phone and accessory collection in July 2009. After that extending the programme furthermore to address the e waste management at the national level, the CEA has signed a MOU with a number of stakeholders of the private sector under a one logo and a theme 'ensuring e waste free environment'. The current practice of e waste disposal of the country is

collection and exporting them through a licensed party to China for recycling under a government approved facility. According to the Central Environmental Authority and a private party engaged in the e waste management in the country, waste mobile phone collection in each year in Sri Lanka was not of an adequate amount to establish an economically viable recycling facility in the country.

Waste mobile phones are collected by the aforementioned public private partnership established in Sri Lanka through a network of collection island wide. Collected numbers of waste mobile phones in each year from 2008 to 2010 are illustrated in the following figure.

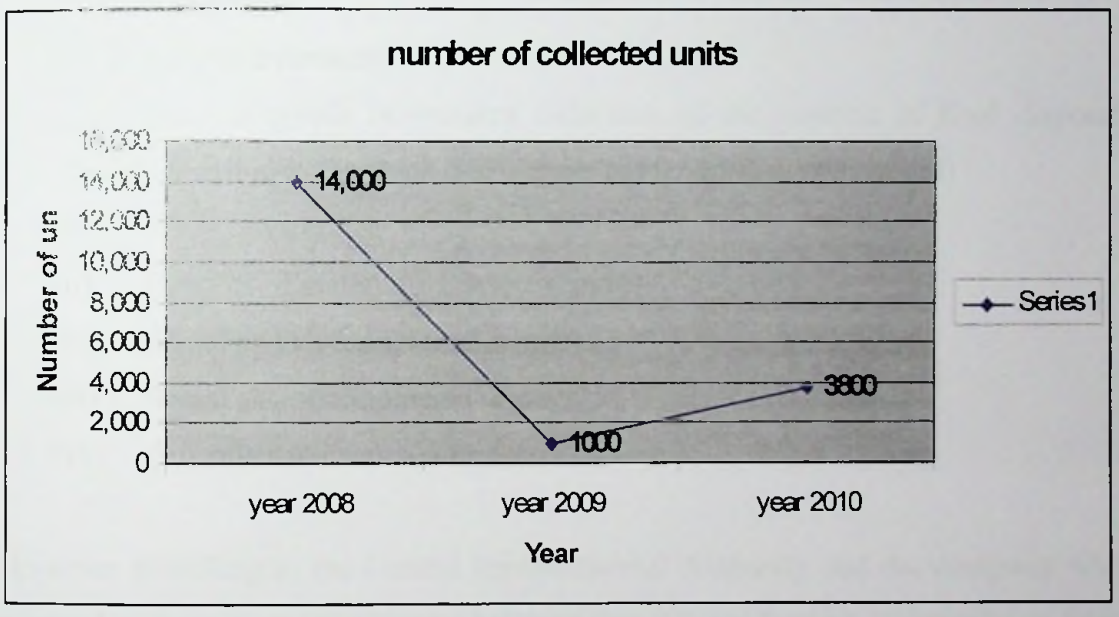


Figure 4.16.: Number of collected waste mobile phones in each year from 2008 to 2010

Collected waste mobile phones are exported to China through a licensed party for recycling was the only way followed by Sri Lanka for waste mobile phone management.

Total disposal cost of mobile phone waste in 2008 = Rs. 200,000.00 for 2.5 MT

(Pers.com. Thilekarathne, 2011)

4.2.11. Prediction of recycling cost of waste mobile phones in Sri Lanka

For the prediction of recycling cost of waste mobile phones following basic information and data are required.

i) Feasibility study
ii) Site selection and preparation
iii) Transport options
iv) Collection
v) Way of storage
vi) Dismantling methods
vii) Feasible technology of material recovery and treatments
viii) Labour cost
ix) Labour awareness
x) Final disposals of remains /selection of the method of final disposal according to the stock of residuals (if land filled or exported)
xi) Public awareness
xii) Benefits of materials recovered and etc
xiii) Social and environmental benefits
xiv) Social and environmental costs
xv) Any other relevant matters

However according to the Central Environmental Authority and the company who engaged with waste mobile phones believed that it is not feasible technically or from the economic point of view to run a recycling plant for waste mobile phones successfully. The reason was there was no enough collection of waste mobile phones to run a recovery plant in Sri Lanka as shown in the following table. According to them 1000 waste mobile phones per day are required to be feasible running a recycling plant (Thilekarathne, 2011).

Consequently there is no clear idea of a methodology or plan on recycling waste mobile phones and as a result it is difficult to predict recycling cost without having a feasible methodology or a plan.

Table 4.8. : Statistics of collected waste mobile phones in Sri Lanka

Year	Number of collected waste mobile phones (WMPs)	Number of WMPs available per day
2008	14000	38.35
2009	1000	2.73
2010	3800	10.41

Therefore this study tried to estimate the real stock of waste mobile phones that would be available for recycling in each year from 2011 to 2013.

In addition to this study estimated possible amounts of each metal that could be recovered from expected waste mobile phones.

4.3. Fund Disbursement

4.3.1. Option 1

4.3.1.1. Identified areas to be funded

i) Adaptation fund for impacts of climate change

ii) Sustainable Energy (for innovations, renewable energy projects)

iii) Forest Conservation and Management /Flora Diversity Conservation, Protected area management

iv) Wildlife Conservation/Fauna Diversity

v) Natural Resource Management (Geological mines, minerals, water management, other aquatic resource management

vi) Marine Pollution Prevention

x) Coast conservation

xi) Areas coming under the purview of Meteorological Department

xii) Pollution Control (eg: subsidies to small and medium scale enterprises)

xiii) Solid waste management (eg; funding Pilisaru project)

xiv) Eco System enrichment/management

xv) Addressing crucial environmental issues (eg; loss of habitats for elephants causing human elephant conflict

(CEA, 2009)

4.3.1.2. Proposed fund disbursement methodology

Total allocations for each sector of a year = Total revenue of a year

$$\sum W_{(1\text{-}n)} X + \sum X_{1\text{-}n} = R$$

$$\sum WiXi = R$$

W = weight for the sector

X = single allocation for a particular sector

R = Total annual revenue

Note: Weight (multiples of 'X') on each area should be decided according to the importance of the particular sector.

Example

If total revenue of the levy of a particular year is Rs.100 million

Solid waste management is a main focal point in Sri Lanka today. The weight could be based on estimations for waste management programmes that have been planned.

Therefore allocation for Solid waste management = 4X

Human elephant conflict has also been a crucial issue now.

Allocation for human elephant conflict = 2X

Assuming all other need similar attention;

Financial allocation for each sector = $X_{1\text{-}14}$

Therefore fund allocations can be;

$4X_1 + 2X_2 + X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}+X_{14}+X_{15}$ = Rs.100 million

$19X$ = Rs.100 million

X = Rs. 5.2631 million

Allocation for Solid Waste Management = 4X = Rs. 21.052 million

Allocation for Human elephant conflict = 2X = Rs. 10.5263 million

All other sectors will be allocated Rs. 5.26 million for each.

This methodology could be applied in allocating funds from the environmental conservation levy account for environmental management and conservation activities in the country.

Deciding the applicable weightage (W) could be carried out by the proposed Environmental Conservation Council.

4.3.2. Option 2

Following areas identified for implementation of activities to address existing environmental problems in Sri Lanka. Short term and long-term plans are required to manage the problems in a sustainable manner.

1) Prevent avoidable air pollution by mobile sources
2) Incentive or loan scheme for small and medium scale enterprises for pollution control
3) Identification and elimination of direct discharges to water bodies
4) Introduction and implementation of innovative or indigenous practices instead of polluting agrochemicals
5) Solid waste management
6) Enrichment of environmental sensitive areas
7) Protecting watersheds
8) Wetland conservation
9) Forest Management
10) Wildlife conservation
11) Conservation of threatened and vulnerable species
12) Identified specific activities at the imposition of taxes
13) Timely environmental problems in the country eg: present power crisis
14) Awareness for politicians and administrative officers of the government

For the execution of activities on the ground project proposals could be called openly under conditions. Fund disbursement could be implemented according to the budget proposals after appraisal of them.

Proposed Environmental Conservation Council can be the responsible committee for the fund disbursement as well as project monitoring as planned by the Government.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. Plastic Polythene Cess

There is no direct relationship between the increases of import Cess imposed on polythene and plastic importation and importation of polythene and plastic raw materials into the country. That is there is no a direct impact of the import Cess on importation of polythene and plastic raw materials.

In 2008 the percentage of polythene plastic waste recycled was 4.27% compared to the total importation in the same year. Around 65.73% plastic and polythene imported, has not been recycled.

Compared to the waste polythene plastic amount collected by local authorities, the percentage of recycled amount of waste polythene and plastic is 11.14% per month during the period from 2007 to 2009. The percentage amount of waste polythene and plastic that was not recycled was 88.86% for the same period. That is there is no an efficient polythene and plastic recycling process in Sri Lanka.

It can be concluded that the tax imposed on polythene and plastic materials at the point of importation has not created a significant behavioural change in the market. Therefore this study recommends introducing a tax to be imposed at the consumer level expecting a behavioural change of the consumer to reduce consumption of polythene and plastic.

Many countries have taken steps to control use of polythene plastic bags. Based on successful experiences in other countries it is suggested to impose a tax on polythene bags at a sufficient rate to induce consumers not to buy a new bag. The proposed tax can be imposed under the provisions of ECL Act No. 26 of 2008.

5.2. Life Cycle Assessment of Mobile phones in Sri Lanka

There is a rapid growth in mobile phone subscribers in Sri Lanka from 2006 to 2010. It is expected a stock of waste mobile phones around 598080 kg (598 metric tone) in 2011 in the country. Estimated amounts of waste mobile phones that can be generated in 2012 and 2013 are 284094.7 kg (284 metric tone) and 342441.6 kg (342 metric ton) respectively.

Table 5.1. : Number of waste mobile phones that would be generated per day

Year	2011	2012	2013
No. of waste phones per day	14830	7025	8490

Expected numbers of waste mobile phones per year in the future are much higher than the collected real numbers from 2008 to 2010.

The following amounts of metals indicated in the subsequent table can be recovered from the estimated stock expected in 2011.

Table 5.2. : Recoverable metals and amounts of them from the expected stock of waste cellular phones in 2011.

Metal	Al	Fe	Cu	Zn	Ni	Sn	Pb	Ag	Au	Pd
Recoverable quantity (kg)	72649	58193	54643	4130	3757	3241	1604	597	142.2	64.5

The total value of expected recoverable materials from the waste mobile phones stock estimated for the year 2011 is Rs. 1094.695 million.

The following amounts of metals indicated in the subsequent table can be recovered from the estimated stock expected in 2012.

Table 5.3. : Recoverable metals and amounts of them from the expected stock of waste cellular phones in 2012.

Metal	Al	Fe	Cu	Zn	Ni	Sn	Pb	Ag	Au	Pd
Recoverable quantity (kg)	24900	23163	29614	1961	1784	1539	762	283.7	67.53	30.68

The following amounts of metals indicated in the subsequent table can be recovered from the estimated stock expected in 2013.

Table 5.4. : Recoverable metals and amounts of them from the expected amount of waste cellular phones in 2013.

Metal	Al	Fe	Cu	Zn	Ni	Sn	Pb	Ag	Au	Pd
Recoverable quantity (kg)	30013	27920	35697	2364	2151	1856	918.6	342	81.4	36.98

According to the results, it can be decided that an enough amount of materials are available within the country to establish a viable recovery plant. Therefore the study recommends carrying out a feasibility study considering environmental factors, technical factors, economic factors as well as social factors to establish a material recovery plant in Sri Lanka. In addition it is better to study the feasibility of incorporating other types of e waste into this proposed recovery plant.

It is obvious that the collection of waste mobile phones is not properly functioning in the country. If an incentive based collection system was operated with a good awareness programme, it would be more successful. Therefore it is suggested to implement an incentive based system to collect waste mobile phones with an awareness programme and to utilize funds generated by the ECL Act to give incentives to waste phone owners.

5.3. Fund Disbursement

The study proposed two options for the utilization of revenue generated by environmental conservation levies in Sri Lanka

Option 1 is based on a weighting system according to the importance of each sector. It will utilize total revenue for environmental management.

Option 2 is based on prioritizing identified environmental issues. Money allocation is upon the project proposal received.

Option 1 is suitable as it is very much compatible with the theory behind environmental taxation

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PARLIAMENT OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

ENVIRONMENT CONSERVATION LEVY ACT, No. 26 OF 2008

[Certified on 06th June, 2008]

Printed on the Order of Government

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Environment Conservation Levy
Act, No. 26 of 2008

[Certified on 06th June, 2008]

L. D.—O. 6/2008

AN ACT TO PROVIDE FOR THE IMPOSITION OF AN ENVIRONMENT CONSERVATION LEVY ON SPECIFIED ITEMS OWNED BY CONSUMERS, ON SPECIFIED ITEMS IMPORTED INTO OR MANUFACTURED IN SRI LANKA OR SPECIFIED SERVICES PROVIDED IN SRI LANKA, WHICH ARE LIKELY TO HAVE A HARMFUL IMPACT ON THE ENVIRONMENT; TO PROVIDE FOR THE COLLECTION AND RECOVERY OF SUCH LEVY; AND TO PROVIDE FOR MATTERS CONNECTED THEREWITH OR INCIDENTAL THERETO.

Be it enacted by the Parliament of the Democratic Socialist Republic of Sri Lanka as follows:—

Short title.

1. This Act may be cited as the Environment Conservation Levy Act, No. 26 of 2008.

Imposition of Environment Conservation Levy.

2. (1) From and after the date of the coming into operation of this Act, there shall be imposed a levy to be called the "Environment Conservation Levy". The Environment Conservation Levy shall be imposed on—

(*a*) a specified item owned by a consumer;

(*b*) specified items imported into or manufactured in Sri Lanka; or

(*c*) specified services provided within Sri Lanka,

at such rate as shall be as specified by the Minister in charge of the subject of Finance in consultation with the Minister in charge of the subject of Environment, by Order published in *Gazette*, calculated on an *ad valorem* or specific basis.

(2) The Order made under subsection (1) may also specify the items on which and the categories in respect of which such Levy may be imposed.

Manner of collection, administration and recovery of Environment Conservation Levy.

3. (1) The Environment Conservation Levy, imposed under section 2, shall, notwithstanding anything to the contrary in this Act—

(*a*) in the case of an item owned by a consumer, be collected through an institution specified by an Order published in the *Gazette* by the Minister in charge of the subject of Finance in consultation with the Minister in charge of subject of Environment;

(*b*) in the case of an importer, be collected on every specified item imported by such importer, by the Director-General of Customs, in accordance with the provisions of the Customs Ordinance (Chapter 235);

(*c*) in the case of a domestic manufacturer, be collected on every specified item manufactured by such manufacturer, by the Director-General of Excise appointed for the purposes of the Excise (Special Provisions) Act, No. 13 of 1989, in accordance with the provisions of that Act; and

(*d*) in the case of a specified service, be collected on every specified service provided by a service provider, by the Director-General of Excise appointed for the purposes of Excise (Special Provisions) Act, No. 13 of 1989, in accordance with the provisions of that Act.

(2) The Environment Conservation Levy collected in terms of paragraphs (*b*), (*c*) and (*d*) of subsection (1), shall be collected, administered and recovered by the Director-General of Customs or Director-General of Excise appointed for the purposes of the Excise (Special Provisions) Act, No. 13 of 1989, in accordance with the provisions of the Customs Ordinance (Chapter 235) or Excise (Special Provisions) Act, No. 13 of 1989, as the case may be.

Environment Conservation Levy to be remitted to the Consolidated Fund.

4. The Institution specified in an Order made under paragraph (*a*) of subsection (1) of section 3, the Director-General of Customs and the Director-General of Excise appointed for the purposes of Excise (Special Provisions) Act, No. 13 of 1989, shall remit all sums so collected as Environment Conservation Levy in terms of this Act, to the "Environment Conservation Levy Account" of the Consolidated Fund.

Order to be placed before Parliament &c..

5. Every Order made in terms of section 2 by the Minister shall—

(*a*) be in operation immediately upon the Minister affixing his signature thereto;

(*b*) be published in the *Gazette* as soon as convenient;

(*c*) be approved by Resolution of Parliament as soon as convenient thereafter ; and

(*d*) if not approved by Parliament, be deemed to be rescinded with effect from the date of such Resolution, without prejudice to anything previously done thereunder.

Penalty on failure to pay the Environment Conservation Levy.

6. (1) In the event of a failure on the part of any person liable to pay the Environment Conservation Levy imposed and collected in terms of section 2 and section 3, there shall be a penalty imposed on every such defaulter in such amount as is specified in the Schedule hereto.

(2) Every person who fails to pay the Levy shall be deemed to be a defaulter in terms of the National Environmental Act, No. 47 of 1980 and the provisions of such Act shall *mutatis mutandis* apply to the recovery of the amount in default.

(3) The Central Environment Authority established under the National Environmental Act, No. 47 of 1980, shall take such steps are deemed appropriate in the circumstances to substantiate the facts relating to such default and the Central Environment Authority shall thereupon recover the penalty and the amount in default and where necessary, shall instruct the Institution specified in an Order made under paragraph (*a*) of subsection (1) of section 3 or the Director-General of Customs or the Director-General of Excise appointed for the purposes of Excise (Special Provisions) Act, No. 13 of 1989, as the case may be, to proceed to recover such penalty and the amount in default. The Central Environmental Authority may for this purpose from time to time, issue such instructions and guidelines as may be necessary.

Sinhala text to prevail in case of inconsistency.

7. In the case of an inconsistency between the Sinhala and Tamil texts of this Act, the Sinhala text shall prevail.

SCHEDULE

(Section 7)

	Column I *Persons liable to pay the Levy*	**Column II** *Penalty to be paid*
1.	Consumer who owns a specified item	Not less than rupees five hundred and not more than rupees two thousand
2.	Importer	Not less than rupees five thousand and not more than rupees ten thousand
3.	Domestic Manufacturer	Not less than rupees five thousand and not more than rupees ten thousand
4.	Service Provider (within Sri Lanka)	Not less than rupees five thousand and not more than rupees ten thousand

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Title	Daily Mirror	Date	Page	Key Words
		1/4/10	1 - A6	

Minister Patali Champika Ranawaka pumping Polypto petrol into a fuel tank of a motor cycle at the launch of Polypto Lanka at Yatiyantota yesterday.- Pic by Waruna Wanniarachchi

World's first in Sri Lanka

Black gold from waste

POLYPTO

By Lakna Paranamanna and Rohan Kumara - Kegalle

Polypto Lanka - the world's first plant in which petrol is generated from polythene and plastic waste - was launched yesterday at Yatiyantota.

The Central Environmental Authority (CEA) in collaboration with

World's first...

Contd. from A1

Ananda Withanage, the inventor of the novel concept, and several lecturers from the Chemical and Process Engineering Department of the University of Moratuwa (UoM) had embarked on this venture in 2009.

The launch of Polypto Lanka was held yesterday headed by Environment and Natural Resources Minister Patali Champika Ranawaka. The newly produced fuel was pumped into fuel tanks of three-wheelers and motor cycles at the event, for the first time.

Minister Ranawaka who spoke at the event pointed out that this was a golden opportunity where extensive profits could be earned from waste that would otherwise contribute to adverse effects on the ecosystem of the country.

"This venture will be a massive boost to achieving the goals of the Pilisaru project as well," he added.

"The CEA, the UoM and Mr. Withanage entered a tri-party agreement on February 19, 2009. The project was initially planned to conclude within nine months. The project was, however, completed in 12 months," said national post consumer plastic waste management project CEO/ Project Director Roshan Gunawardena.

The plant which is still in the secondary stage, processes non-biodegradable matter such as mixed plastics, except for PVC (Polyvinyl chloride) and directly produces three most valuable forms of crude oil - petrol, diesel and kerosene. It has the capacity to process waste plastics from a minimum of 500 kilos up to a maximum of 1000 kilos daily.

"We have currently estimated that the output can range around 0.75 to 1 litre of petrol from one kilo of waste plastics. Therefore the tion of Polypto from 500 to 1(the main man t ture, Mr. Withai

The main go ect is to provid tion for the was Sri Lanka while low cost fuel op masses. "Accor estimations we made, we believe that a l petrol can be priced at R Rs.80," said Mr. Withana

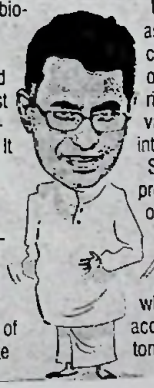
It has been nearly four Mr. Withanage invented t gy. He said he faced num lenges in transforming thi to action.

DM QUOTE

"The main goal of the project is to provide a stable solution for the waste problem of Sri Lanka while introducing low cost fuel options to the masses"

"Although many invitati private secto tions to launc ect, I was det initiate the ve collaboration ernment orga feel very plea: been able to r dreams and m success," he added.

Polypto petrol has already ted on three-wheelers and m cles. "The fuel was exposec cle emission test several da and was approved. Therefor currently looking into the pos of transforming the project in scale commercial venture," Gunawardena. Speaking furt added that sanction has been from the Ceylon Petroleum C tion (CPC) to manufacture fu waste plastics.



UoM lecturer Dr. Shant asinghe who also spoke currently testing is being out the possibilities of fu rifying Polypto petrol so t variety of Polypto petrol c introduced to the market.

Six percent of the entire g production in Sri Lanka co of polythene and plastic w The total amount of garb generated in the country about 6,500 metric tonn while polythene and plastic accounts for about 390 metr tonnes.

Fuel from discarded plastic, polythene

By Gamini Mahadura

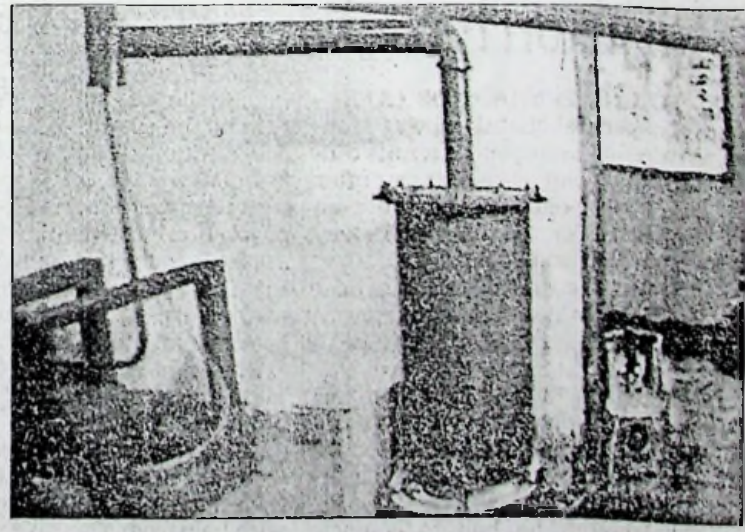
In a new scientific breakthrough, a retired police officer has invented a formula to produce fuel from discarded polythene and plastic.

N.W. Ananda Vithanage (39) of Yatiyanthota, Kabalumulla who retired from the police department after a service of ten years took to the building industry as a contractor. He first experimented with a formula to invent plastic sheets with sawdust and discarded plastic. During the experiment he realized that discarded material could also be used to produce fuel. The process involves the melting of plastic and polythene cut into small pieces and fed into a machine invented by Mr. Vithanage at a cost of more than Rs.100,000 in which the mixture is subjected to intense heat.

When the mixture reaches boiling point, the stem is cooled and collected through a process similar to distilling liquor. About 86 per cent of the end product is petrol and the balance kerosene and diesel. The residue is used in the manufacture of plastic sheets.

Galle

"A team led by Moratuwa University Chemistry Faculty Head Dr. Jagath Premachandra, confirmed that the fuel produced through this process was of high quality. Ceylon Petroleum Corporation has placed an order for 15,000 litres a day. High engine performance and longer mileage are special features of my fuel. A vehicle does an extra seven miles per litre using the fuel produced by me. At present more than 20,000 metric tons of plastic is imported to the country every year. The environmental damage caused by discarded plastic and polythene could be avoided by using them for a gainful purpose. I will be able to produce fuel in large scale and save more than Rs.2 billion to the country, if facilities are provided," Mr. Vithanage said.



Title (ලංකාදීප) | Date 17/12/07 | Page 23 | Key Words

ප්ලාස්ටික් - පොලිතීන්වලින් වාහන ධාවනයට ඉන්ධන

ලීටරය රුපියල් 25 කට දිය හැකියි

(ගලිගමුව විශේෂ රොහාන් කුමාර)

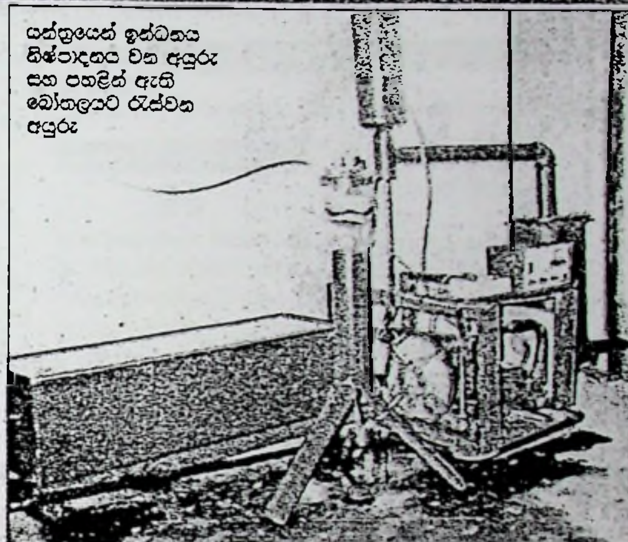
ඉවත දමන ප්ලාස්ටික් හෝ පොලිතීන්වලින් වාහන ධාවනය කළහැකි ඉන්ධන ලීටරයක් රුපියල් 25-30 කට නිෂ්පාදනය කළ හැකි බව යටියන්තොට වැසියෙක් කියයි.

වසරකට ඉවත දැමෙන ප්ලාස්ටික් ටොන් 180000 ක් මේ සඳහා යොදා ගැනීමෙන් රට සල්ලි ද ඉතිරිකැර ගනිමින් පරිසරයද රැකගත හැකි බව යටියන්තොට ආනන්ද විතානගේ (45) මහතා පවසයි. ඔහු අවුරුදු 18 දී ශ්‍රී ලංකා පොලිසියට බැඳී වසර 12 ක සේවා කාලයකින් පසු විශ්‍රාම ගියේය. ඉන්පසු ගොඩනැගිලි කොන්ත්‍රාත් කරුවකු ලෙස තම දිවිය ආරම්භ කළේය. එහිදී ඔහුට පිවිලින් හැදීමට කල්පවත්නා තහඩුවක් අවශ්‍යවිය. එම තහඩුව නිර්මාණය කිරීමට පරීක්ෂණ පවත්වද්දී

යතුරු පැදියට ඉන්ධනය දමන අයුරු

මෙම ඉන්ධනය සොයා ගැනීමට හැකි වූ බව ආනන්ද මහතා පවසයි. ඉවතදමන ප්ලාස්ටික් හෝ පොලිතින් කිලෝවකින් ඉන්ධන ලීටරයක් නිෂ්පාදනය කළ හැකි බව ඔහු කියයි. ඉන්ධන නිපදවාගැනීමෙන් පසු ඉතිරි ද්‍රව්‍යයෙන් ලී කුඩු දමා හෝ නොදමා දිරානොයන එමෙන්ම ඝනත්වයකින් යුතු ලෑලි හදා ගත හැකිය. ඉන්පසු එමගින් ග්‍රීස්ද සාදා ගත හැකි බව ඔහු කියයි. ආනන්ද මහතා තමා සොයාගත් ඉන්ධනය යොදා යතුරු පැදියක් හා මෝටර් රථයක් පණ ගන්වා ධාවනය කර පෙන්විය. කිසිදු වෙනසක් නැතිව සමාන්‍ය පරිදි වේගයෙහි වෙනසක්ද නැතිව ඒවා ධාවනය විය. සාමාන්‍ය ඉන්ධන යොදා ගන්නා වාහන වලින් පිටවන කළු දුමද මෙහි නැත. කාබන්ද නොබැදේ. මෙය පරිසරයට හිත කර ඉන්ධනයක් බව පරීක්ෂණවලින් තහවුරුවී ඇති බවත් මෙම ඉන්ධන ලීටරයක් රුපියල් 25-30 අතර මුදලකට දිය හැකි බවද ඔහු පවසයි. තම මෝටර් රථය මෙම ඉන්ධනයෙන් ධාවනය කරන බව එම මෝටර් රථ සමාගමට ඔහු දැනුම් දුන් විට ඔවුන් පවසා ඇත්තේ අනම් මනම් දමා තමන් ළඟට නොඑන ලෙසයි. මෙම වාහනය නඩත්තු සේවා සඳහා ගිය අවස්ථාවේ දැඩි තත්ත්ව පරීක්ෂණයට භාජනය කළ බවත් එහිද කිසිදු වෙනසක් නැති බව එම ආයතනය පවසා ඇති බවත් ඔහු පවසයි.

අප රටට වසරකට ප්ලාස්ටික්වලින් නිෂ්පාදිත නොයෙක් දේ දළ වශයෙන් ටොන් එක්ලක්ෂ අසූදාහක් පමණ ගෙන්වනු ලැබේ. මේ මගින් අප රටට අහිතකර ප්ලාස්ටික් පොලිතීන්වලට විසඳුමක් ලැබෙන බවද ආනන්ද මහතා කීය. මොරටුව විශ්ව විද්‍යාලයේ විද්‍යා අංශයේ මහාචාර්ය අල්විස් සහ ආචාර්ය ජගත් ප්‍රේමචන්ද්‍ර මහත්වරුන් ද පවුලේ සහෝදර සහෝදරියන් හා බිරිය දරුවන්ද තම සොයා ගැනීම් වෙනුවෙන් [illegible] බවද [illegible]



යන්ත්‍රයෙන් ඉන්ධනය නිෂ්පාදනය වන අයුරු සහ පහළින් ඇති බෝතලයට රැස්වන අයුරු

යන්ත්‍රය හා ඉන්ධන සොයාගත් ආනන්ද විතානගේ

WE MUST LOOK FOR ALTERNATIVE ENERGY SOURCES: PROF. VITHARANA

By Sandun A. Jayasekera

ENERGY

Sri Lanka may have to soon turn to alternative sources of energy such as bio fuel, solar power and nuclear and the government must take a policy decision to produce these locally if we are to remain competitive in the world, Science and Technology Minister Tissa Vitharana said yesterday.

At a function where the 3rd interim report of the "Inter Ministerial Committee on Implementing Bio Fuel Use" was presented Prof. Vitharna told the media of plans to produce bio fuel as a by-product of the sugar industry.

"Experiments have been carried out on producing ethyl – alcohol or ethanol from molasses, a by-product in the production of sugar," he said.

Prof. Vitarana said Sri Lanka produced only 10 per cent of the national consumption of sugar and the rest was imported but if the government could increase sugar production by 2.7 per cent and increase the land area set aside for sugar cane cultivation to 60,000 hectares by 2015 it would help the country to become self sufficient in sugar and thus boost the production of bio gas.

He said the sugar cane residue from the production of sugar could be used to supply fuel for boiler gas.

"World's petroleum resources are fast dwindling while the demand for petroleum products is rising rapidly. This will result in a sharp increase in petroleum prices. The results of using fossil fuel, are environment pollution, global warming, ice cap melt down with an increase in sea levels. If we are to avoid the impending perils that stare us in the face is to fall back on safe and alternative sources of energy such as bio fuel," Prof. Vitharana said.

He said another pollution free source of energy was from Gliricedia that can be grown easily and on a mass scale as an undergrowth in coconut plantations.

The Atomic Energy Authority is exploring the possibility of setting up a nuclear power plant in Sri Lanka with the assistance of India and the International Atomic Energy Authority with the possibility of using Thorium found in abundance in Sri Lanka as the source of energy for nuclear power generation.

Inter-Ministerial Committee headed by Prof. K.K.Y.W. Perera includes Prof. Ajith De Alwis, Ariyaseela Wickramanayaka, P.G. Joseph, T.A. Wickramanayaka, Dr. Ray Wijewardana, Dr. C. S. Weeraratna, Dr. A. M. Mubarak, Kinsley Bernard, Jayantha Ranatunga, Harsha Wickramasinghe, E. M. Piyasena, Jayantha Gunatilaka, Anura Satharasingha, Parakrama Jayasingha and Dr. Saman Fernando.

BIOFUEL

Biofuels are a wide range of fuels which are in some way derived from biomass. The term covers solid biomass, liquid fuels and various biogases.

⊙ Biofuels are gaining increased public and scientific attention, driven by factors such as oil price spikes and the need for increased energy securily.

FIRST GENERATION BIOFUELS

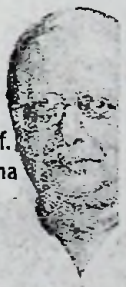
'First-generation biofuels' are made from sugar, starch, vegetable oil, or animal fats using conventional technology.

© DM GraphicsDesk

DM QUOTE

"World's petroleum resources are fast dwindling while the demand for petroleum products is rising rapidly. This will result in a sharp increase in petroleum prices.

– Prof. Vitharana



IN THE SUPREME COURT OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

In the matter of an application under and in terms of Article 126 read with Article 17 of the Constitution.

SC Application No.336/08 .

1. Ven Thiniyawala Palitha,
Chief incumbent
Nalandaramaya,
Nalandaramaya Road,
Nugegoda..

2. Ven Maduluvawe Sobitha,
Chief Incumbent,
Nuga Viharaya,
Kotte.

Petitioners

Vs

1. P.B.Jayasundera,
Secretary,
Ministry of Finance and Planning,
Colombo 01.

And 6 others.

Respondents

SC Application No.336/08 .

Before: S.N. Silva CJ
Sripavan, J
Ratnayake, J

Counsel M.A.Sumanthiran with Ms sSharmain Gunaratne for Petitioners
Manohara de Silva,PC for 3rd Respondent
Mrs B.J Tilakaratne , DSG, for 1st, 2nd and 5th Respondents.

Argued &
Decided on 01.12.2008

S.N.Silva, CJ

Leave to proceed has been granted in this matter on the alleged infringement of fundamental rights guaranteed by Article 12(1) of the Constitution in respect of the order made under Environment Conservation Levy Act No.26 of 2008 and produced marked P2 (a), P2(b), P2(c), and P2(d) . These levies relate to bulbs, other than compact Florescent Lamps , Cellular phones, Television transmitting towers, Broadcasting transmitting towers and Telephone transmitting towers., motor vehicles and motor cycles. It is now agreed that levy would continue only in respect of Cellular phones referred to in Gazette No. 1559/10 published in Government Gazette dated 22.7.2008(marked P2) c). Levy on that order would continue. The other levies would not be operative and be rescinded.

The imposition of further levies would be considered by the executive in consultation with the respective parties. The proceedings are accordingly terminated. No costs.

Sgd/.. CHIEF JUSTICE

Sripavan, J

I agree.

Sgd/. JUDGE OF THE SUPREME COURT

Ratnayake, J

I agree.

Sgd., JUDGE OF THE SUPREME COURT

I do hereby certify that the foregoing is a true copy of the order dated 01.12.2008 in SC FR Application No. 336/2008 filed of record in the Supreme Court.

Typed by ~~AU~~
Compared with f .

W. A. PRIYANI S. PERERA
REGISTRAR 111
CHIEF CLERK/SUPREME COURT
SUPREME COURT.

Chief Clerk/Supreme Court

C.F 958990
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05/01/2009

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21 JAN 2009
SRI LANKA

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