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ZERO WASTE

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ABSTRACT

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The aim of the thesis was to develop a clear vision on better waste management system. The thesis introduced the sustainable waste management along with innovation. The aim of the research was to find out the types of waste being introduced to environment, their consequence on human beings and surroundings, best policies, principles and practices to minimize the effect of the waste to lowest.

The study was based on literature. The thesis includes the introduction of types of waste, clarified the concept of zero waste, and came to a reasonable conclusion.

Keywords

Innovation, sustainability, waste management, zero waste

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1 INTRODUCTION

While comparing our old generation, our surrounding was not like what they are today. Development in technologies and infrastructures has made the universe much narrower and easy to live. Rapid urbanization and industrialization are providing a sophisticated living standard for growing population, but there are few consequences that came along with the changes is waste. Definition of waste has changed its dimension and expanded its circumstances as its types are increasing with the outnumbered products that are being introduced for better life. Waste is an unnecessary product of human activities at a given time. Waste is discarded material that is no longer used so its management has to be kept in great consideration. The management of waste requires various apprehending actions. Depending on the type of waste the definition of management may vary but the key concept is always minimization of waste to its lowest level.

A PHD chemist Paul Palmer introduced Zero Waste during 1970s. This theory is semi-philosophical theory because reaching 0% in waste management is not possible as there is always a residue. But, it is not only focused on reuse and recycle like other waste management systems but it also explicates the reuse.

The purpose of this thesis is to follow the procedure of waste production and minimization by all possible means. The research question is “How production of waste can be minimized sustainably so that the risk to the environment is at its lowest?’’

This thesis aims to point out the factors that might be overseen during waste management concerning its risks to the present and the future. It will discuss on the referred allied management system that conjointly works with the previous one. This thesis will first establish a concept about waste and its types and also describe the management systems and legislations. Finally the thesis will conclude the appropriate system of management depending on the type and surroundings.

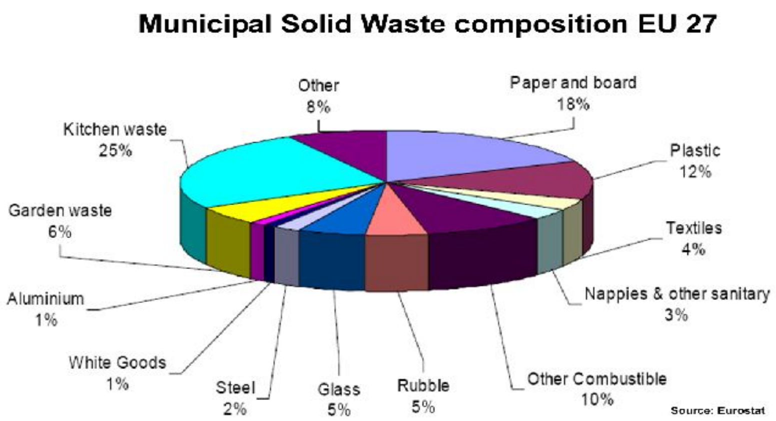
2 TYPES OF WASTE

The modern age is analogous with waste generation. Waste has always been a part of human life that has increased proportionally with increment in standard of living. Developed countries contribute more on waste production. Urban civilization and its influence has convince the developing world that production of waste is step taken towards development, and this step causes the unplanned and non-engineered society. This type of society will sooner be considered as ghetto as the management fails and also the production fails to meet the consumption. Waste, which is generated from these places, lacks proper treatment and epidemic diseases are spread in the environment causing global effect. Technologies associated with development are more or less waste contributors to our surroundings. Nuclear power plants, chemical industries, agrochemical industries, hospitals, vehicles, waste energy power plants are all waste generators (toxic). Depending upon the origin and toxicity of waste, they are dealt with in the following sub-headings. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989.)

2.1 Municipal Waste (Including Household)

Municipal waste is heterogeneous. Municipal waste comprises only around 10-15% of total waste generated. However, the political prominence of municipal waste is high because of its complexity due to its composition, its distribution among many waste generators and its link to consumption patterns. This waste is solid and semi-solid substances of organic and inorganic origin generated by human activities in households, services, trade, public and technical facilities, administration in cities and communities. (Tölgyessy. 2001.). It consists of residual waste (like food, vegetables, cooking oils), bulky waste, and secondary materials from separate collection (like paper and glass), household hazardous waste, street sweepings and litter collections, paper, cardboard, metals, textiles, organics (food and garden waste) and wood. It comprises of waste from hotels, motels, camping sites, recreational and spa resorts, cultural places, parks, graveyards, sports institutes, market places, solid dirt accumulating in waste water traps, ice and snow. Bulky waste that is not intended for reuse or their life span has finished like home appliances, carpets, furniture, carpets, mattresses, lighting appliances, heating radiators is also municipal solid waste.

MSW is also known as Local Authority Collected Waste because the authorized company collects the household waste. It comprises of both organic and inorganic material. That is the reason why there is a specific technical elucidation for its amassing, transportation, elimination or utilization. If we count for utilization it is necessary for to sort the waste in relevant categories and they are stored separately. This waste has been landfilled for generations but from mid 90's incineration has been another management system used for municipal waste along with landfill. There are several potential influences associated with the landfilling of waste including the production of leachate and landfill gas, odors, flies, vermin and the use of land. On the other hand incinerators produce smoke and some harmful gases as well as ashes that are toxic. (Daniel, 2011.)

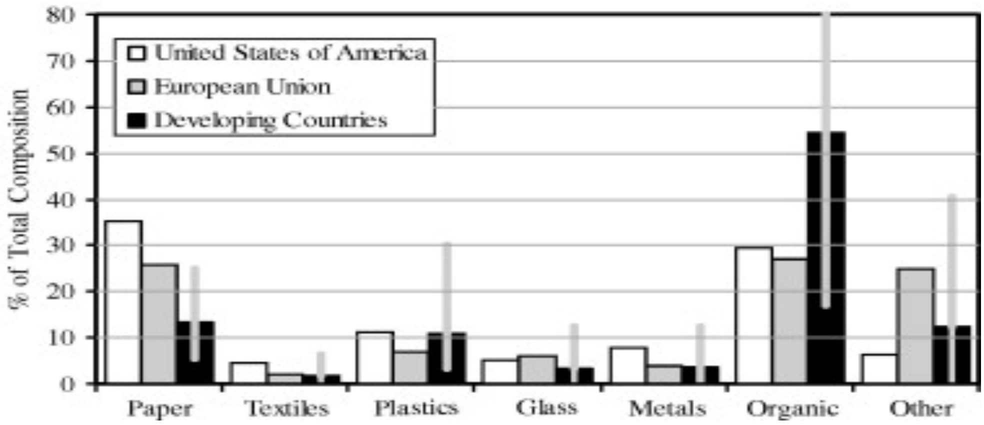


Graph.1. Municipal solid waste composition EU. (Daniel, 2011.)

Graph 1 illustrates the distribution of solid waste into 13 different categories. In this graph, kitchen waste comprises the highest percentage of solid waste whereas the lowest percentage is for aluminum and white goods that are 24% less than the kitchen waste. i.e. 1%.(Daniel, 2011.)

2.2 Industrial Waste (Including Commercial)

The difference between municipal waste and industrial waste is not only in quantity but also in the composition. It is specific for each factory and sometimes even each batch. Industrial waste varies from harmless to very toxic. Most of the industrial waste arises from heavy, chemical and consumer industries. Industrial waste can be subdivided according to the procedure during the whole mechanism of production. Production waste that is residues of raw materials and this waste is originated in different phases of production mechanisms. (Tölgyessy. 2001.). Process waste is produced during the processing of raw materials and fuel consumption. Consumption residues are that materials that have lost their value during reactions or process and do not meet the quality and composition of desired product.



Graph.2. Industrial waste composition of different states. (Tölgyessy. 2001.).

Graph 2 shows the percentage of industrial waste composition of US, EU and Developing Countries. The highest percentage of organic waste is around 55% in the developing countries and the lowest percentage of organic waste is around 29% in the European Union. In United States of America waste is composed of paper around 35%, textiles around 5%, plastics around 10%, glass around 5%, metals less than 5%, organic 30% and other around 5%. Whereas in the European union waste is composed of paper around 25%, textiles below 5%, plastics more than 5%, glass around 5%, metals less than 5%, organic more than 25% and other around 25%. While in developing countries waste is composed of paper more than 10%, textiles less than 5%, plastics more around

10%, glass around 5%, metals around 5%, organic more than 50% and other around 10%.

Waste can further be divided by their utilization i.e. returnable and non-returnable. Some types of industrial waste are mentioned below. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989). From the era of industrialization, waste arising from industries have been polluting the environment in all sectors i.e. water (from drains, and outlets), land (from discarded chemicals, scarps), and air (from gas emission during production). (Eionet 2009.)

Even though the regulations in early 80's had been employed to check every outlet and meet the authorized level but still there is a negative impact on eco-system and diversity. Especially in context of developing and under developed countries the regulations are not followed because the authorities are not concerned.

2.3 Hazardous Waste

Hazardous waste is generated from different sources including households, commercial activities and industry. Waste that is considered toxic to living beings and surroundings is hazardous waste. Mostly this waste arises from chemical plants like medicine, pesticides, insecticides, dyes, bio-chemical industries and paint factories. The waste generated contributes only 1% of all waste but it is the most dangerous and this waste is properly handled. This waste is categorized by its flammability, reactivity, toxicity and corossivity. Depending on these characteristics hazardous waste can be further subdivided into its level of harmful effect i.e. low risk to high risk hazardous waste. (Johnson, 1986.)

2.4 Construction And Demolition Waste

We are living in a society where the number of houses grows more than trees. This society contributes heavily on construction and demolition waste. This waste that is obtained from the production and destruction of commercial enterprises are said to be the construction and demolition waste. This waste includes nails, rubber and plastic pipes, electrical wiring, insulation, brick, glass, steel, and wood. Most of this waste can be reduced, reused and recycled. This type of waste does not create any chemical or biochemical pollution. Since this type of waste is heavy, bulky and has high density, there should be proper management for the collection, transportation, utilization and disposal of the construction and demolition waste. (Tölgyessy. 2001.).

2.5 Mining Waste

Mining and processing of mineral resources such as coal and ores generates large amounts of solid waste. This type of waste includes mine heaps, sediments from ore dressing, waste rock and topsoil. However waste rock cannot be considered a waste that simply has to be disposed in mine dumps. In order to use the industrial composition they have to be separated from the mineral rock by either mechanical or physic-chemical way. The separated waste rock is accrued in dumps and as it is almost non-utilizable substrate it may poses a severe ecological problem. Mining consists of a variety of industrial waste such as lead, carbonates, sulphides and metal oxides. This type of waste creates pollution in the environment. (Tölgyessy. 2001.).

2.6 Waste From Electronic And Electronic Equipment (Weee)

The waste that is obtained from the electrical equipment is called electrical and electronic equipment waste. The main sources of this waste are IT and telecommunication equipment, lighting equipment, monitoring and control instruments. This waste does not create any chemical or biochemical pollution. (Thomas, 1998.)

2.7 Biodegradable Municiple Waste

The degradable waste, which is obtained from kitchen, garden, as well as paper and cardboard, are considered to be biodegradable waste. Similarly, biodegradable municipal waste comprises all solid waste from hotels and restaurants. A characteristic feature of municipal solid waste is its heterogeneity. Due to its specific feature there is a specific solution for its accumulation, transport, removal or utilization. (Tölgyessy. 2001.).

2.8 End-Of-Life Vehicles

Almost all of the things found on the Earth have certain lifetime. Similarly vehicles and tyres also have the life span of fifty to sixty years, and then they cannot be reused but they can be recycled depending on the nature of the materials. Due to high density and heavy weight it is not so easy to utilize them and also it costs more. Similarly, tyre that is composed of polymer also costs more to recycle. (Thomas, 1998.)

2.9 Forest And Agricultural Waste

Waste is also generated in the process of forest exploitation. A large amount of solid waste is generated from modern agricultural mass production. The waste includes solid parts of excrements resulting from bedding less large scale cattle stabling, which cannot be used for fertilization in their original form, but have to be treated in such a way that they will not pollute the environment. (Tölgyessy. 2001.).

2.10 Radioactive Waste

If we compare the impact of waste on environment, radioactive waste is most harmful as a small amount is capable to destroy the large scale area in very short period of time compared to any other waste. If not handled properly it will become a worldwide threat. This waste can further be described according to their characteristics.

Military radioactive waste is generated from the recovery of spent fuel from military reactors, driving ships and submarines, experimental reactors and weapon testing. Commercial radioactive waste is from commercial programs of nuclear industry (generates both low and high level like x-rays, infrared rays, gamma rays and ultraviolet rays). Medical radioactive waste is from radiopharmaceuticals, scintillation solutions (low level). Industrial radioactive waste is from industrial application of radionuclides (low level). High-level radioactive waste is from the recovery of spent fuels. Transuranic waste is from spent fuel recovery, production of plutonium for nuclear weapons and production of oxide fuels. Low-level radioactive waste is from all operations of radioactive materials. Other than above categorization radioactive waste these waste can also be divided into alpha, beta and gamma sources according the emitted radiation. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989.)

3 WASTE MANAGEMENT SYSTEM USED GLOBALLY

When it comes to waste management system, 3R hierarchy system (i.e. reduction, reuse and recycle) is very commonly used as most preferable management system that deals with sustainability and environment friendliness. The waste hierarchy arranges an order of priorities for waste management with the preferred choice of waste prevention, followed by re-use, recycling, other procedures of retrieval such as energy from waste, and improved final disposal followed by monitoring. Management of waste should be done so that it does not endanger human health, harm the environment, pose risks to air, water, soil, plants or animals, be a nuisance through odors or noise, or adversely affect places of special interest. (Ritchie & Randall 2009.)

The rules and regulations to achieve decent waste management system requires to minimize the production of waste at each and every community and every individual level. The less utilization of materials results in less waste generated society.

Every individual could contribute to reducing waste by different means like buying and using less, especially buying the products that have long life span, repairing the broken materials inspite of replacing them, choosing walking as an healthy option instead of using private vehicles for certain distances, increasing the use of public transportation. (Daniel, 2011.)

Before reducing, refusing can also be a step in waste management. An individual or a customer has the right to refuse the product if it is not suitable to the environment. For example polyethene bags. Most of the stores replaced them with paper bags. The 3R hierarchy is followed by disposal and energy recovery.

Graph.3. Waste Management Hierarchy. (Thomas, 1998.)

Graph 3 shows the waste hierarchy system used globally. The waste management hierarchy is nationally and internationally accepted guide for prioritizing waste management practices with the objective of achieving optimal environmental outcomes. It points out the preferred order of waste management practices, from most to least preferred.

3.1 Reduction

Reduction in waste production is the first step in waste management. Less production means less effort for management. Local authorities play a vital role in reduction of waste. Mainly municipal waste can be minimized if it is treated carefully within the households. There are efforts by government on different levels like media and public education to minimize household waste. Industrial level is also concerned about reduction but it is not sufficient enough to make a change. Reduction is the first and most important stage in the hierarchy. This step includes taking an active view in purchasing and using only what is necessary for individual. The idea of reduction is to be careful of materials' source stream and waste management exercises to reduce raw materials. (Zerowasteinstitute 2005.)

3.2 Reuse

Reuse can be defined as the process of using the product for second or third or many times to prolong its life. We reuse many things in our life. In this way, if we know the materials or goods, we can reuse it. It helps to reduce disposal costs and needs. (Zerowasteinstitute 2005.)

3.3 Recycle

Recycle can be defined as the re-use of any materials. Most of the materials can be recycled and the objects of recycling are residues from the production or consumption of products. The residues, which are not recycled, become waste, and enter the environment. The recycled materials cannot perform as new and unused raw materials but they serve as raw materials for some percentage of the manufacture of new products, or as the source of energy. This differs according to the products. (Zerowasteinstitute 2005.)

Graph.4. Waste Management Hierarchy. (Thomas, 1998.)

The graph 4 is the waste management hierarchy which is a nationally and internationally accepted guide for prioritising waste management practices with the objective of achieving optimal environmental outcomes. It sets out the preferred order of waste management practices, from most to least preferred.

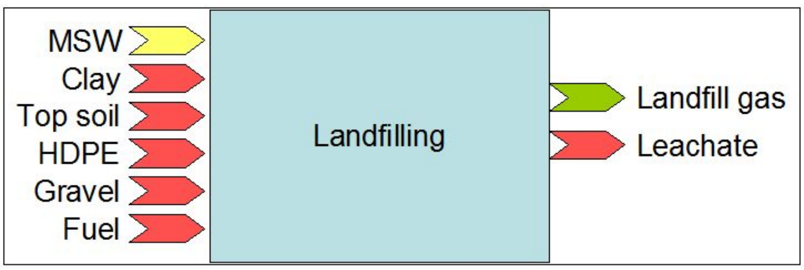
4 WASTE DISPOSAL SYSTEM

A waste disposal system usually refers to a selected technique, strategy, or device accustomed treat waste materials. This might embody the gathering, transportation, recycling, disposal, or process of waste. The employment of waste management systems varies in step with each the sorts of stuff to be treated and therefore the aims of the treatment itself. In general, waste management systems plan to curb waste for reasons like public health threats, environmental issues, or the overall look of a location. (Thomas, 1998.)

4.1 Landfill

Dumping is the oldest and the most common method of waste disposal. Even in the most developed countries more than 90% of solid waste is dumped. Waste is dumped in a certain area by studying the ecology, ground water system, living inhabitants in the surroundings and geographical orientation. The waste in dump is liable to many physical, chemical and biological changes.

Biological degradation of organic substances (aerobic and anaerobic) that are accompanied with the generation and release of odorous gases and liquids. In the landfill there is a chemical oxidation, leaching of organic and inorganic materials and migration of leachate in a dump. There is uneven settling caused by compression of material into the cracks created by various compressibility of waste. If the landfill is uncontrolled and unmanaged it will endanger the whole surroundings by contaminating the surface and ground water and deteriorating the environmental hygiene (smell, smoke, epidemic diseases). (Thomas, 1998.)

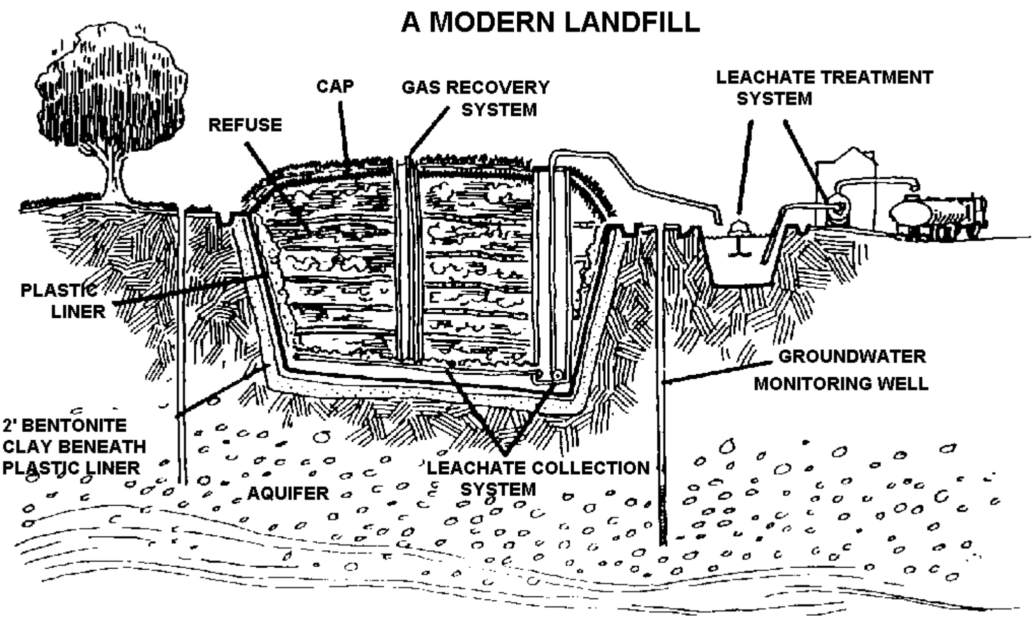


Graph 5. Landfill chart. (Tölgyessy. 2001.).

Graph 5 illustrates the methods implied on landfill. The first table shows the requirements, the second table shows the process and the last one shows the product from landfill. In order for landfills to be compliant with state and federal regulations, methane and other gases produced as a result of decomposition of organic waste must be captured and managed efficiently. More channel offers a range of landfill-related design, installation and maintenance services for both passive and active gas collection and condensate and leachate collection.

Thus the landfill site should be selected considering factors like area assessment for landfill, the decisive factors given by social interests, hydrological survey, engineering-geological survey, climatic condition, geomorphologic condition, geological and pedological setting, natural and social economic condition (proximity from hospitals, schools, recreational zones).

Once the landfill is constructed it should comply of proper leachate drainage (not effecting the surface and ground water). It should be equipped with gas drainage system installed at the bottom during construction and there should be a proper monitoring system. (Ecocycle 2012.) At the time of closure the operator is obliged to close the landfill in a way that will secure the environment from leakage of leachate and emitting gas from the site by covering the surface insulating efficient liner.

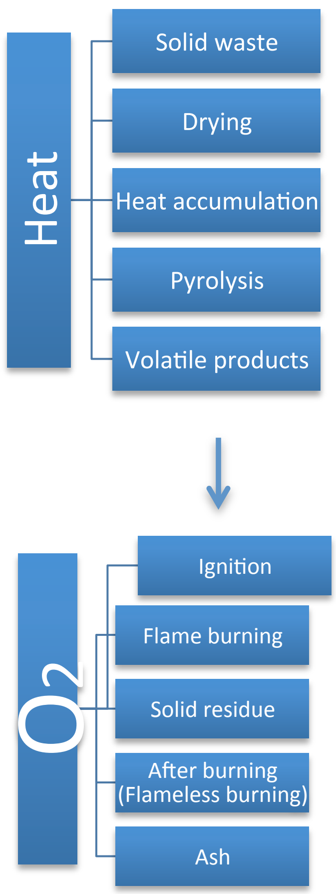


Graph.6. Modern landfill design. (Johnson, 1986.).

Graph 6 is a sample for modern landfill. These landfills are made in high acre land after studying the geographic situation along with the environmental impact on the surroundings. The science of landfill construction has progressed remarkably from the days when waste was deposited in open, unlined “dumps.” Today, modern landfills like High Acres are carefully designed to contain waste and protect the environmental integrity of the surrounding area – including the air, water and soil. The landfill incorporates advanced design features, including multi-layer liner construction, gas extraction and leachate removal systems.

4.2 Incineration

But all waste cannot be deposited at landfills and that waste is treated by incineration. Incineration is a very complicated process consisting of a series of reactions. Solid waste does not burn when heated even when oxygen is present. Volatile products of pyrolysis react with oxygen and then ignite, which means that flame burning starts. The heat released during the flame burning secondarily causes the pyrolysis of the rest of solid material, or the material oxidizes because it contains more carbon, and afterburning-flameless burning starts. Graph 7 below explains the incineration. (Johnson, 1986.).



Graph.7. Incineration Process. (Johnson, 1986.).

Graph 7 shows heat from the waste incineration is used for heating water to high-pressure steam. The steam is used to produce electricity and district heating. About 20 percent of the steam is converted to electricity, while the rest of the energy is used to heat water for the district heating system. During the incineration, the pollution in the waste is passed on to flue gas and the slag left after the incineration is completed. The flue gas is cleansed in several stages before being released through the chimney.

For its combustion properties, waste is classified into well combustible waste and waste difficult to burn. Well combustible waste is some industrial waste which are similar to municipal waste e.g. textile waste, packaging materials, cardboard foils. Waste that is difficult to burn has to be mixed with well- combustible waste in the ratio that secures continuous burning of mixture. Waste that is difficult to burn is plastic and chemical materials containing fluorine, chlorine, electroplating sludge and other toxic waste which sinter and form slags during combustion at high temperatures, enrich chemically has toxic components and is insoluble in water. (Tölgyessy. 2001.). Plastic waste has taken more prominent place among industrial waste. The way plastic behaves in the first stage of incineration process is most important. Thermoplastics soften when they are heated and solidify when they cool down. Thermosets are irreversibly transformed into infusible and insoluble state.

Table 1 below shows the caloric value of some waste. These values are necessary during energy to waste phenomenon as they describe the amount of energy received during the process.

Table 1. Caloric value of waste. (Tölgyessy. 2001.).

Waste	Caloric values $MJkg^{-1}$
Wood waste	1.6 to 16.3
Paper waste	14.60
PVC waste	18.80
Leather cuttings	18.30
Old tyres	36.20
Polyethylene waste	41.80
Dry peat	12.5 to 21
Pulp from paper production	3.40
Artificial leather trimmings	25.00
Ethenoid plastic waste	46.16
Fresh vegetable waste	3.35
Straw	14.00
Straw dust	14.20
Municipal waste as a whole	5.86 to 8.40

This waste is often burnt with a small amount (10-15% by weight) of conventional or high-grade fuels (coal, fuel oil, gas), which functions as stabilization fuels.

Solid waste incineration can provide path for various technical processes, e.g. thermal energy for heating. Incinerators contribute to solve the problem of waste as well as contribute to saving conventional energy sources such as coal, crude oil. They require smaller spaces than landfilling and also an option for non-degradable waste. In terms of transportation cost they are also flexible as they are built nearby towns or suburbs.

The following table presents different types of incinerators according to selected factors. The type of incinerator and the choice of combustion chamber type depends on the characteristics of the non-recyclable waste. Non-recyclable waste can be specified by its calorific value (CV), chlorine content, homogenicity and density. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989.).

Table 2. Types of incinerators for selected factors. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989.)

Factor	Types of incinerators
Operation mode	Continuous Continuous in limited interval Discontinuous
Number of incineration stages	One stage Two stage Multistage
Oxygen content in the combustion chamber(most often in primary combustion chamber)	Direct oxidation Pseudopyrolytic Pyrolytic
Function and shape of primary combustion chamber	With a simple stationary chamber (grateless) With a fixed grate With a travelling grate With stationary multistage chamber Tunnel furnace with endless grate (cylindrical rotatory) Chamber with fluidized bed hearth
Sort of incinerated waste	Municipal waste Hospital waste Industrial waste
Incinerator capacity and emissions limits	Municipal waste Max 1t/h Max 3t/h Over 3t/h Special waste, especially hazardous waste Max 3t/h Over 3t/h

NOTE: Single stage incinerator is no longer in use in waste incinerators, but it is still convenient for the incineration of oils or some simpler waste.

Every waste that is generated make their way to disposal as 3R never leads to zero percent minimization. Energy recovery from waste can be done before or after disposal.

5 ENERGY FROM WASTE

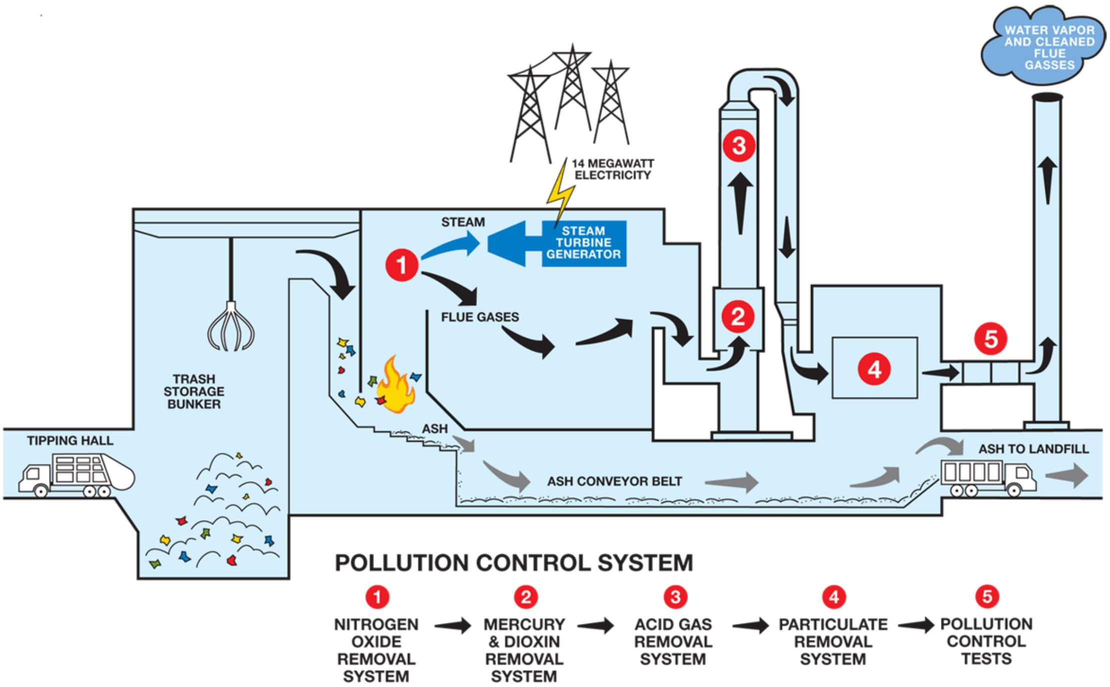
Energy can be retrieved from waste by different technologies. It has always been very vital that recyclable waste is removed initially, and then energy is recovered from what remains as unrecyclable waste (residual waste). We can get energy from waste with the method discussed below.

5.1 Combustion, Pyrolysis And Gasification

In combustion method the residual waste is burned at 850 ^{0}C and the energy is recovered as electricity or heat. Main fuel for this method is municipal solid waste, commercial and industrial waste, refuse derived fuel (RDF) or solid recovered fuel (SRF). In pyrolysis and gasification method the fuel is heated with little or no oxygen to produce “syngas” that is used to produce energy or as a feedstock for methane production, chemicals, biofuels, or hydrogen. Main fuel for this method is municipal solid waste, commercial and industrial waste, refuse derived fuel (RDF) or Solid Recovered Fuel (SRF), and non-waste fuels, (e.g. wood / other forms of biomass). (Withouthotair 2008.)

5.2 Anaerobic Digestion

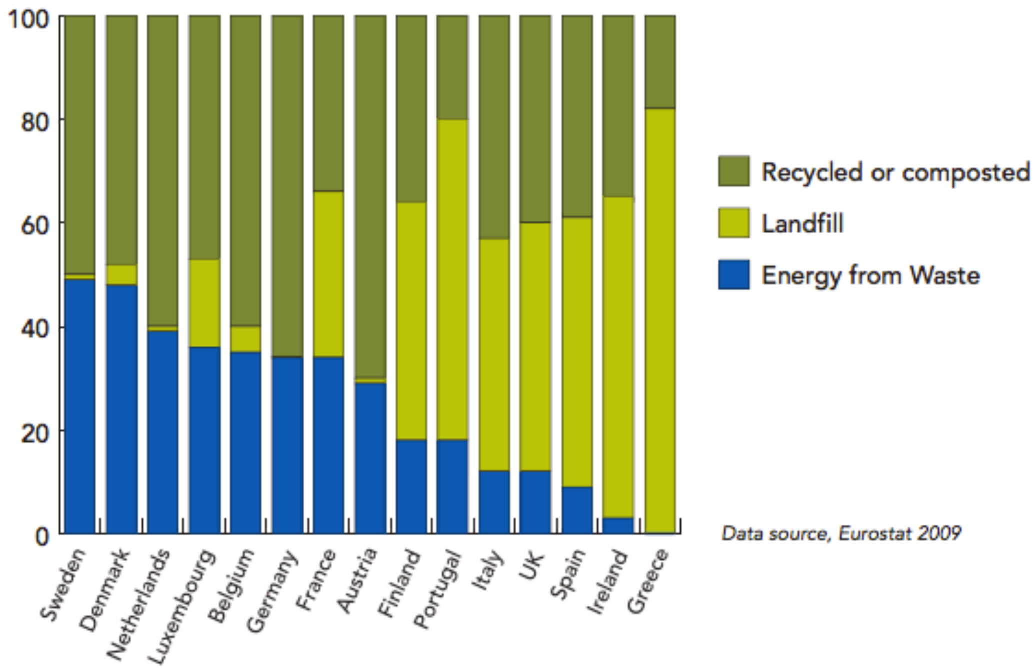
In this method microorganisms are used to transform organic waste into a methane-rich biogas that is combusted to generate electricity and heat or converted to biomethane. This technology is most favorable for wet organic waste or food waste. The other output is a biofertiliser. Main fuel for this method is food waste, some forms of industrial and commercial waste, e.g. abattoir waste, agricultural materials and sewage sludge. (Attfield, 2003.)



Graph.8. Energy from waste summarized chart. (Ecomine, 2008)

Graph 8 explains the pollution control system used in developing countries. The numbers describe the phases that are carried out during energy to waste process. Nitrogen oxide removal system is followed by mercury and dioxin removal and then acid gas is removed. After the particulates are removed the pollution control test is carried out.

It is also possible to harvest energy from the waste after it has made its way to landfill. Since landfill has been used as a traditional method of disposing waste, after exploiting its landfills, landfill gases that are produced as waste decomposes are collected. Landfill gases contain methane in high percentage. Capturing this gas prevents it from polluting the atmosphere. The production of landfill gas will slowly decline as we move towards more sustainable and efficient practices of waste management, focusing on the technologies described in thesis. But till now these gases are purified and used as fuel. (Withouthotair 2008.)



Graph.9. Energy generation from waste in EU countries. (Conway, Warner, Wiles, Duckett EJ, Frick, 1989.)

Benefits of energy from waste are reduction in the dependency on energy imports and reduction in carbon emissions and meeting the renewable energy target. When used for electricity generation, these technologies have a steady and controllable output, sometimes referred to as providing “base load” power. The characteristics also include good sustainability and saving greenhouse gases.

6 ZERO WASTE

It is a semi-philosophical theory that deals with the minimization of waste to its lowest level. This term was coined in the mid of 1970's by PhD. chemist Paul Palmer. Zero waste practice is about how to gain maximum efficiency from the use of resources. It is third generation planning, where wasting is the first generation and recycling is the second. The theory deals mostly with waste as a resource for another product. For example: during a chemical process a by-product which is considered as waste is used as raw material for other new product. In other words, it is concerned with the reduction of waste from the beginning. Generally speaking zero waste deals with waste sustainably.

The simple answer is less the waste, less is the cost for its management. Most of the developed countries are practicing zero waste as first step for better environment. It emphasizes the reuse again and again as much as possible. It is better consistent tactic to competent use than recycling the waste. According to zero waste the best way to evade waste is to reuse everything over and over – continuously. And this can only be done if all products are designed to reuse from the beginning. It is not useful to design ultimate discard into a product and then struggle after discard to find some way to reuse the bare materials, as recycling does today. (Palmer, 2005.)

In 19th century recycling was a better idea as it enhanced the use of discarded materials after undergoing a chemical processing. (Miller, 1999.) But only half of them were usable whereas the rest made their way to landfill. If we take an example of aluminum products only half of them are recycled as the rest goes into dumps in every use cycle either because of ignorance or its composition. If we take glass on the other hand they are crushed, melted and reshaped as it is done in the manufacturing process i.e. same amount of cost and labor is wasted. If those bottles were made reusable and refillable by the costumer then money and time would have been saved along with the environment.

6.1 Principles Of Zero Waste

This document outlines the principles and a few of the sensible steps being taken round the world in every big urban community and little rural communities within the pursuit of Zero Waste. Zero Waste programs are the quickest and most value- effective ways in which native governments will contribute to reducing temperature change, defend health, produce green jobs, and promote native property. Zero Waste is connected to property agriculture, design, energy, industrial, economic and community development. Every single person within the world generates waste and intrinsically is a component of a non-sustainable society. (Palmer, 2005.)

6.1.1 Design For Entire Lifecycle

Do not conceive piecemeal, simply to advance one product, replace one material, reprocess some cancel, decrease some power use or make a case for one restricted localized problem however, view the whole image, encompassing all the implications of your alterations from wherever they're being applied. Raise wherever all input product square measure being made, however wasteful they are, however those producing processes were altered successively and what impacts your amendment to due the reutilization of your merchandise. (Palmer, 2005.).

6.1.2 Associate Degree Demonstration

The forbidding of plastic baggage is not an option. Do not believe in periods of bans however do believe in periods of associate degree alternate and thanks to complete the identical factor (except better). The aim should be on the alternate, not on ostracize. Forbidding things may be an untidy thanks to green wash efforts, contrasted to the adversity of conceiving associate degree alternate. Do not settle for a perishable alternate. Perishable artificial is not any higher than standard artificial. It does not embody any inherent style for reprocess – thoroughly – it implies the robust, expensive and labor-intensive creation of an extremely purposeful molecule foll. (Attfield, 2003.)

6.1.3 Push The Design Upstream

Correct style starts once a product is contemplated. Even as prices, markets and materials area unit elementary style concerns, therefore should perpetual reutilization be. Ending up with degraded or mixed garbage once use is not a given, solely a style failure. Coming up with for post use diversion from garbage is not acceptable. Many corporations claim to be inexperienced these days as a result of however they handle some scrap or excess, whereas they proudly send merchandise out into the market that cause large amounts of discard and waste.

Zero Waste is not simply a slim crosscheck of your native behavior however it associates analysis of the impact of your styles. The upstream could also be your provider of components or materials. Once doors recessed hinge cutouts were complete with chisels, hinges required being square as a result of chisels cut square recesses. Once hinge recesses began to be cut out by routers, sq. corners were a strain therefore hinges were redesigned to own spherical corners, therefore saving the requirement to suit a square hinge into a spherical hole. Before the transition was complete, hinge recesses that were cut with routers had to be prodigally finished with a chisel. Although once highly useful recycle is not any longer potential, and writing should be reduced to its part materials for his or her recycle. Use higher-level style to create that operation simpler. Prime examples square measure metals and plastics as a result of either of them could include thousands of potential alloys. Keeping track of their precise composition is crucial to their recycle. (Palmer, 2005.) (Attfield, 2003.)

6.1.4 Design To Capture Highest Function

Do not style for materials capture except for the repair and use of each article's highest price. For example, removing an outsized shaped plastic half from an automobile and grinding it up into chips is not a Zero Waste operation unless there's no need to use the whole shaped half. It is employment of all-time low price, as a result of all of the resources that was gone to make the half are randomly discarded. Materials that are shaped by careful and dearly won molecular style (such as plastics or alloys) are high performing things. Any technique that destroys molecular organization may be a destruction technique, even though it masquerades as material employment. Compost ability is not a useful technique for extremely organized molecules. Perishable plastics are primarily an inventive substitution of destruction (green washing) under the pretense of composting. Composting may be a technique for recapturing natural nutrient values from complicated natural merchandise. It is not role in treating anything like "getting eliminates garbage". Composting is not a special add-on idea, however, it is the traditional Zero Waste response to the necessity for planning closed agricultural cycles. Someone responsible WHO (World Health Organization) merely does not need to use an area or item does not justify employing a lower performing technique. Capricious personal decisions at the expense of the earth are not ok. Do not honor them. (Palmer, 2005).

6.1.5 Focus On Highest Manifestation And Financing Reuse

Do not demolish buildings, cooling systems, processing plants, conveyor systems, display systems, forklifts, trucks, buses but preserve them as complete systems and reinstall them elsewhere as needed. Repair, reuse is not an add-on facility and cannot be alleged that way. It is a promise that a civilized society makes towards its design for living, and must be allowed for financially and fully at the earliest possible time. (Attfield, 2003.)

6.1.6 Separate All Articles

The rubbish mentality assertions that every one rejects square and measure identical, and all the candidates for discarding, so that the mixture does not cause any harm. The Zero Waste mentality claims that every things square measure is distinct, requiring distinct vigilance to use them. Mixture degrades them. This is applicable strongly to chemicals, however conjointly to abandon, customer excesses and every single industrial excesses. Notably conspicuous is that the enduring connecting of incompatible parts cannot be reused as a unit. (Palmer, 2005.) (Attfield, 2003.).

6.1.7 Some Examples

The utilization of glues is to cement plastic to steel or to timber as a cosmetic or shielding cowl or veneer. The utilization of mortar (cement) is to construct clay brick organizations (is there a better method to connect clay bricks together?) The utilization of bronze plating on alternative metals (e.g. gold on copper for circuit boards), is also important structures that no obvious alternate is definitely found.

For e.g., No item for reuse might proceed through any intermediate stage inside which no one takes blame. These stages can cause irremediable degradation. As soon as an item has no proprietor, nobody accountable, the garbage mentality takes over. This implies that articles cannot be ‘thrown’ into a canister for ‘someone else’ to take care of. Focus that every owner of an item keeps blame for the next reuse of that item until the next owner has assumed blame and encompassing the obligation to maintain data. Allow no zone of irresponsibility, (garbage containers and move positions are the existing, lowest examples), except somebody is in charge and committed to reuse and conservation of the history. (Palmer, 2005.)

6.1.8 Information

An aimless identification of discarded, abandoned articles (as happens in thrift shops) is hardly more than garbage management. Information about every article must be captured and preserved at all times through labels, notations, rfid’s, bar codes, Internet sites, specification sheets and every other possible means. (Palmer, 2005.).

6.1.9 Admit Ignorance

We do not, and cannot be anticipated to have all the responses. Several of the required responses will solely be discovered through investigation. Never permit the garbage world to belittle non. Waste method as an outcome of answers should be discovered. It is solely rubbish dumps that have one affirm everything. Universal exercise can demand advisors and know-how, notably with the allotment of mechanical forms of things. It is, sadly, no allotment of an enclosure trade for folks of mental handicaps than the other mechanical trade. It's solely the management of rubbish, and their low-grade kind of workout mentioned to as diversion, that need no information or understanding. Reuse may be a mechanically tough and sophisticated trade. The answers are not very simple. Usually assortments should to be believed considering tangled life circuits or the correct time to leave a system or to structure it through repair or upgrade. Get comfortable with the difficulties. Challenge everyone to seek out their own, tentative, however, innovative solutions to approach up with the utilization.. The workout can alter skeptics that apply is not all that troublesome to method for, one time one abandons the idea of the ever hospitable waste.

6.1.10 Do Not Compete

Exclusion of all subsidies for rubbish and a robust upward force on all garbage charges may be a major weapon for the transition to ZW. The grants for rubbish are countless and attractive. A dangerous one is that they are allowed to dismiss a little of the surface of the world from future useful use, while not giving for that loss of planetary exterior. Then the enterprise monitors and gets rid of for a number of years one time loading them, one time that they expect the general public to buy all future issues. Rubbish assemblage is not a public service. The support of garbage creation through assortment and trading will terrible harm to society. It should be eradicated, not respected as a service. Municipalities should not be getting for it. A smallest of for currently, the garbage business should to be compelled to compete within the public marketplace, while not grants, like each different business, for as long because it still lives. The money that is wasted on trash assemblage and trading is cash, which is expended to destroy our planet. We must habitually be eliminating that cash from trash assemblage and applying it to Zero Waste solutions and investigation. There’s a tremendous quantity of cash accessible for investigation into Zero Waste, although it's being wasted these days on trash collection.

The study of garbage generation, dumping practices, collection fees and other trivia of the garbage industry is not the proper business of the reuse industry, and is never a concern of the Zero Waste activist, except insofar as it helps in the elimination of such practices. Only putting “recyclables” into a separate bag is not recycling. Until a precise piece has a productive and operational use pathway, it is not reused. Simply decreasing the allowance of sure issue going into a get eliminate is not a Zero Waste success. Increasing the lifetime of a get eliminate is not a Zero Waste action. Zero Waste achievements are not assessed at the get eliminate however at the consideration, use or repair facility. The exercise commerce has deceived the government into treating the low-cut assortment of electrical devices merchandise as some quite positive virtue, even once there's no illustrious style for reusing them. (Palmer, 2005.) (Attfield, 2003.)

7 FACTORS THAT ARE ESSENTIAL FOR INNOVATION

Besides these we need to focus on something that leads us to sustainability and durability in both waste and energy sector. There need to be plans, procedures and implementation of methodology in both sociological and scientific field. Awareness in people can help those plans to succeed, as these factors are directly proportional with the behavior of an individual on a daily basis. When we talk about innovating to zero there are some issues that need to be absorbed giving them priority. These issues include all scientific, sociological and legislation for innovation. (Thomas, 1998.)

7.1 Basic Research Funding

For innovation research is essential. Research in every related field is necessary to figure out the solution for waste management. The term often brings funding obtained through a competitive process, in which potential research projects are evaluated and only the most promising receive funding. Such processes, which are run by government, corporations or foundations, allocate scarce funds. (Palmer, 2005.)

Almost all research funding comes from two main sources, organizations (through research and development departments) and government (primarily carried out by state universities and specialized government agencies such as government laboratories and research centers). In both of these funding there are advantages and disadvantages.

7.1.1 Government Funding

Government funding is monetary help the government offers to eligible projects and businesses with no payback. This can be a standard procedure in most governments and is finished for several completely different reasons. Table 3 explains the one side of state funding, that the indisputable fact that the money given is not repaid by the person or business UN agency who received it. It is not thought-about a loan, however rather a grant. Most government grants should be applied for before they are given. Some grants square measure won through coming into a contest against people or businesses. Others square measure simply given out if applied for and accepted. Many times the government offers funding to stimulate the economy. By promoting education, folks acquire higher jobs. A higher job results in a lot of financial gain that is spent within the economy. Most sorts of government payment will stimulate the economy in some way.

Table.3. Advantages and disadvantages of Government funding. (Palmer, 2005.)

Advantages	Disadvantages
• Major research that benefits the whole country • Mass collaborative projects • Results publicly shared • Intelligent human resource • Advance technology	• Small scope research not funded • Selection team might fail to fund important research • Demotivates minor researches.

7.1.2 Organization Funding (Private)

Private funding is from a selected company and agency, which has determined to fund a project. It is a lot seemingly to concentrate on rising problems, new needs, populations not nevertheless recognized as "special interests." Table 4 explains the merits and demerits of private funding. It is usually willing to pool resources with alternative funders. It has wide selection in size of obtainable grants; some will build terribly massive awards, others are strictly for little native comes. It has average grant size sometimes abundant smaller. Whereas priorities will amendment terribly cut down and continuation support may be tough to predict. Applicants have restricted influence on the choice creating method.

Table.4. Advantages and disadvantages of Organization funding. (Palmer, 2005.)

Advantages	Disadvantages
• Good for specific research • Minor research with high importance • Targets universities and schools for research laboratory.	• Results not public • Only profit oriented

Depending upon the country there are different ways of research funding. Researchers should meet the criteria and have strong ideas to receive funding from their source.

7.2 Market Incentive To Reduction

This is another important subject to consider with high value. Reduction is not as easy as it is said. The products that go to the consumer are not reducible. Needs cannot be compromised. So the market should be motivated to reduction. That means producers should be concerned about the products that go to the consumer. Products should me made that they can be consumed but should not generate waste.

The concept that follows market incentives to reduction is supported by the idea that industrial source executives are more familiar of their operations and are, consequently, the best entity to make cost-effective results. Preferably, the result should improve regulatory flexibility and accelerated progress toward environmental goals. Accept insistent "Pay-As-You-Throw" residential rate structures once pavement and yard waste employment services are out in service. (Thomas, 1998.)

Accept incentives for businesses to extend employment. Provide "curbside" employment services to businesses sufficiently small to use an equivalent service. They need to have permissible transporter to supply employment services at no cost to businesses, or at a reduction, which is not larger than 50% of the rates for waste transportation services. They need to provide at least equal volume of employment and garbage bin, cart or should have capability to every business. They should review industrial garbage rate structure and eliminate "volume" discounts for big waste generators.

Emissions' trading is one of a good example of market incentives for reduction. An emission trading system is an influential policy tool for managing industrial greenhouse gas (GHG) emissions. The trading system inspires operational excellence and delivers an incentive and path for the deployment of new and existing technologies.

As a policy tool, emissions' mercantilism is desirable to taxes, inflexible command-and-control regulation, and taxpayer-funded support programs because it is that the most economical means of reaching a given emissions reduction cap or target. It is specifically designed to deliver the environmental objective. It delivers a transparent value signal against live abatement investments.

Trading is not the sole policy instrument that governments ought to use. However failing to offer a significant role to mercantilism can impose excess prices and build policy confusion. Trading responds to the central objective of global climate change policy of expeditiously leading capital at intervals markets towards low-to-zero carbon emissions investments. To attain this aim, associate degree emissions market requires the scarcity of emission allowances – the unit of "Carbon Reduction Value" – so as to form the value signal for businesses and governments. There should be long-term clarity and foregone conclusion of rules, targets and also the restrictive systems guiding emissions markets worldwide. Compliance periods should be adequate and corporations should be permitted to structure a "make or buy" approach to their emissions reductions over time. A global carbon price gives birth to a new commodity, and a new set of investment and financing opportunities. These opportunities can link the metrics and methods for GHG abatement with larger capital markets flows aimed at financing low-to-zero carbon investments all over the world. (Thomas, 1998.)

7.3 Enterepreneurial Oppurtunity

Concentrating the enormous environmental challenges that we face, waste management has become a rising field that offers entrepreneurial opportunities, scope for innovations and investment prospects. Today, more and more project investors are looking into waste management and value repossession. Waste management adapted is thought of a public sensible, wherever municipal authorities provided this service. But municipal authorities alone cannot alter the challenge of managing waste in today's world, as a result of speedy rise in solid waste creation.

Interestingly, the non-public sector would play a large role in providing the service economically and with efficiency and therefore the role of this sector is well accepted in policy circles across the planet. There are multiple advantages arising from inflated non-public sector participation. Aside from the likelihood of quick technology adoption, innovation potential in waste management technology and processes and new ways of exercise, the non-public sector will contribute by making thousands of employment opportunities within the exercise and waste management trade and facilitate to produce cleaner cities and a provide boost to a greener economy. The micro, tiny and medium enterprises (MSMEs) have vast business opportunities within this sector, as a result of out of the whole four billion tones of waste made worldwide, only 1 billion is presently being recovered and solely a part of them recycled. (Palmer, 2005.)

There are two aspects that outline prospects for personal sector, especially, MSMEs within the waste management sector. Firstly, the tremendous speed at the urbanization is occurring across the developing economies and second, the scope and great potential for international interchange secondary raw materials recovered from waste. Management of waste has large business potentials and it will emerge as a core sector of the rising inexperienced economy. (Palmer, 2005.).

7.4 Rational Regulatory Framework

Waste administration might be a utility on the previously mentioned organizations and families crosswise over the planet. The standards can uphold conveyance of the government's zero waste driving force and targets while furthermore making helpful that the most extreme level of utility to give is healthier than that of in present modern times. The significant center of waste administration has been to redirect material from landfill; associate degree result significantly in accordance with the later European Waste Framework Directive. Marsh charge has furnished a budgetary motivation to keep far from swamp and meet this result.

For supply unattached waste streams, this has for the most part indicated that they need gone onto be reused. Jumbled (waste from that utile materials haven't uprooted at origin) presents a unique set of tests. The business has normally had the aforementioned tests by giving lingering waste medication offices that as a rule are recuperation operations like ignition & Mechanical & Biological Treatment. Similar to all enormous base, such plants have long operational existence compasses & however this sort of foundation is fundamental, cohort degree overreliance on this methodology to supervising waste might bait key materials at interims the jumbled waste, deterrent chances to catch & reuse prime value materials. (Palmer, 2005.).

To drive advance updates to on the other hand waste is supervised, the standards present a progression of prohibitive measures to: Maximize the sum & nature of materials accessible for use & minimize the essential element for remaining waste medication limit.

Move remaining waste administration up the waste progressive system in this manner on concentrate asset worth from those materials they won't reuse.

Generate the business sureness fundamental to underpin backing by organizations inside the usage, materials reprocessing & waste administration segment. Improve open certainty in use to support certify position as a use country. (Palmer, 2005.).

A root thought in investigating the draft standards has been making a prohibitive skeleton that minimizes, as a great deal as doable, short term fiscal effects (e.g. backing in new instrumentation & forms) while not precaution chances for augmented term money related funds or investment chances. The tenets square measure a component of an accumulation of activities beneath the Zero Waste arranges. Diverse imperative movements exemplify the occasion of a waste block technique & activities to prod change in edge & conduct towards waste. (Palmer, 2005.). Here is the alternative industrial system that is in use now and how it will be in zero waste industrial system.

Table.5. Difference in current and ZW industrial system. (Palmer, 2005.)

Current industrial system	Zero waste industrial system
• Linear • Focus on increasing products, creating financial wealth • Depends on large scale, centralized, capital incentive resource extraction industries and waste disposal facilities. • Products used once before destruction in large waste facilities • Goal is to manage waste • Attention principally on production and sales • Short product life span increases sales. • Use cheapest materials • Subsidies for natural resources extraction, below cost energy and water • Focus on end of pipe hazard management. • Belief in technology can solve problem.	• Cyclical • Focus on increasing service quality, maximizing natural capital • Depends in small scale decentralized, knowledge intensive business • Products are recycled back in to commerce or biosphere • Goal is to eliminate waste • Attention to waste minimization and durability. • Plan for ultimate disposal • Critical part of design considerations • Use recycled feedstock materials. • Sustainable • Non toxic chemical and materials • Plan for avoiding pollutants and toxics.

8 FINLAND AND STEP TOWARDS ZERO WASTE

Finland has become one of the successful countries in economic growth, living standard and energy production and distribution. Finland has contributed in environmental sector by research and funding. Legislations that are introduced by the country are effectively working in waste management. Below is the example of two companies moving towards zero waste.

8.1 Lahti Energy Plant

Finland's new 90 MW Kymijärvi 2 power station is an example for setting in its novel energy efficiency and environment technology: a waste-to-energy CHP production unit using clean biogas as its fuel. Lahti Energy as a technological platform for Finland operates the power station. They are using innovative technology to cool the extracted biogas to temperatures where impurities can be removed very easily when the gas is hot.

The plant's raw material is rubbish collected within a 200 km radius from households, industry and construction sites. Waste management companies in Lahti process those waste to meet detailed standards. Lahti Energy features these standards. For the process waste to biogas the sorted waste that consists of energy rich materials (plastics, wood and paper) is gasified and burnt. The waste is cut into 6 cm size to reduce the moisture content to 20-30%.(COSPP, 2012).

A laboratory at the entrance to the power plant station tests sample from each truckload. Kymijärvi 2 can receive two truckloads – or 360 m^3 of waste – per hour for gasification, totaling 250,000 tones of waste annually that would otherwise go to landfill. When approved from lab the waste is unloaded and it is fed into two 7500 m^3 silos from where it is conveyed 240 meters to the gasifiers.
The innovative alchemy of this power plant begins from here, with the solid fuel entering a circulating fluidized bed (CFB) reactor where it mixes with sand, limestone and air at a temperature of 900°C, under which conditions the solid

fuel breaks down into gas. The hot biogas rises to the top of the gasifier and thence into a cooling system where its temperature falls to 400°C.
The gas does not burn in the reactor because there is no sufficient oxygen for combustion and the cooling is necessary to clean the gas of unwanted particles (metal compounds and alkalis) that re-solidify and fall to the bottom and are then removed. The gas is purified so that the emissions are practically zero except for carbon dioxide produced during gasification. (COSPP, 2012).

8.2 Akkuser

Akkuser is the first in EU to innovate a technology for recycling of hazardous batteries and accumulators in an environmentally sustainable routine. Their technology elevates the grade of material retrieval from batteries and accumulators to a level that restores the original meaning of the term recycle. The recycling plant is located in Nivala, Finland, and it is ISO 14001 and ISO 9001 certified. Akkuser is a response to the battery and accumulator directive that was introduced in Finland on 26 September 2008. The directive obligates manufacturers to recycle all their batteries and accumulators, regardless of their shape, size, composition, or intended use.

The AkkuSer's recycling technique – Dry-Technology® – is exclusive inside the earth. It represents the latest technology that raises the degree of material recovery from batteries to a replacement level. It jointly permits safe handling of the hazardous materials.

The use rate of Dry-Technology® is over 90 % compared to totally different technologies like metalwork Technology though nearly 1/2 the processed material lands up in landfills. Another major quality of Dry-Technology® is that the terribly low energy consumption that is nearly 90 % however in metalwork Technology. (Akkuser, 2012).

AkkuSer processes most of the reversible batteries and battery waste generated in state and Baltic state, and 1/2 the waste generated in Norway and Sweden. The company has the potential to simply settle for waste from various countries and jointly to export its ways. In a new kind of dry technique, used batteries and accumulators are treated whereas not water or chemicals, eliminating waste water problems and minimizing the number of solid waste. The strategy provides an inexpensive and eco-efficient answer to the new EU directive relating to the utilization of batteries and accumulators.

In the treatment technique for dry-cell batteries and accumulators, the valuable metals are recovered for any use, and totally different parts, like plastic and cardboard, and are used in energy production. The strategy chain contains the reception of accumulators, intermediate storing, sorting to support the metal content, and thus the particular treatment. The sorted batteries are crushed and ground, the subsequent mud and gases treated, and thus the metal recovered. The whole technique is machine-controlled, and through this innovative dry technique, no water or chemicals are used. As a result, there is not any waste and thus the number of solid waste remains least. Moreover, the energy consumption is relatively low compared to smelting technologies. The utilization efficiency of the strategy is good. (Akkuser, 2012).

Development of the treatment chain has required a pioneering role in battery sorting, recognition and tracing likewise as in technique safety technologies. A full-scale exercise of the strategy desires that the infrastructure for the gathering of used accumulators and batteries be improved in state. The EU directive on batteries and accumulators would need employment of these materials. A law supported by the directive will enter into force in state in 2008, so this type of technique is in nice demand. What's additional, the supply of economical and affordable employment will make certain that used accumulators and batteries do not end up in landfills or third-world countries. (Akkuser, 2012).

9 CONCLUSION

Waste was, is and will always be the problem until and unless better ideas are introduced for its management. Since life standards of people are growing and so is the production of waste. Starting from a dinning table to an office desk generating waste has been part of everyone’s life. Even thought are so many policies going through the waste management the system is lacking the success to minimize it to the lowest. Different principles have been applied in the field of waste management. Reducing, reusing and recycling were the best practices for waste management. If the growing population is taken in consideration 3R is not the best answer for the waste management despite of its effectiveness. (Palmer, 2005.).

Talking about sustainability (The definition by United Nations on March 20, 1987) “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. ‘’ The same theory applies with sustainable waste management ‘’ waste produced in present should not be left for the future generation to deal with.’’ Simply the producer of waste bears the responsibility of waste.

The aim of this research was to investigate the types of waste being introduced to environment, their consequence on human beings and surroundings, best policies, principles and practices to minimize this waste to lowest. Zero waste is a theory that is semi-philosophical theory because reaching 0% in waste management is not possible as there is always a residue. Zero waste practice is about how to gain maximum efficiency from the use of resources. It is third generation planning, where wasting is the first generation and recycling is the second. This thesis mostly deals with the waste as a resource for another product. The research simply summarizes the methods that do not lead the waste to landfill or incinerator. This paper aims to point out the factors that might be overseen during waste management concerning its risks to the present and not the future. It also it be connected to refer allied management system that conjointly works with previous one. (Palmer, 2005.).

There might be a misconception about zero waste and 3R (reduce, reuse and recycle). Zero waste is related to all three of them but it deals with the change in production phenomenon. If the product should be made in such a way that despite letting its waste to dumps, it uses its waste as a raw material or other products. This concept might be costly in the beginning but the results obtained will give us a better planet to live.

This thesis points out the clear visions that should be adopted has solid goals, is a solitary call to action, involving the national awareness, predicts and reshapes the future, designs a climate for continual improvement, out-competes existing waste disposal methods, constructs a innovative monetary model supporting the market to drive the change.

Zero waste is not about all the garbage or dumps; it’s about innovation for future and sustainability. This paper concludes the appropriate system of management depending on the type and surroundings.

REFERENCES

Juraj Tölgyessy. 2001. Solid Waste and Chemistry Management. Slovakia. Banskä Bystrica.

Martin, Johnson. 1986. Hazardous Waste Management Engineering. New York. Van Nostrand Reinhold.

Letcher, Daniel. 2011. Waste: A Handbook for Management. Burlington. Elsevier Inc.

Elizabeth Thomas.1998. Solid Waste Management. Canada Hignell Ltd.

Conway, Warner, Wiles, Duckett EJ, Frick.1989. Hazardous and Industrial Solid Waste Minimization Practices. ASTM. USA. West Conshohocken.

Sarah, Diane. 2009. Eco-Living Handbook. London. Cariton Book Ltd.

Duncan Clark. 2009. The Rough Guide to Green Living. London. Rough Guide.

G. Tyler Miller Jr. 1999. Living in the Environment. 11th Edition. Atlanta. International Thompson Publishing.

Robin Attfield. 2003. Environmental Ethics. UK. Polity press.

Paul Palmer. 2005. Getting to Zero Waste. USA. Purple Sky press.

Modified: 28 June 2012. Introduction to Waste. Available: http://scp.eionet.europa.eu/themes/waste. Accessed: 8 Dec 2012.

Palmer, Paul. Modified: 18 April 2009.The zero waste Institute. Available: http://zerowasteinstitute.org/?page_id=120. Accessed: 8 Dec 2012.

Amato, Ivan. Modified November 1988. Can We Make Garbage Disappear. Available: http://www.time.com/time/magazine/article/0,9171,992527,00.html Accessed: 10 Dec 2012.

Gulland, Lian. Modified: 22 March 2013. Working Together For Zero Waste Society. Available: http://www.zerowastecotland.org.uk/ Accessed:19 April 2013.
World Redsources Institute. Modified: 5 Sept 2012. Zero Waste:

The Choice for a Sustainable Community. Available: http://ecocycle.org/zerowaste Accessed 6 February 2013.

MacKay, David JC. Modified 15 April 2008. Sustainable Fossil Fuels. Available: http://www.withouthotair.com/c23/page_157.shtml. Accessed: 15 January 2013.

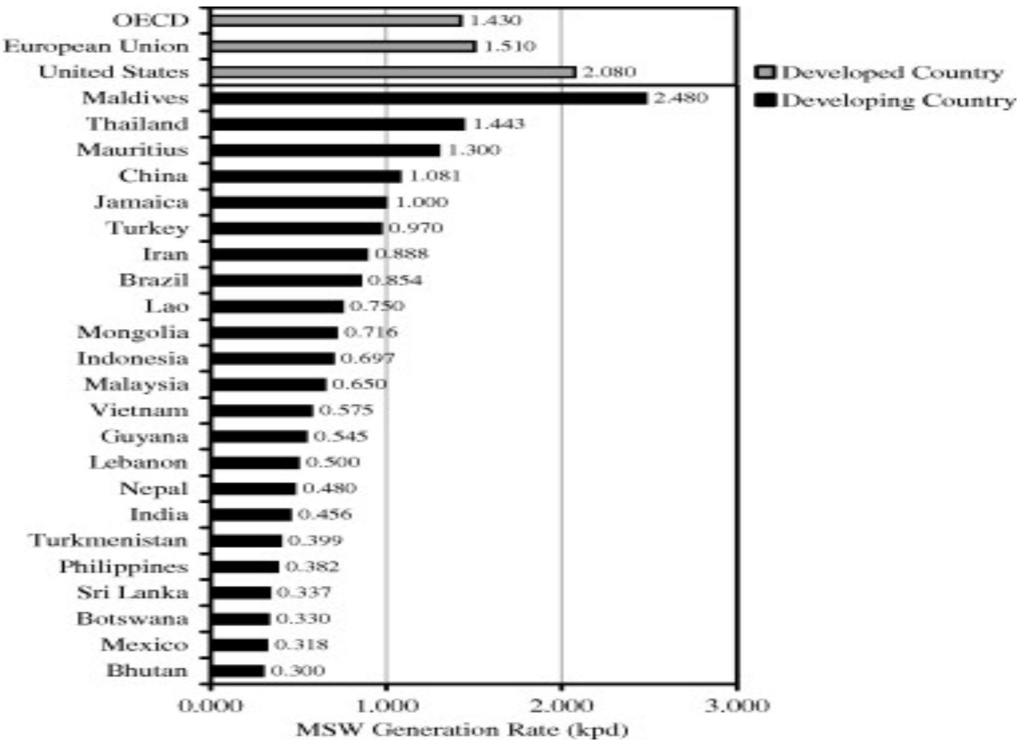
Salo, Marko. Modified 12 February 2009. Municipal Solid Waste Management in Finland. Available: http://www.ejkl.ee/content/files/FinnishMSWM.pdf. Accessed: 13 March 2013.

Pagni, John. Modified: 1 May 2012. Finns pioneer waste-to biogas CHP/district heating technology. Available: http://www.cospp.com/articles/print/volume-13/issue-3/features/finns-pioneer-waste-to-biogas-chp-district-heating-technology.html Accessed: 18 March 2013.

Pudas, Jarmo. Modified 23 Oct 2012. Akkuser Ltd- A Win-Win Situation. Available:
http://www.akkuser.fi/en/news.htm#AkkuSer_and_OMG_Kokkola_Chemicals, Accessed: 24 April 2013.

APPENDICES

Appendix.1. MSW Genereation Rate for developed and developing countries



Appendix.2. Solid waste management cost

	Low Income Countries	Lower Mid Inc Countries	Upper Mid Inc Countries	High Income Countries
Income (GNI/capita)	<$876	$876-3,465	$3,466-10,725	>$10,725
Waste Generation (tonnes/capita/yr)	0.22	0.29	0.42	0.78
Collection Efficiency (percent collected)	43%	68%	85%	98%
Cost of Collection and Disposal (US$/tonne)				
Collection[2]	20-50	30-75	40-90	85-250
Sanitary Landfill	10-30	15-40	25-65	40-100
Open Dumping	2-8	3-10	NA	NA
Composting[3]	5-30	10-40	20-75	35-90
Waste -to-Energy Incineration[4]	NA	40-100	60-150	70-200
Anaerobic Digestion[5]	NA	20-80	50-100	65-150

NOTE: This is a compilation table from several World Bank documents, discussions with the World Bank's Thematic Group on Solid Waste, Carl Bartone and other industry and organizational colleagues. Costs associated with uncollected waste—more than half of all waste generated in low-income countries—are not included.

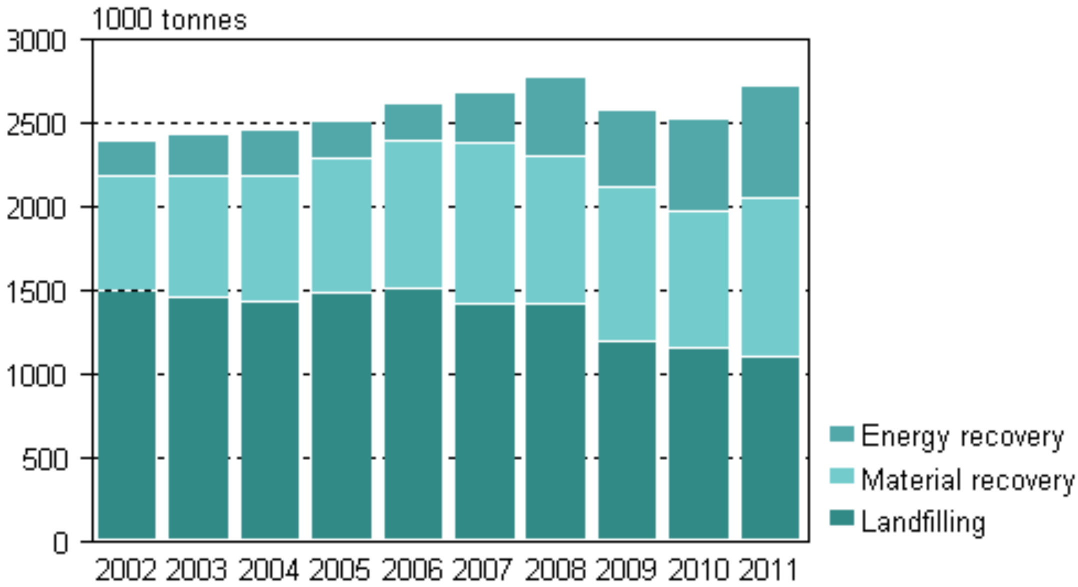
Appendix.3. Solid waste management cost

Estimated Solid Waste Management Costs 2010 and 2025

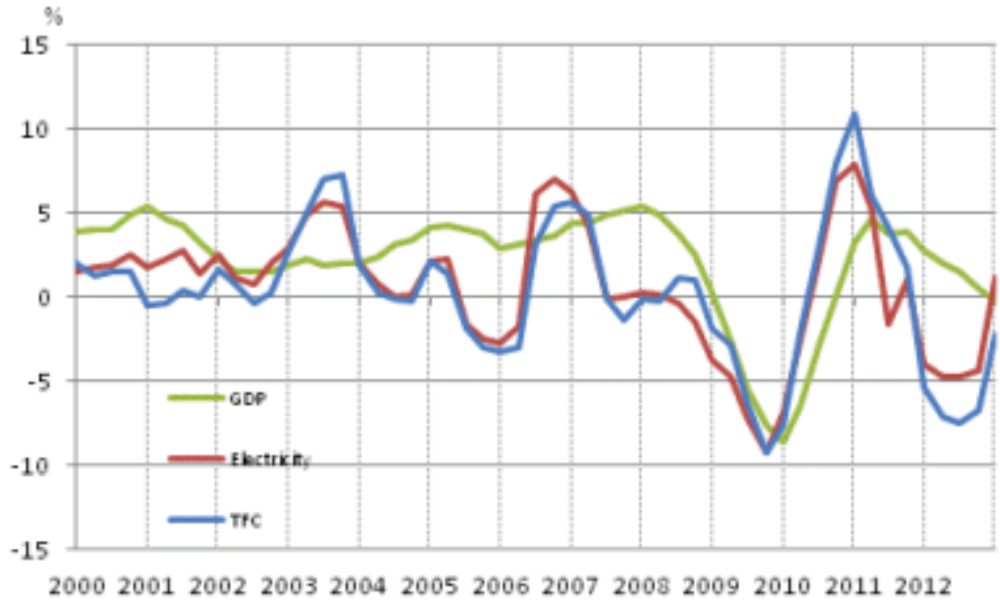
Country Income Group	2010 Cost[6]	2025 Cost
Low Income Countries[7]	$1.5 billion	$7.7 billion
Lower Middle Income Countries[8]	$20.1 billion	$84.1 billion
Upper Middle Income Countries[9]	$24.5 billion	$63.5 billion
High Income Countries[10]	$159.3 billion	$220.2 billion
Total Global Cost (US$)	**$205.4 billion**	**$375 billion**

Source: Authors' calculations with input from *What a Waste* report (Hoornweg and Thomas 1999) and the World Bank Solid Waste Thematic Group and Carl Bartone.

Appendix.4. Finland waste management

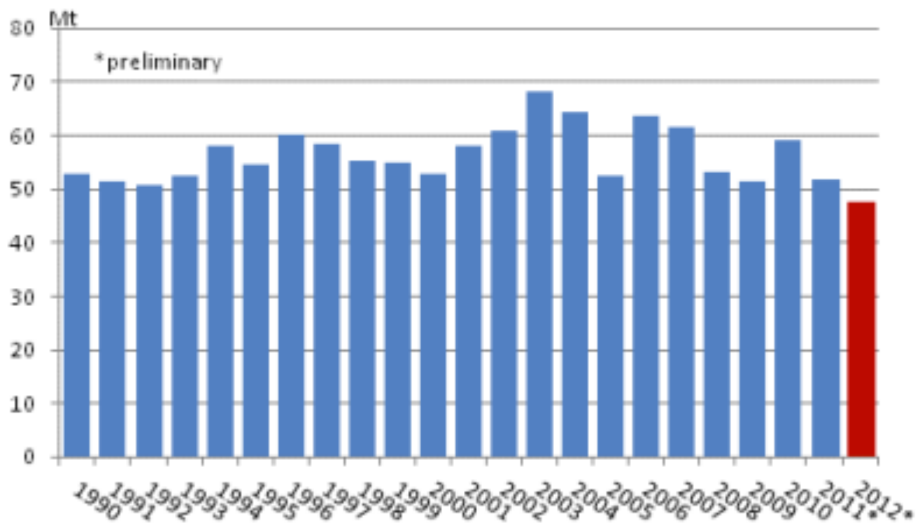


Appendix.5. Finland GDP and Electric growth

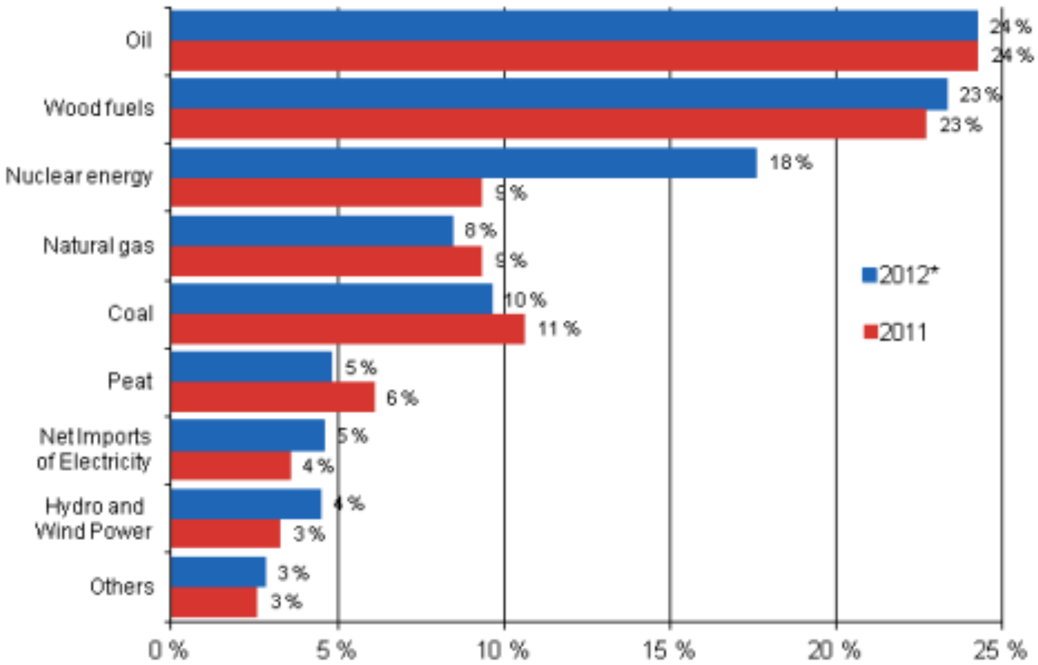


12-month moving total

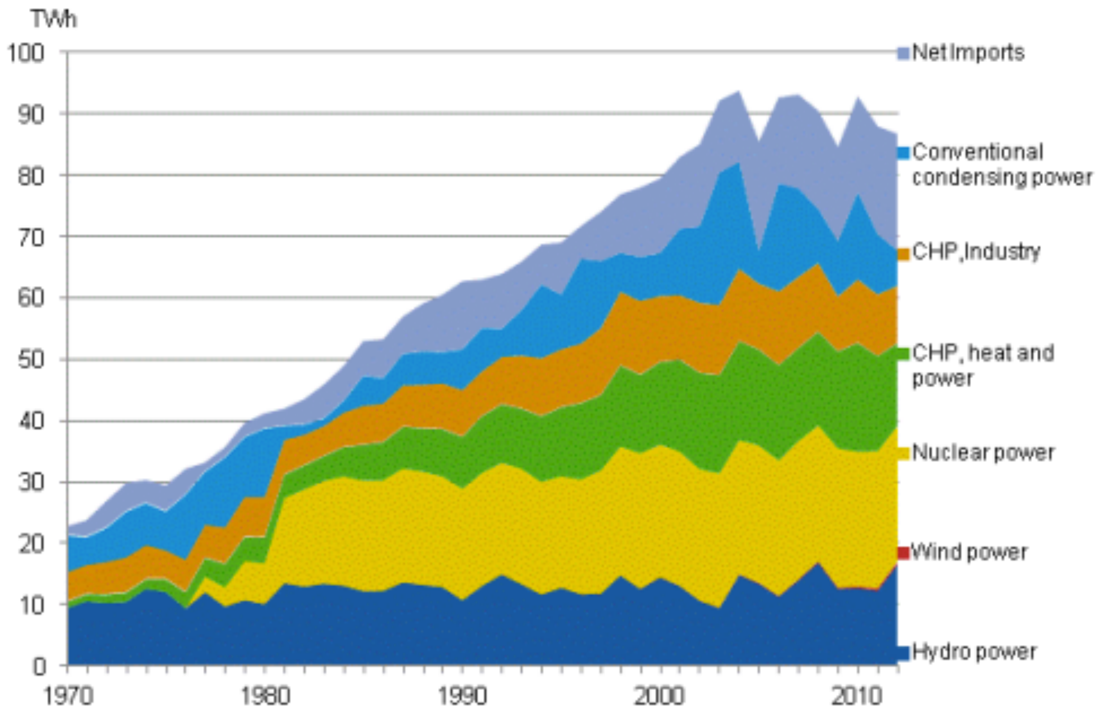
Appendix.6. Carbon dioxide emissions from fossil fuels and peat use



Appendix.7. Total energy consumption 2012 Finland

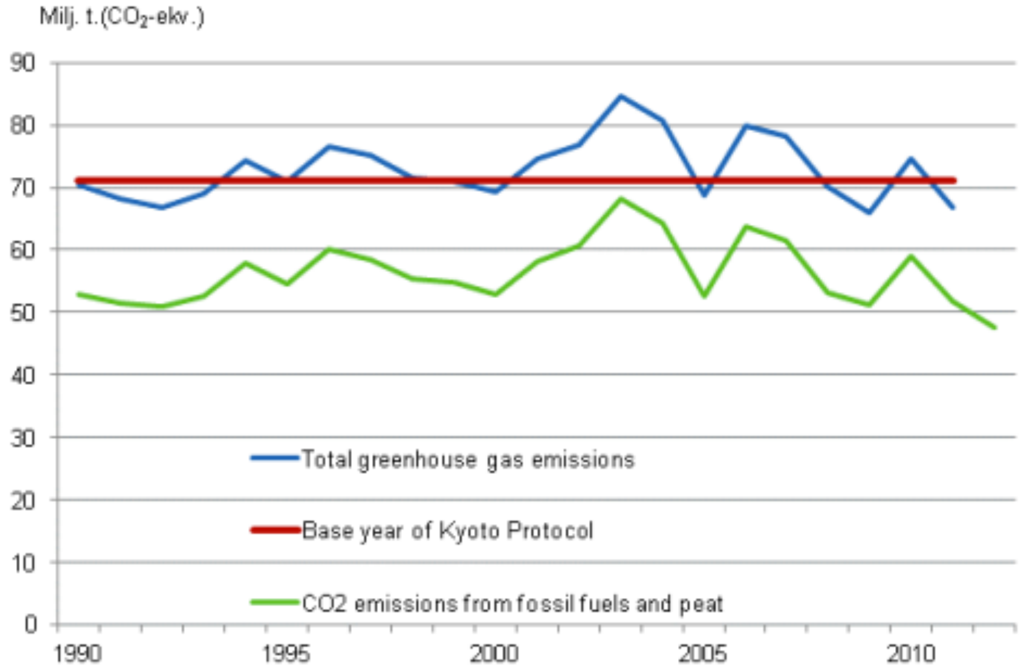


Appendix.8. Electric supply 1970-2012 Finland



Source: Finnish Energy Industries, Finnish Wind Power Association, *preliminary

Appendix.9. Greenhouse gas emmissions Finland



Appendix.10. Electricity generation capacity in peak load period in begining of 2013.