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Waste Generation and Planet's Sustainability at Current Level of Consumption

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Abstract

Human beings have been able to decode the law of nature to a very large extent starting with late seventeenth century. This has led to high level of consumerism and materialism in society with the use of science and technology coupled with innovation on market and socioeconomic front, ushered in very high level of social and economic inequality, and huge consumption of non-renewable materials, energy sources and other resources. On the one hand, level of comfort and luxuries got increased for those, who are able to coordinate and participate in consumerism and materialism, and acquire and harness the relevant skills, but remained cursing for those who could not participate in harnessing those opportunities on the other. In the race of consumerism and materialism, human being has been able to conquer time and space, controlled the nature like death rate through medical facilities and advancements, challenged the darkness by manmade lighting and chosen their own timeframe of working, however, separated the workplace from residence, higher level of urbanization, huge significance of education and training, unique lifestyle and comfort in daily routines in terms of food habits, hygiene like use of sanitary diapers, use of air-conditioners and supportive utensils like dishwashers, washing machines and electronic devices for communication, and so on, while creating his or her own environment different from specified by nature. Facilitation for all these required suction of physical resources of gigantic order and produced huge externality in terms of waste generation and environmental hazards like greenhouse gas emission, global warming, acid rain, rise in level of ocean to such an extent that survival and sustainability of human race on this planet are at the verge of getting questioned. Not only the current civilization is going to face a crisis for survival but also planet and its environment is threatened for its sustainability. The central issue remains a decision on economic development and growth versus that on environmental externalities, meaning a decision on driving engine versus broader goal of civilization in the light of environmental and civilization's existence, sustainability and spirit.

Keywords: Consumerism, Consumption, Economic Development, Externality, Sustainability, Waste Generation.

Introduction

During 52,000 years of human existence from the age of hunters and gatherers through pastoral, agrarian, and traditional civilizations, human beings arrived at the modern age (Giddens 2009, 2013), whereby individuals are enjoying not only mechanized and luxurious life style but also automated and digitized way of living, social interactions and transactions, while harnessing the nature for material benefits and damaging the environment. In this unidirectional process tailored

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for luxuries and personal enjoyment in the current period, individuals not only forgot and undermined the coexistence of their fellow-beings and other species (Figures 7, 9 and 10) but also manipulated the nature and sucked in huge quantum of resources from mother planet (Figures 6 and 7), which questioned the natural functionality of environment. It got immersed in the business of mega-scale consumption of material resources to such an extent that it is not only sucking the non-renewable resources but also approaching to a situation of swallowing the human civilization itself, while generating giga-level debris and hazardous wastage. The whole process got driven by unique belief of Puritanism, a faith in Protestants' culture for material consumption in such a manner that it is nullifying others. The process got further complicated as human race wants to maximize their current level of pleasure and benefits at the cost of that will remain available for future generations, without caring for availability of non-renewable resources, polluting environment and dumping with undesirable and harmful debris and materials, which is at the verge of questioning the sustainability of environment on the mother planet leading to threat on existence of current civilization on one hand and bio-diversity on the other. One can get a feel for level of environmental externalities in the race of economic growth.

Human mind has been engaged in identifying and innovating unique things during its course of journey in the process of its existence. Moreover, since 50,000 BCE through 1,700 CE, human race had been more or less in conformance with nature virtually without any sign of environmental externalities. However, starting with decoding the nature's behavior by Sir Isaac Newton (1643-1727) and subsequent inventions equipped the world with unique scientific knowledge (1687), which was complemented by distinct learning underpinned by Sir Adam Smith (1723-1790) through division of labor and their specialization (1776-1787) gaining team productivity of the order of 100 to 1000 times (Smith 1904). Subsequently, it was further escalated by invention of inanimate power sources like steam engine (1712) and electric motor (1821) a unique development and subsequent application of science and technology, especially in Europe, the industrialization process got ushered in. This revolutionized the process of human interventions in nature for material benefits in society of gigantic order, which was further fueled by Puritanism (a unique belief by Protestants' faith in Christianity) by increasing the scope for materialism and consumerism manifold (Weber 1950; Giddens 2009, 2013). There emerged the issue of conflicts between process of value creation, waste generation and that of value capture for material benefits at the cost of environmental sustainability and that of civilization. To continue on this tread mill of conflict between value capture and value creation through above mentioned process of industrialization in seventeenth and eighteenth centuries, Europeans started commercialization on mega scale for whole world by heavy emphasis of accelerated colonization with the use of military power, which itself got modernized through these scientific and administrative inventions and practices. Finally, the baton was grabbed by Americans in the last quarter of nineteenth century and Henry Ford (1863-1947) started batting with his unique concept of mass production, and mass consumption, which was partnered by Fredrick W Taylor (1856-1915) with his unique technique called scientific management, which got furthered by Alfred P Sloan (1875-1966) offering choices to customers and also with involvement of a galaxy of technology and management thinkers of 20th century through exploration of technological and management practices in fields like design, engineering, marketing, finance, human resources, economics, information technology, quality management and strategy with mega scale use of technology and inanimate power leading to exponential growth in scale and scope of productivity (Deming 1966, 1993, 2000; Juran 1964, 1980; Hammer and Champy 1993; Keen 1997; Kaplan and Norton 1999). These kept the tread mill of capitalism, industrialization, materialism, consumerism and profiteering on a faster track by sucking in giga-order planet's non-renewable resources and generating tera-order debris and harmful wastages, while limiting and constraining the revival

capacity against environmental evils and questioning the sustainability capability of the planet. One can appreciate the level of externalities or devastation for both the civilization and planet per se.

Due to interactions of multiple variables, environment on the mother planet earth possesses higher level of inertia on the one hand and being inanimate in nature on the other cannot express its damages on related scale and scope instantaneously. For example, the effects of emissions of green house gases in the form of water pollution, acid rain, air pollution, ozone layer depletion, global warming, depletion of arctic and land ice and corresponding rise in sea level, desertification, soil degradation, deforestation, space requirement for land-filling and energy needs for recycling and genetic modification are visible only after a rise in their threshold level in terms of human visibility and sensing capability only with elapse of centuries. The process of industrialization kept on polluting the environment for past two and half centuries till 1960s, when some signs of these evils started signaling to human beings, by this time human being got habituated with emerged newer lifestyle and consumption pattern and quantum. These were consequences on physical side of environment still there are some non-physical and invisible issues like social and economic inequalities, poverty, hunger and malnutrition, deterioration in human immune systems, sanitation problems, unemployment, crime and deviance, war and terrorism, and disintegration of family. All these episodes were created and accelerated by human beings for roughly three centuries with the aim of material benefits, so called economic growth and development through the process of industrialization. Despite, some of the highly industrialized states, who remained on forefront for and were one of the main responsible creators (Table 6) of above mentioned damages refused to take corrective action even after 2001 with multiple calls from global societies on the excuse of damage of its economy (Giddens 2009:184). Ultimately, current civilization has to take its inventories of activities and arrive at a bold decision, whether it wants to continue with perpetual existence or close the chapter of human civilization in the race of consumerism, materialism, industrialization and globalization in the name of economic growth and development by the end of current century. The real issue is not of economic growth and development versus environmental externalities, but it is sustainability of climate and environment for perpetual existence of civilization versus economic growth in the name of current material benefits, undesirable choices and pseudo pleasure.

Objective, Rationale, Research Approach and Data Gathering

Thus, one gets some feel for mega scale development in terms of choices and luxuries availability on one hand and constraints on civilization and planet earth on the other. Meaning, can current civilization get continuous support from mother planet earth at this level of social consumption? Hence, motivation and rationale remain to understand the relative significance of growth and developments with heavy concentration of scientific and technological development, and their major incorporation into life-style on one side, versus, distinct challenges posed in terms of poverty, inequality, social and family tensions versus fear of survival and sustainability on the other. To appreciate the process, one is doing some kind of exploration through case based approaches to the emergence of some pattern through analytic generalization rather than statistical one. While continuing on the task, tracing and using the data like, wastages and debris along with mining, manufacturing and environmental statistics for mother planet earth, press releases, other researchers' work and participant's observation seems quite interesting.

Industrialization Process

Adjoining diagrams in Figures 1 and 2 present the intricacies of modern industrialization processes based on input, throughput (process), output, purpose, utilities and facilitation parameters.

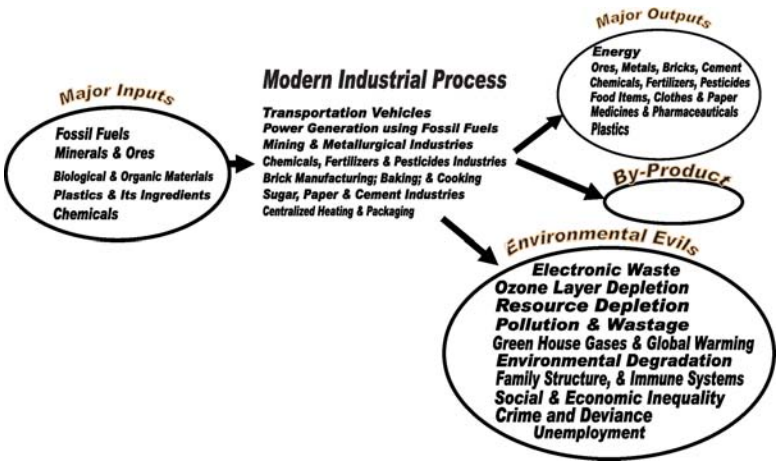


Figure 1: Modern Industrialization Process

Source: Author's Sketch and View for Illustration only- Giddens (2009)

Industrialization process has produced three kinds of outputs, viz. desired and intended outputs consisting products like energy, ores, coal, oil and petroleum products, bricks, cement, chemicals, fertilizers, pesticides, plastics, food and beverages, clothes, houses, medicines and pharmaceuticals, paper, automobiles, aircraft, other consumer durables, luxuries and lots of services along with some by-product having some utilities on one hand, and huge undesired and unintended externalities called wastes forming environmental evils like emission of greenhouse gases inducing ozone layer depletion, global warming, acid rain, and air pollution, water pollution, depletion of non-renewable resources, and generation of huge debris and wastages (Table 1), which are difficult to be processed and recycled causing non-recoverable environmental degradation in the form of soil erosion and degradation, deforestation and desertification, land occupation, health hazards on the other.

Figure 2: Need-Product Facilitation Process

Source: Author's Sketch and View - Buffa (1976); Martinich (1997); Schroeder (2007); UNDP (2014)

Table 1: Type of Wastes and Related Handling Methods

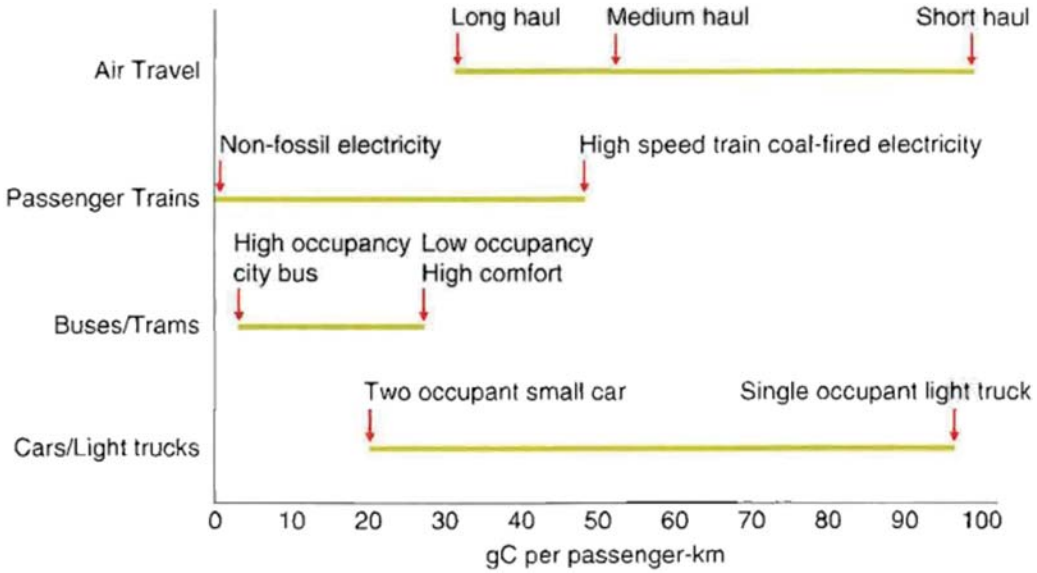
Waste Types	*Examples*	*Disposal Methods*	*Problems*
Solid	Mining Debris, Metallurgical Solid Wastes, Power Plant Solid Wastes, Construction & Demolition Wastes	Land Filling	Space Constraints, Leaking and sipping into water table – Water Pollution
	Manufacturing Wastes – Metallic – Non-metallic Hazardous & Electronic Wastes	Recycling, Land Filling, Extraction of Rare Metals & Land Filling/Incineration	Energy & Cost Constraints, Space Constraints, Leaking and sipping into water table – Water Pollution, Hazardous to Human-beings
	Plastics, Packaging Materials, Municipal Solid Wastes, Food Wastes	Land Filling, Incineration, Recycling	Air Pollution, Ozone Layer Depletion, Global Warming, Energy & Cost Constraints
	Agricultural Wastes, Pastoral Wastes, Wood Wastes, Leather Wastes, Yard Wastes	Land Filling, Burning, Incineration, Recycling, Discharge into river	Air Pollution, Ozone Layer Depletion, Global Warming, Energy & Cost Constraints, River Pollution
Liquid	Dies, Insecticides, Hazardous Chemicals	Discharge below water table through deep-well, Discharge into river	Energy & Cost Constraints, Land Infertility, River Pollution
Gas	Transport Operation (Figure 3), Consumer Durables (AC, Freeze), Power Generation, Metallurgical Processes, Mining Activities	Discharge into atmosphere	Air Pollution, Ozone Layer Depletion, Global Warming
Nuclear Waste	Nuclear Vessels & Equipments, Nuclear Fuels (Waste), Water and Associated Liquids	Dumping after Packaging	Radioactive and takes very long life for decaying

Source: Author's Conceptualization with Data from various United Nations Reports

Major Concerns

Let us focus our attention on historical emergence of environmental issues – major difficulties imposed on civilization due to gradual intensification in industrialization process for past three centuries. Current industrialization process emerged with the use of inanimate power by development of steam engine and its commercialization since 1715 and got intensified after 1825, when invention and commercial application of electric motor appeared. Efficiency requirements of industrialization process demanded and got facilitated by city and urbanization (Giddens 2009), educational and training of manpower (Weber 1950) and separation of workplace from residence (Giddens 2009), inviting duplication of space, utilities and sanitary facilities coupled with mega scale personalized transport requirements. Repercussion of transportation is presented through Figure 3. In twentieth century, electrical and electronics innovation picked up its momentum and started complementing the plain mechanical and thermal power, and accelerated the consumption of latter on gigantic scale. By later half of previous century, innovation got focused on data processing and communication mechanism, which led to

convergence of electronics, computing, information technology and communication. In this process, value addition and value capture activities got highly mechanized, automated and routed through heavy use of information and communication technology (ICT), which invited and facilitated feminization of work place. In this dynamics of mega scale industrialization and modernization, gigantic order material consumption emerged not only at users' end but also at process level - leading to huge demand on materials like various metals and their substitutes such as plastics and fibers along with heavy consumption of energy and its resources in routine life style of human beings. To support the material conversion process from ores to respective metals as well as that from petroleum products (Figure 4) to plastics were facilitated and energized by fossil fuels. Additionally, non-metallic materials and related manufacturing activities like brick making, cement production, toilet facilities (seats, wash basin, tiles making, rubber, chemicals), tubes, tires, ships, aircraft, transport vehicles, sugar and food processing industries started sucking fossil fuel or woods on mega scale. On the similar front even energy requirements for transportation (Figure 3), air-conditioning, centralized heating of houses, running of industrial motors and automation facilities, energizing and mechanization of house hold activities, multiplexes, stadiums, educational and ICT facilities, and so on, were huge and demand on fossil fuels or nuclear fuel got highly intensified on giga-scale. Rather any activities using inanimate power suck either fossil fuels or nuclear fuel. Physicists and engineers are suggesting that the efficiency and effectiveness of fossil and nuclear fuels for above mentioned activities remains around 40% to 50%. Thus, mega scale suction of fossil fuel generates more than 20-to-50 fold mega level order of debris, wastes and green house gases (Figures 4, 5 and 6, and Tables 1, 2 and 3) including sulphur dioxide, mainly responsible for air and water pollution, and also the acid rain creating phenomenon like soil erosion, global warming and rise in sea level during its process of mining, extraction and refining (Figures 4, 5 and 6, and Tables 1, 2 and 3). This has not happened for few years or for few decades, but it continued on exponential growth path for past three centuries.



European carbon emissions (grams of carbon per kilometer) by mode of transport, 2007
Source: ATAG http://atag.org/flles/PR%20LON-170002A.pdf (Slide 6, accessed 18 January 2008)

Figure 3: Carbon Emissions by Mode of Transport 2007
(Source: Giddens 2009:163): ATAG (Air Transport Action Group)

One episode of generation of green house gases and level of air pollution is depicted in figure 3, whereby one can get a feel of quantum of green house gas emitted during transportation process using different modes. In 2013, air aviation sector consumed 1.5 billion barrels of jet A-1 fuel, generated 745 million tons of carbon dioxide, which is roughly 2% of total human production of 36 billion tons of carbon dioxide emissions (ATAG 2016) while accomplishing our will of flying like bird and concurring time. Aviation sector is responsible for 12% of emissions of transportation sector, while road transport responsibility remains at 74% level. As per ICAO (International Civil Aviation Organization), specialized agency of United Nations, aviation industry has to come up with newer design of jet aircraft with half the level of emission, which was faced in 2005. Meanwhile, they have to cut 1.5% of emissions annually till 2020 (ATAG 2016). Similar level of concern is visible for road transport emissions from different authorities with some positive sign of results. However, volume of growth in consumption worsens the scene.

Table 2: Environmental Externalities during Industrialization and its Mass-scale Commercialization

Dimensions	*Processing Issues*	*Effects*	*Indirect Effects*
Mass Production	Mass Consumption ↑	Mass Purchasing Power ↑ (Demand)	Imitation ↑ (Consumption Habit)
Material usage	Metals (extraction) ↑ Mining ↑ Electrical Energy ↑	Green house gases – Emission ↑ Usage – Recycling ↑	Global Warming ↑ Sea Level ↑
	Plastics ↑ Non-Metal Production ↑ Chemicals & Pharmaceuticals ↑	Green house gases – Emission ↑ Usage – Recycling ↓	Acid Rain ↑ Wastage ↑
Mechanization	Automation ↑ Deskilling ↑	Quality ↑ Cost ↓ Uniformity ↑	Customization ↓
	Manpower ↓	Unemployment ↑ Purchasing Power ↓ Poverty ↑ Inequality ↑ Hunger ↑ Malnutrition ↑ Crime & Deviance ↑	Social Tension ↑ Social Cohesiveness ↓ Feminization ↑
Automation, Display & User-Interface by Electronics	Silicon/Germanium Chips ↑ Plastics ↑ Mercurry ↑ Batteries ↑ Cadmium ↑ Nickel ↑ Molibdenum ↑	Technological Pilferage ↑ Recycling Hazardous ↑ Incineration/Land Filling (Poisionous) ↑	Health Hazardous ↑ Human Organ Disabler ↑
Customization	Skilled & Smi-skilled Manpower ↑	Employment ↑	Skilling Process ↑
Packaging	Wastages – Materials ↑ (disposal) – Energy ↑	Recycling ↑ Release of Methane ↑ Consumption of Fossil Fuels ↑	Air & Water Pollution ↑ Dumping ↑
Feminization (Work)	Redistribution of household efforts	Inequality ↑ Family disintegration ↑	Social & Family Tension ↑
Garments & Consumer durables	Fashion (Possessing versus Utility)	Throwing away – Wastages ↑	Trigger (Mega-Consumption) ↑
Urbanization	Sanitation ↑ Inner city problems ↑	Wastage handling ↑ Crime & Deviance ↑	Emotion ↓ Market Mechanism ↑
Waste & Debris Generation	Land Filling ↑ Recycling ↑ Hazard Disposal ↑	Quantum & Order ↑	Air & Water Pollution ↑
Globalization	Cultural attack ↑	Western attack – on all culture ↑	Social Confusion ↑ (local versus western)
Dependence on Agriculture	Industrialized: 0.7% – 4.6% Mental Stress ↑	Developing (Rwanda, Uganda, Ethiopia, Nepal, Bangla Desh): 63% – 90%	Physical Effort Focus ↑ Immune Systems ↓

Source: Author's Conceptualization and view (inputs from sources like United Nations, NASA, World Bank sites)

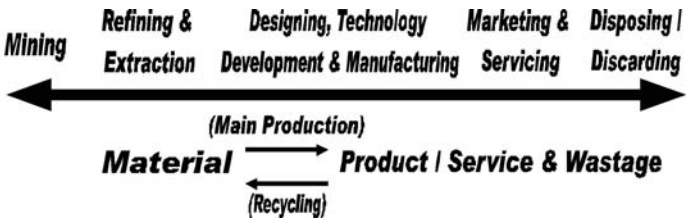


Figure 4: Production and Facilitation Process (Forward and Recycling)

Source: Author's Skech and View Including Proter (1985); Martinich (1997); Schroeder (2007)

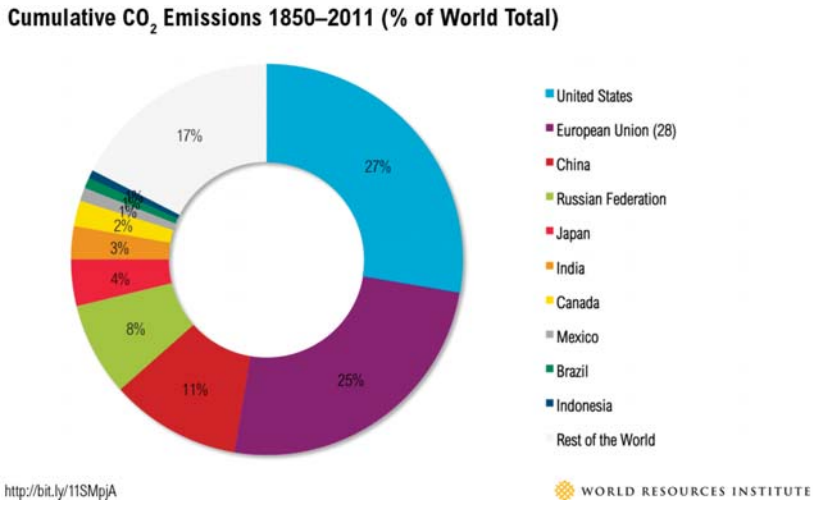


Figure 5: World's Cumulate Emissions (Carbon Dioxide) 1850-2011 (http://www.wri.org/comment/2150#comment-2150)

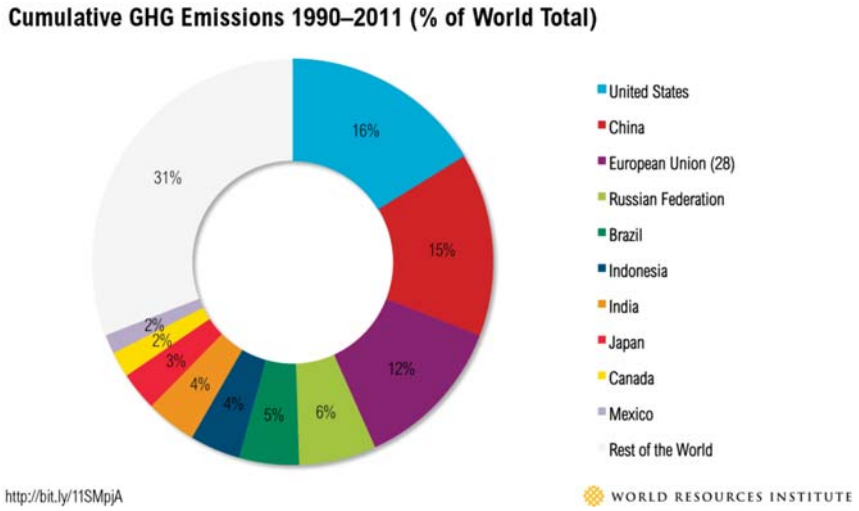


Figure 6: World's Cumulate Emissions (Green House Gases) 1990-2011

(Source: http://www.wri.org/comment/2150#comment-2150)

Table 3: Environmental Variables/Data (Source: NASA/GISS – 29 Feb. 2016: 14:00 IST)

Dimensions	*Change*	*Rise/Fall*	*Since*	*Long Term Effects*
Carbon Dioxide	402.26 ppm	↑	650,000Years (Highest)	Global Warming↑ Rise in Sea Level↑ Ocean Acidification↑
Global Temperature	1.4 Deg. Fahrenheit	↑	1880	rise of 2.5 to 10 degrees Fahrenheit over next century
Arctic Ice Minimum	13.4% per Decade	↓	Lowest in 2012	essentially ice free in summer before mid-century
Land Ice	287 billion tons per year	↓	Greenland Ice Loss doubled between 1996 & 2005	Greenland lost 150 to 250 cubic kilometers (36 to 60 cubic miles) of ice per year between 2002 and 2006 Antarctica lost about 152 cubic kilometers (36 cubic miles) of ice between 2002 and 2005.
Sea Level	3.41 mm per year	↑	7" up in 100 Years	Sea level will rise 14 feet by 2100
Precipitation/Rain	Land Surface: 22% ofTotal		Sea/Ocean: 78%	Storm increases the scope for higher level of precipitation on land due to movements of clouds – adverse effect may occur
Solar Energy absorbed by earth surface	48% (Both Land & Ocean)			

Above mentioned level of emissions of green house gases has created high level of air pollution, which has resulted into global warming with a rise of temperature of 0.8 degree Celsius since 1880 and highest level of carbon dioxide 402.26 ppm (highest in 650,000 years), resulting into rise of sea level by 7 inches in 100 years and acidification of upper layer of ocean mainly due to absorption of 2 billion tons of carbon dioxide per year, creating difficulty on lives of many marine species and changing the bio-diversity (Table 2). It is also causing loss in arctic and land ice, which will lead to 1 to 4 feet further rise in sea level with an additional rise of 1.4 to 5.5 degree Celsius by 2100.

Table 4 presents some of unique dimensions of water problem like contamination, especially during the process of production of fossil fuels, followed by level of consumption during industrial production versus that during energy production (main cycle as well as cooling purposes) another scope for adulteration. Additionally, it also presents the energy requirements for treating the water for safe human consumption from various sources. What is more significant that diseases like diarrhea and cholera are mainly caused due to adulteration or contamination of water and is quite prevalent in developing countries, where availability of portable water is more costly and difficult, especially for people surviving on less than $2 per day. This kind of diseases claims millions of lives per year from developing countries and is more vulnerable to children. Water pollution is more prevalent once industries discharge their untreated liquid waste or other kind of waste into rivers and lakes; sometimes they discharge their liquid waste into underground water table without any knowledge of governing authorities, which is even more dangerous.

As we have seen through previous paragraphs and Table 1, the quantum of wastages produced during metal and non-metal extraction, manufacturing, technological facilitation using electronics, electronic waste disposal (Box 1), packaging and service industry remains of very tall order and of all possible combinations of hazardous - non-hazardous, voluminous - less voluminous, bio-degradable and bio-non-degradable, and hence waste disposal system of this tall order (Table 5) remains a major challenge for responsible authorities. For example, referring Figure 4, four tons of bauxite ore is required to get one ton of alumina from which aluminum is produced through the use of electrical energy, again claiming higher level of energy, where efficiency remains around 40% claiming fossil fuel and generating wastage and greenhouse gases. Further rolling of aluminum ingots to make structural material or foil or electrical items will require further processing, claiming additional electrical energy. Additionally, to get 4 tons of bauxite ore, one need to get around 12 tons of debris from related mines. Hence, one is able to notice that to get one ton of aluminum, two tons of alumina, eight tons of bauxite ore and 20 tons of

Table 4: Water Related Data (http://unesdoc.unesco.org/images/0022/002269/226961E.pdf 15 Mar 2016)

Dimensions	*Volume*	*Reason*
Contamination	15–18 billion m^3 of freshwater resources	– contaminated by fossil fuel production annually
Industrial Consumption	777 billion m^3	(20% of world's total withdrawals)
Energy production	583 billion m^3	(15% of world's total withdrawals) (90% power generation – water intensive)
Energy production (Europe)		(43% of its total withdrawals)
Energy production (USA)		(50% of its total withdrawals) > That for agriculture
Energy production Cooling (China)	100 billion m^3 annually	More than 10% of the national cap (700 billion m^3) (Bloomberg, 2013)
Water Treatment Needs		
Lake or river	0.37 kWh/ m^3	Amount of energy requi red to provide 1 m^3 water safe for human consumption from various water sources
Groundwater	0.48 kWh/ m^3	
Wastewater treatment	0.62–0.87 kWh/ m^3	
Wastewater reuse	1.0–2.5 kWh/ m^3	
Seawater	2.58–8.5 kWh/ m^3	

debris (including that during mining) are required. According to EPA, "release of perfluorocarbons during the aluminum smelting process are 9,200 times more harmful than carbon dioxide in terms of their affect on global warming" (Leigh 2010). Similarly, on power requirement side, one can estimate the debris produced and greenhouse gases emitted. Let us get a feel for value addition process for consumer goods. On the one hand, industries engaged in value generation, value capture and value delivery activities suck major resources like fossil fuels, capital, land, labor, motivation, emotional and social feelings, and very little is left for waste handling purpose, however, it seems that requirements for these activities remains diverse and of tall and mega order (Box 2 and Table 5). Challenge is on both the front of market mechanism and administrative one during the process of handling wastes as well as that during generation of mega order and fixing up of responsibility and accountability for these. Society and economy is engaged in enjoying the benefits of modernity and industrialization, who is bothered about mega level excretions and toiletry activities of modernity (Box 1 and 2). Merely left with municipal and local authorities with meager resources and motivation, they handle it in their own way, example remains US handling its electronic wastes through Chinese Guiyu with huge health hazards for persons involved in processing (Box 1; Figure 7). Important approaches followed are recycling and land filling, and both involve its own kind of complexity and have to face different kinds of vagaries. Let us visualize three distinct types of process – like land filling, disposal of hazardous materials and that of recyclable ones.

Box 1: Quick Facts about E-Wastes (Worldwide Generation versus Dumping into Guiyu, China)

- 40-50 million metric tons of e-waste are generated worldwide every year. This is the equivalent to a pile of e-waste eight times that of the Great Pyramid.[1]
- In a year, the average American produces 48 pounds of e-waste, which is five times as much as the average Chinese citizen.[1]
- E-waste represents 2% of America's trash in landfills, but contributes 70% of overall toxic waste.[2]
- A large portion of what is labeled as "e-waste" is actually not waste at all, but rather electronic equipment or parts that can be reused or recycled.
- The average Fortune 500 company provides 3-4 electronic devices to each employee.[3]

E-waste is short for electronic waste - the stream of discarded consumer electronics and electronic equipment that have outlived their usefulness. Common products include computers, televisions, VCRs, stereos, toys, copiers, fax machines, laptops, and phones. The vast majority of e-waste can be reused, refurbished, scrapped for parts, or recycled. However, in the US, only 20% of Americans properly dispose of their e-waste, and only a fraction of that 20% that is properly disposed of is recycled or reused within the US.5 Ideally, proper disposal of e-waste would take place in factories where recycling is undertaken by machines with proper environmental regulations and procedures to protect workers and the local environment from exposure to harmful materials and pollutants. Often, however, that isn't the case.

The environmental damage in Guiyu is grave. Residents exhibit digestive, neurological, respiratory, and bone issues and diseases. Children in Guiyu are at a higher risk of lead poisoning and 80% of children experience respiratory ailments. In a 2007 study, 82% of the children in Guiyu had blood lead levels exceeding 10 µg/dL. In the village of Dutou, every child tested was lead poisoned.

(Source: http://batteriesandsustainability.org/chapters/ewaste.html – 08 October 2017: 15:00 IST)

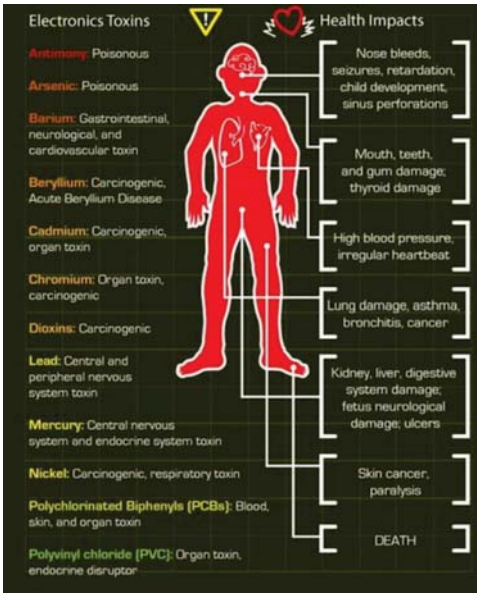


Figure 7: Effect of Disposal of Electronic Wastes on Human Health

(Source: http://batteriesandsustainability.org/chapters/ewaste.html–accessed on 08 October 2017:15:00 IST)

Table 5: Level of Waste Generation versus Recycling and Resources/Funds Needs

Consumption / Generation versus Society	***Quantum of Resources/ Wastes/Money***	***Data Source***
Wealthiest 20% People	Consume **75%** of Planet's Resources	World Bank
Recycling of Municipal Solid Waste (MSW)	**3.5** fold	UNEP
Current Municipal Solid Waste (MSW)	**1.3** Billion tons	
Projected Municipal Solid Waste (MSW) for 2025	**2.2** Billion tons	
Land Resource Requirement per Person	**1.8** Hectares	
Continuation of Urbanization of World Waste (Projected)	**70%** Increase in Urban Solid	World Bank
Global Market for Waste Management (Collection and Recycling)	**US $ 400 Billion**	UNEP
Global Market for Scrap Metal and Paper	**US $ 30 Billion**	World Bank
Textiles thrown away by United Kingdom	**2 Million tons** Every Year	
Textiles Recycling by United Kingdom	**24%**	
Use of waste textiles to make new items	**10%**	DEFRA
Buildings' Consumption of Energy by European Union	**40%**	Sustainable Energy for all (se4all.org) & World Bank
Iceland's Consumption of Energy (100% from Renewable Sources)	**13%** from Geothermal **87%** from Hydropower	
Brazil's Energizing	**83%** Hydroelectric Power	

(Source: UNDP (2014) Southern Innovator: Waste & Recycling Issue, Issue 5, United Nations Development Program)

Box 2: China's and Indonesia's Emissions

China's emissions are not link *by* Kate Kemp on Sep 14, 2015 (http://www.wri.org/comment/2150#comment-2150)

China's emissions are not only from global consumerism but the business opportunities embraced by China, from western countries ordering components for Solar Energy panels and wind turbines, trying to lower their emissions!!! For instance, in the UK, re-cycling targets are set by the EU and heavy multi-million fines by the EU if we don't meet those targets. But, re-cycling plants are closing down because globally, the prices per tonne of plastic/paper / tin has dropped significantly. So, NOW, our recyclable waste is sold cheap by local UK Councils, to re-cycling plants in Indonesia and gets loaded onto enormous container ships, going 9,400 nautical miles, JUST to avoid EU fines!

Basically, the west and their 'first world' countries, are giving contracts to China for solar Panels and wind turbines, to visibly reduce THEIR global pollution and emissions and LOOK as if they are playing their part. It's such HYPOCRISY by western countries. China and Indonesia are vilified for being top global polluters, at the expense of Western countries appearing to comply and look good. No-one talks about the inefficiencies of wind turbines, using electricity to keep the damn things turning in zero wind and them completely falling apart in high winds, even falling over. UK Conservative Government said they would be the greenest government and then stopped 'Free solar panels on private homes' ... much to the upset of Solar Panel installers, who were making a fortune, importing solar panels from China!

The links mentioned below, are just an offering, from left and right wing newspapers who sometimes do decent journalism regardless of politics.

http://www.bbc.co.uk/news/magazine-21432226

http://www.telegraph.co.uk/finance/newsbysector/transport/10289821/Conta...

http://www.cifor.org/publications/pdf_files/research/governance/XSunetal...

http://www.dailymail.co.uk/home/moslive/article-1350811/In-China-true-co...

http://www.dailymail.co.uk/news/article-1241872/EXCLUSIVE-Inside-Chinas-...

http://www.dailymail.co.uk/news/article-2362762/The-dirty-secret-Britain...

http://www.theguardian.com/environment/2012/aug/07/china-rare-earth-vill...

- **REPLY**

Cannot agree more!! Most link *by* Anonymous **on Nov 16, 2015**

Cannot agree more!! Most people totally ignore that one of the biggest parts in Chinese economy belongs to export, which means some developed countries actually need to seriously consider their way of living, and develop more ecological consumer culture.

The large volume of debris both bio-degradable and bio-non-degradable is mostly thrown into land filling either because of lack of resources, attention and inclination for recycling, or because of ease or a combination of all these. It involves market mechanism and administrative process for grabbing the land site on one hand and disposal of bio-degradable material in land filling – generates methane, a type of green house gas, further adding into air pollution cycle, generally not in direct notice of society on the other. Second type of disposal of hazardous materials – a

case on disposal of radioactive material, cobalt-60 from one of the Chemistry laboratory of University of Delhi (in March 2010), claimed the life of one person of contractor and severely handicapped around 8 people from Mayapuri area of Delhi (Singh et al 2013). Though law enforcing agencies came into picture, one needs to understand and appreciate the role played by Delhi University in terms of – whose fault, whose responsibility and whose accountability. However, initiator remained one of the apex institutions like Delhi University, not able to appreciate the need of waste disposal for hazardous material in society, who else should be held responsible to usher in society for this role. Can Delhi University be freed from this type of accountability, a mere negligence on one hand and ushering in and inculcation of such practices in society on the other? Let us focus our attention on the third type namely recyclable waste disposal through the episode of UK, as detailed in Box 2. Market for tin, plastics and some other ingredients has become cheaper and hence recycling of these wastes is no longer attractive for western world. For example, non-compliance of recycling standards, EU used to put huge penalty on its member countries (UK in this case). Accordingly, UK authorities are passing the responsibility of recyclable waste disposal on distant processor from Indonesia, forcing consumption of fossil fuel in transportation of voluminous waste through containers for 9,400 nautical miles, inducing further generation of green house gases just to avoid EU fines – either due to cost of processing in UK could be high or might not be interested in handling such kind of wastes, which were created by their society or to look good, while reducing their level of pollution. One can get a feel for mega order generation of wastes and corresponding disposal mechanism – how will it be handled, either market mechanism or hierarchies or on God's grace? One can get another feel for economic development versus environmental externalities.

On one hand, developed world is demonstrating their requirements for heating their homes, moving on luxurious vehicles and enjoying affluent life style, while sucking the earth's resources and polluting the environment at the order of 486 times (Menzel & D'Alusio 2005) not only for its necessities but also for luxuries (Tables 6 and 7), on the other roughly 800 million people are starving and live without 2 courses of meal every day, children face malnourishment with high mortality rates. Table 6 presents the level of consumption for USA having five percent population of the world and correspondingly 40 percent of garbage generation of the world demanding 4.1 numbers of earths (Table 7) for survival, if everybody starts consuming as US citizen does. It gets further worsened if consumption pattern is that of citizens of UAE (Table 7). Similarly, Table 5 presents level of garbage and waste generation in the new urban world and its demand for resources and funds for disposal, accordingly two million tons of textiles are thrown away every year, however poor lacks for this kind of cloths.

Table 6: Population and Consumption Level Data for USA

Items	***Portion of the World***
Population	**5%**
Energy Consumption	**20%**
Meat Consumption	**15%**
Garbage Generation	**40%**

(Source: UNDP (2014) Southern Innovator: Waste & Recycling Issue, Issue 5, United Nations Development Program)

Table 7: Level of Consumption versus Number of Earth Requirements

Consumption in Society	***Number of Earth Requirement***
UAE	**5.4**
USA	**4.1**
France	**2.5**
Costa Rica	**1.4**
China	**1.1**

(Source: UNDP (2014) Southern Innovator: Waste & Recycling Issue, Issue 5, United Nations Development Program)

Considering the significance of Figure 4, one gets a feel for the level of waste generated during the process of production and facilitation process (forward and recycling) both for product manufacturing and related technology development, and the same is presented through diagram of Figure 8 for European Union (EU-28) for 2012. Levels in pie-chart vary from countries to countries depending upon relative emphasis on economic activities and also with respect to time frame. For EU-28, mining and construction activities generate more than 60% of wastage (Figure 8).

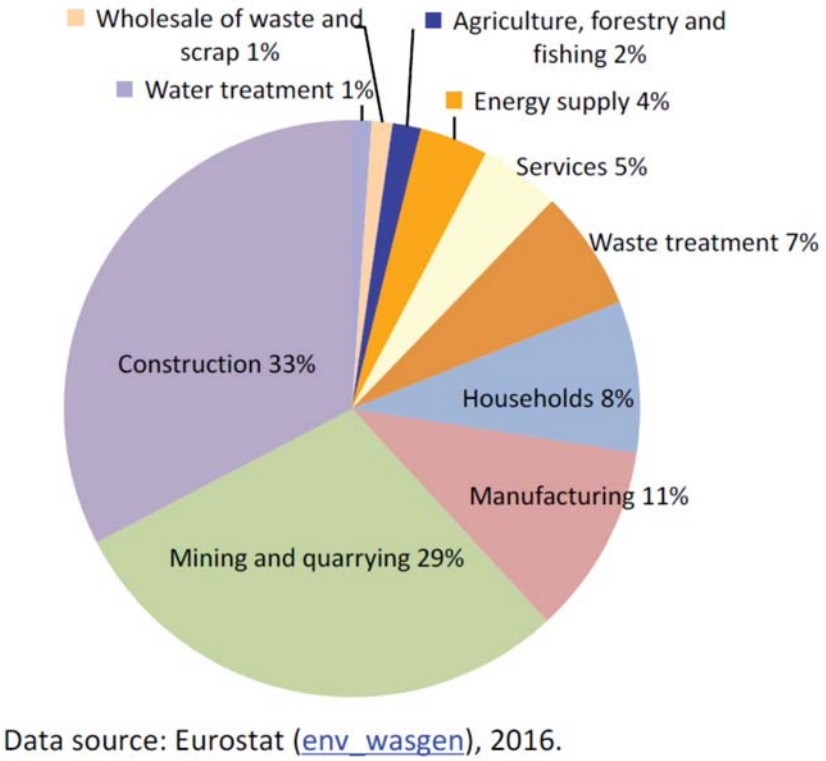


Figure 8: Waste Generation in EU-28 by Sector (2012)

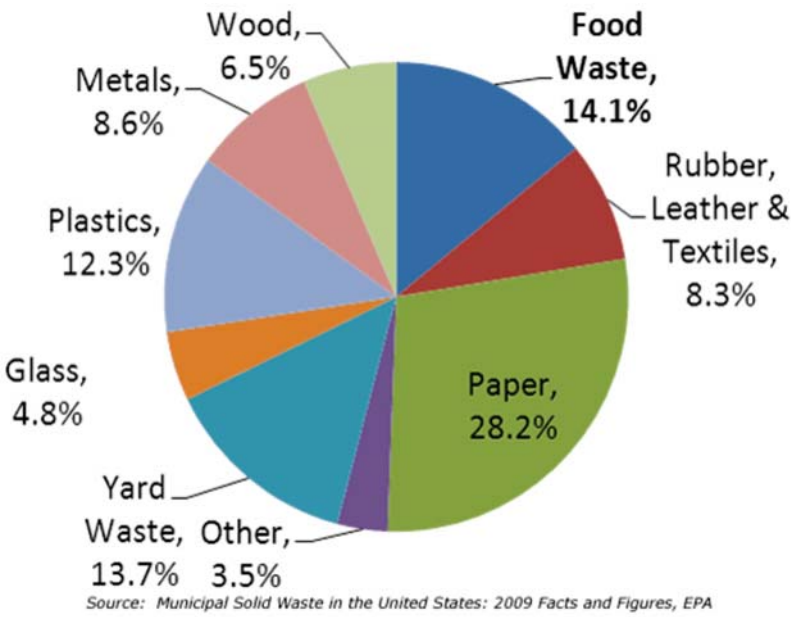


Figure 9: United States 2009 Total Municipal Solid Waste Generation by Material before Recycling, EPA

Similarly, Figures 2 and 11 present the levels of different types of wastes during need-product facilitation process and product life span (technology versus economics) related activities as pie-chart and bar diagram sketched in Figures 9 and 10 USA for 2009. Significant point remains quantum of food waste going into landfill versus level of hunger on the planet versus emission of greenhouse gases through this process.

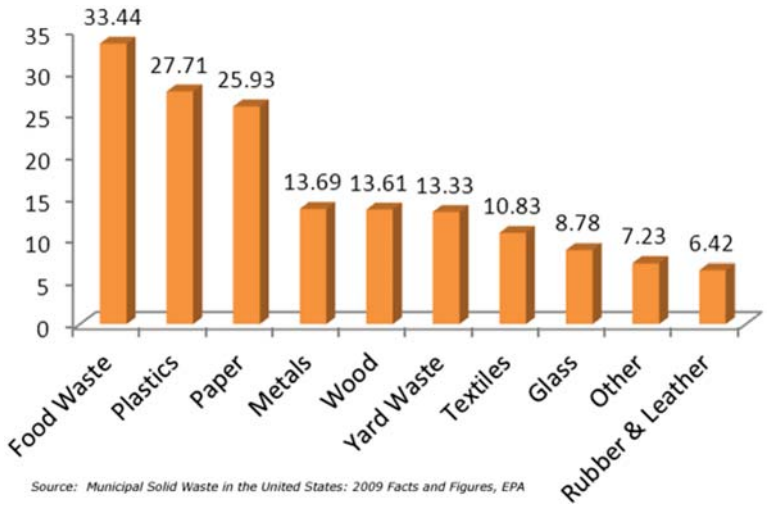


Figure 10: United States 2009 Municipal Solid Waste Discarded in Landfill (in 1000 of tons)

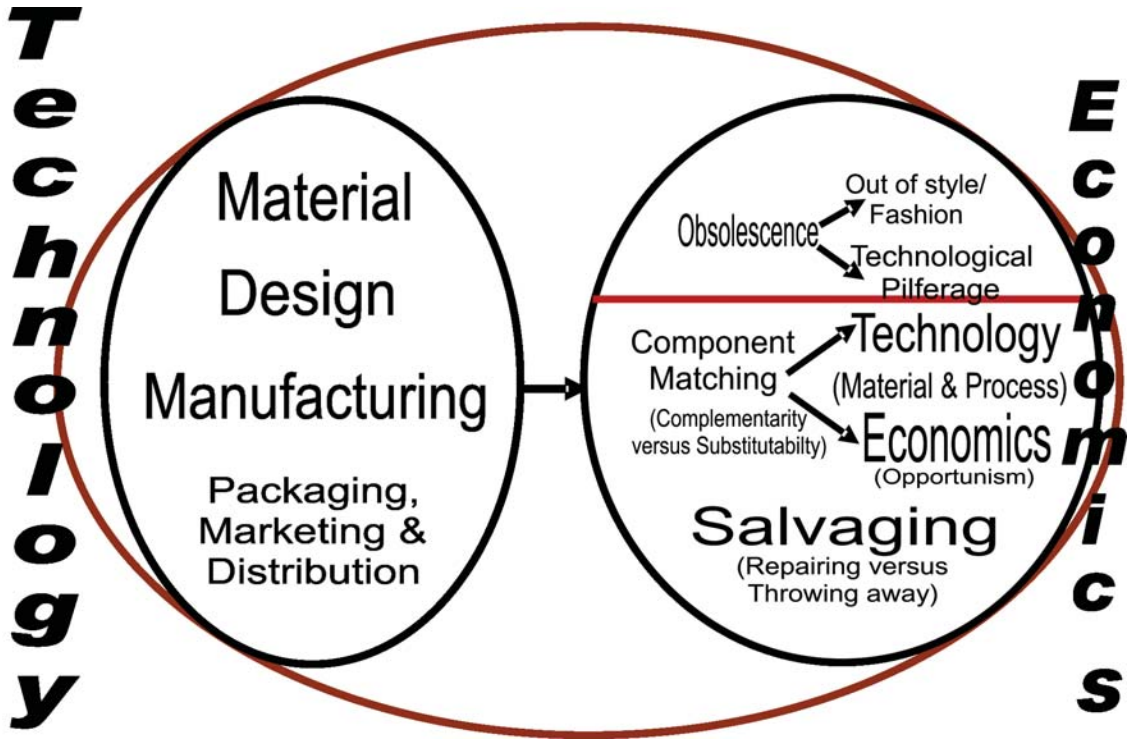


Figure 11: Product Life Span (Technology versus Economics)
Source:Author's Sketch and View (Economics and Manufacturing) - Buffa (1976); Martinich (1997); Schroeder (2007)

Let us get a feel for various ways of disposing the wastes. These could be through reusing, recycling, composting, land filling and incineration. Intricacies of land filling remain with acquisition of land, preparing the same and finally filling it appropriately. Each will have its own kind of complexities and costs and some of them are documented earlier. Incineration releases some energy and power can be generated, however level of carbon dioxide and other greenhouse gases (GHG) emerge and air pollution results in the process. Composting looks to be one meaningful option, whereby bio-degradable wastes are converted into organic fertilizer. Can this method be used for sanitary diapers? If one explores the possibilities, unique process of disposing of diapers seems to be composting by tearing and separating the biodegradable portion from leak-proof portion and putting the former with composting material in the pit. Here, significant consideration remains that how many of diaper users will be having willingness to do this, especially when toilet cleaning is done by mid-servant only. Thus, consumerism, comfort and lifestyle facilitated with sanitary diaper but could not suggest effective method for its disposal and eventually land up through land filling and posing the difficulty of GHG like methane emissions.

Figure 12: Business Positioning by Entrepreneur

Source: Author's Sketch and View based on Economics and Strategy including Koutsoyiannis (1979); Peteraf (1993); Amit and Schoemaker (1993); Martinich (1997); Schroeder (2007)

Analytical Framework in Consumption and Waste Generation

Referring Figure 4, one can expect wastages at each stage of mining; refining and extraction; designing of product versus design, development and facilitation of technology, and manufacturing; marketing and servicing; and finally disposing the product (for example, electronic-waste disposal at Guiyu, China by USA; Box 1, Figure 7). This has been explained by production of aluminum foil from bauxite ore lying in bauxite mines. Figure 2 suggests wastages in terms of debris, garbage, wastage during trimming or emergence of useless materials in conversion process, rejection due to poor quality of output, out of fashion, and nice to possess – leading to obsolescence and pilferage. However, sketch of Figure 11 clarifies the role of technology versus that of economics on three distinct dimensions such as obsolescence, component matching and salvaging. For example, obsolescence can happen due to faster rate of technological innovation (as in electronic, telecommunication and IT industry), which yields quantum jump in terms of benefits or due to socioeconomics and product getting out of fashion. At the next level of component matching, the role of technology versus that of economics gets complicated due to complementarity (Amit and Schoemaker 1993; Peteraf 1993; Milgrom and Roberts 1995) versus substitutability (Amit and Schoemaker 1993; Peteraf 1993) nature of components with respect to other components or that with the whole product per se in terms of material, composition, strength, cost, size, shape and utilities. Here, technology tries to bring parallelism in life-span and synergy among these components or with the product itself, however, economics may bring opportunism and product may malfunction after sometime due to poor mismatch among or ill-intended match of components in terms of material, composition, strength cost,

and hence needs replacement either of components or of product itself (for example, design and assembling of shoe upper with its sole in manufacturing of footwear). Opportunism (Williamson 1993) disturbs the balances of complementarity versus substitutability among components and their fitness (Milgrom and Roberts 1995; Porter 1996) with the product due to ill or profiteering attitude applied through economics. At the third level, salvaging the product can be executed by either throwing away or discarding its usage even though it may be functioning with reasonable level of utility or by deferring the salvaging process by repairing the product.

The central question remains, why does an entrepreneur behave like an opportunist to persuade the consumers either to salvage the product once its functionality is still available or design the product with components not having proper fit among them (Milgrom and Roberts 1995; Porter 1996) in terms of strength, composition, life span with lack of perfect technological complementarities? Answer to this question may yield us the reason for quantum, scale and scope of waste generation by business, especially for the case of electronic waste disposal by USA as noticed through Box 1 and Figure 7, and textile waste by UK spelt in Table 5. Theories of microeconomics illustrated through Figure 12 illuminate the three distinct practices adopted by entrepreneurs, viz. monopolistic versus perfect competitive kind of approaches in the product market to yield abnormal profit versus normal profit (Koutsoyiannis 1979; Amit and Schoemaker 1993; Peteraf 1993). In between the above mentioned two extremes lies the stage of Chamberlin's theory of monopolistic competition yielding supernormal profit (Koutsoyiannis 1979; Amit and Schoemaker 1993; Peteraf 1993). It seems the profiteering attitudes of entrepreneurs orient them to earn supernormal profit and practice the process of monopolistic competition, as monopolistic practice in product market is not permitted. Reason remains that in the case of perfect competition, an entrepreneur is left only with normal profit that is, like normal wages as earned by any other worker engaged in business, and former does not get anything for bringing land, labor and capital while executing his business activities on one hand and taking the risk and uncertainty (Knight 1921) of business on the other. Meaning, the profiteering attitude of business induces the entrepreneurs to look for technological, market, economic, social and psychological innovation in market place and market space. To proceed on the path, entrepreneur tries to maximize revenue and minimize cost. During revenue maximization process, one has to maximize the price of product as well as quantity demanded or both. It is this quantity demanded, which is maximized by increasing consumption. The volume of consumption need not be constrained by actual quantity consumed by customers but volume actually bought by them. It is immaterial, whether consumption has taken place at customers' end or not. For entrepreneur, it is volume bought by customers what matters, whether product is consumed or used, lying idle, obsolete, stolen, damaged, thrown out, partially consumed or used, pilferage before technological life (electronic products), or persuaded to buy without any use for customers (just only for nice to have and possess by customers). In all these cases, except full utilization by customers with the end of technological life of the product, the whole process of extraction through production from mining stage to marketing and servicing stage becomes wastage only despite huge resources from planet in the form of ores, inanimate energy like fuels, human skills and effort, facilitation of technology design and development becomes shear waste. In this process, who is the gainer versus who is the looser? Little consideration suggests that at the face of it, entrepreneur looks to be gainer with supernormal profit for product manufacturing and he or she becomes millionaire, billionaire, or trillionaire depending upon his or her abilities, and people possessing less skill in terms of either technological and commercial or entrepreneurial becomes looser. However, our assumption remains that mother planet earth has got infinite resources. Is it so? One should appreciate that mother planet has got quite limited resources either endowed with nuclear one when separated from sun or physical one like land and

environment conducive to and sufficient for survival of organisms including human beings, or still another one like fossil fuels, which was cooked and stored by our mother earth in millions of years. Central question remains, can we afford to waste these… as being done in the mindless race of growth and development through the motive of profiteering via actual versus pseudo consumptions in name of life style, flying like bird while conquering time and space, food habits, living standards, multiplexes, lifting in multistoried houses with the process called consumerism, modernity, digitized lifestyle, capitalism and so on?

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