

16. ‘Sustainable Development for Safe Living in World’ ‘Promoting All Economic Development Programs with Environmental Protection’

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Abstract:

The SOCIAL, ECONOMIC, POLITICAL, SCIENTIFIC & TECHNOLOGICAL Perspectives for ‘Sustainable Development’ Combating POLLUTION & CLIMATE CRISIS & Providing CLEAN Chemical-Free AIR, WATER & FOODS for Safety of Society

Some Important Scientific Actions to Promote

SUSTAINABLE DEVELOPMENT for SAFETY & SURVIVAL in World

Production & Development of–

- a. *Clean SOLAR, WIND, HYDROGEN, GEOTHERMAL & BIOMASS Energies Replacing the FOSSIL FUELS from World.*
- b. *CLEAN COAL Technology Producing HYDROGEN & METHANE Gases from Dirty COALS.*
- c. *ELECTRIC VEHICLES Replacing the PETROLEUM Products from World.*
- d. *Eco-Efficient Appliances Saving ENERGY in Daily Life.*
- e. *Eco-Efficient Appliances Saving WATER in Daily Life.*
- f. *ECO-HOMES for Safe Living with Less Use of WATER & ELECTRICITY every day.*
- g. *ORGANIC FERTILIZER by Biodegrading HUMAN WASTES into VERMICOMPOST by Earthworms Replacing the Toxic AGROCHEMICALS.*
- h. *Chemical-Free & Nutritive ORGANIC FOODS by VERMICOMPOST.*
- i. *Clean VERMIFILTERED WATER from WASTEWATERS by EARTHWORMS for RE-USE in Farm & Garden IRRIGATION Saving Huge FRESH WATER.*
- j. *BIO-MINING Technology to Produce METALS from MINERALS Excavated from Earth.*

- k. ECO-EFFICIENT & NON-MINERAL Materials to Replace the MINERALS Excavated from Earth, Reducing the MINING Activities:*
- l. DEMATERIALIZATION Technology to Produce METALS, GLASSES, PLASTIC CONTAINERS, CANS & BOTTLES reducing the Use of MATERIALS & also Saving ENERGY.*
- m. RECYCLING Technologies to Produce METALS, GLASSES, PAPERS & CARDBOARDS & TOUGH PLASTICS from their WASTES for their REUSE Saving Materials from Natural Resources:*
- n. ECO-DESIGNED Products for improving EFFICIENCY & also Reducing the Use of MATERIALS.*
- o. ECO-EFFICIENT INDUSTRIES for High Productivity of all Essential PRODUCTS Used by Society with Minimum use of ENERGY & Valuable RESOURCES & by Using Benign CHEMICALS.*
- p. Environmentally Benign & Safer Chemical-free SHAMPOOS, WASHING POWDERS, LUBRICANTS, SOAPS, DETERGENT & COSMETICS.*

All the above Actions to Promote 'SUSTAINABLE DEVELOPMENT' in World will Protect the Global Human Society from many 'ENVIRONMENTAL DESTRUCTIONS'. They will highly Reduce POLLUTION & Emission of GREENHOUSE GASES & also the Use of Several TOXIC CHEMICALS & Generation of Human WASTES including the HAZARDOUS Industrial WASTES.

Keywords:

Environmental Destructions, Sustainable Development, Environmental Protection, Economic Development, Human Society.

16.1 Introduction:

The first ever 'World Conference' by United Nation Environment Program (UNEP) on 'HUMAN ENVIRONMENT & SUSTAINABLE DEVELOPMENT' was held in Stockholm, Sweden, in June 1972 where representatives from more than 70 Nations 'Participated and Pledged' to Save the Global ENVIRONMENT. This is also considered as the 1st 'Earth Summit'. The Conference was chaired by Mrs. Gro Harlem Brundtland, the then Prime Minister of Norway. She was later entrusted with the task of forming the 'World Commission on Environment & Development' (WCED) in 1987 where she conceived the term 'SUSTAINABLE DEVELOPMENT' i.e., 'DEVELOPMENT Without DESTRUCTION of ENVIRONMENT'.

The agenda 21 (Agenda for the 21st Century) was adopted at UNCED (United Nation Commission on Environment & Development). It was the blueprint for global SUSTAINABLE DEVELOPMENT. It cautioned the World that the 'Growing POPULATION' and 'POVERTY' in the 'Developing Countries' and the 'UNSUSTAINABLE' pattern of 'CONSUMPTION' in the 'Developed Industrialized Countries' would thwart the spirit and pace of 'SUSTAINABLE DEVELOPMENT' throughout the World. For 'ENVIRONMENTAL SUSTAINABILITY', the 'SOCIO-ECONOMIC PROSPERITY' and 'ENVIRONMENTAL LITERACY' of the Global

Human Society, and 'POLITICAL STABILITY' throughout the World should be a 'Pre-condition'. POOR and the DEPRIVED people, and the 'POLITICALLY DISCRIMINATED' would Violate all ECONOMIC & ECOLOGICAL Imperatives in order to SURVIVE in World (because SURVIVAL is more important than SUSTAINABILITY) thus leading to UNSUSTAINABILITY. Even HIGHLY EDUCATED people can be 'ENVIRONMENTALLY ILLITERATE' and fail to realize the importance of SUSTAINABILITY.

Another 'United Nation' (UNEP) Conference on 'ENVIRONMENT & DEVELOPMENT', was held at Rio de Janeiro, Brazil, in 1992. This was the 2nd 'Earth Summit' Organized 20 years after the Stockholm Conference and was participated by 172 Nations (more than twice that participated at Stockholm in 1972) this time. 'ENVIRONMENT & SUSTAINABILITY' and 'SUSTAINABLE DEVELOPMENT' was the focus of discussion. The World leaders declared – 'Human Beings are the Centre of Concerns for Sustainable Development. They are entitled to a 'Healthy and Productive Life' in Harmony with Nature'.

Huge ENVIRONMENTAL DESTRUCTIONS in World & their DISASTROUS IMPACTS on HUMAN HEALTH: An Eye-Opening Situation Inspiring the Govt. of Nations to Embark on the Path of 'SUSTAINABLE DEVELOPMENT' for SAFE LIVING in World

Some 189 'Hazardous Air Pollutants' have been identified in the ATMOSPHERE released from all the 'Developmental Activities' especially from the operation of 'COAL POWER PLANTS' & 'PETROLEUM AUTOMOBILES'. All forms of AUTOMOBILES and Transport Systems (Buses, Cars, Trains, Trams and the Airplanes) in World are the biggest POLLUTERS & emitters of GREENHOUSE GASES throughout the World. On average, for every 80 KM that each Automobile drives, it uses up enough OXYGEN (O₂) which are needed in RESPIRATION of one Person for one Month.

The Automobiles in World alone consume 30 % of the world's ENERGY and gives out TOXIC EMISSIONS which constitute 70 % of the Global AIR POLLUTION. Automobiles all over the world produce 60 % of CARBON MONOXIDE (CO), 42 % of NITROGEN OXIDES (NO_x), 40 % of HYDROCARBONS (HC), 18 % of the CARBON DIOXIDE, 13 % of PARTICULATES and 3 % of SULFUR DIOXIDE emissions (UNEP Report, 1992).

PETROL Vehicles Pollute more than the DIESEL Vehicles, and the 'Two & Three Wheelers' Automobiles are WORST POLLUTERS. DIESEL VEHICLES emit LOWER amounts of CARBON MONOXIDE (CO) and HYDROCARBONS (HC) than PETROL VEHICLES, but they emit 30-50 times more 'Particulate Matters'. They emit over 100 'Micro-particles' smaller than 'One Micro-meter' in diameter, which are easily carried away by the AIR Currents and settles in the 'Lower Respiratory Tracts' of 'Human Lungs' when inhaled. These Particulate matters contain hundreds of 'Organic Compounds', several of which are CARCINOGENIC.

In most Cities of World 'Vehicular Pollution' levels often exceed the guidelines recommended by WHO (World Health Organization). Studies near the Motor

Highways shows increased concentrations of HEAVY METALS Cadmium (Cd), Lead (Pb), Zinc (Zn), Nickel (Ni) and Chromium (Cr) in the Vegetation and Soils. AUTOMOBILES are also the major source of PHOTOCHEMICAL SMOGS in Cities. OZONE is the major component of this 'Photochemical Smog.'

Scientists at United Nations Environment Program (UNEP) estimates that over 3 million People in World die every year from 'Air Pollution' related diseases and the 'Non-Cigarette' Smokers LUNG CANCER rate due to the Outdoor Air Pollution in the World today is about 2000 cases every year. Scientists at World Health Organization (WHO) reported that the COAL POWER PLANTS in the U.S.A cuts short the lives of nearly 24,000 people every year - 2,800 from 'Lung Cancer' and nearly 38,200 from 'Heart attacks.'

Every 24 hours over 7 billion Tons of 'Greenhouse Gases' are being released every year into the Atmosphere from all the 'Developmental Activities'. The AUTOMOBILES alone emit more than 700 million Tons of CARBON every year in various 'Gaseous Forms' which includes CARBON DIOXIDE (CO₂) and METHANE (CH₄) and also the NITROUS OXIDE (N₂O) which works as the 'Greenhouse Gases'. With them they are responsible for inducing over half the problems of 'GLOBAL WARMING & CLIMATE CHANGE' leading to the growing 'CLIMATE CRISIS' in the World. All Greenhouse Gases absorb intense 'SOLAR RADIATIONS' of Various Wavelengths WARMING up the Global ATMOSPHERE. According to 'Intergovernmental Panel on Climate Change' (IPCC) the Global average 'SURFACE TEMPERATURE' has increased over the 100 years from 1906 to 2005 by about 0.74 o C. The Temperature of the Earth is gradually 'rising' by 0.3o C every decade due to Global Warming. Eleven of the twelve years 1995-2006 were the WARMEST since 1850 and 1998 was the 'WARMEST' year since 1861. Global TEMPERATURES have risen in the last 4 decades of the 20th Century in the lowest 8 km of the Atmosphere.

Reports of the IPCC shows that an increase of 1°C in GLOBAL TEMPERATURES has already made the World a more DANGEROUS place to live. A further half (1/20) a degree rise will have Serious Consequences for Human HEALTH, LIVELIHOODS, FOOD & WATER SUPPLY, Human SECURITY, INFRASTRUCTURE & the Global ENVIRONMENT. While 2°C WARMING will be highly DEVASTATING for the Global Human Society.

The SOCIAL & ECONOMIC Consequences of 'Global Warming & Climate Change' may be severe in terms of 'Human Health', Increasing frequencies & intensities of 'Natural Disasters' & the 'Damages' done by it such as 'Crop Failures' & 'Loss of Fertile Croplands', 'Submergence of Coastal Habitats' etc. NATURAL DISASTERS like 'Oceanic Swells', 'Cyclones', 'Tornados', 'Hurricanes' & 'Storms' are increasing in 'Frequency & Magnitude' all over the World.

Some Other Important Reasons Why the Govts. of Nations must Promote the TECHNOLOGIES for 'SUSTAINABLE DEVELOPMENT' for the 'Safety of Society'

(All Information Below are Based on Reports of UNEP 1992; WHO 1997; UNDP 2004 & Steffen et. al., 2004);

- a. Two Billion People do not have access to Modern ELECTRICAL ENERGY Supply & Services.
- b. More than 1.1 billion People in World do not have access to safe DRINKING WATER. It is predicted that WATER SUPPLY will be the major constraints on 'Sustainable Living' of Global Human Society in future. About 2.4 billion People in World Suffer from having 'Adequate & Improved SANITATION';
- c. More than 3 million People die due to AIR POLLUTION, and the same number dies from diseases caused by 'UNSAFE and POLLUTED WATER'. The target of WHO for 'Good Health' of all in the Future never became a reality.
- d. Worldwide about 80 -100,000 CHEMICALS are in use every day in our INDUSTRIES and other DEVELOPMENTAL ACTIVITIES and some 1000 'New Chemicals' are added every year. There are some 861 NEURO-TOXIC CHEMICALS in use in our 'Cosmetics', 'Perfumes' and 'Toiletries'. A relationship between 'CHEMICALS & CANCER' is Scientifically proved and Women are more vulnerable. According to UNEP and WHO some 25 million Farmers and Agricultural Workers are POISONED by 'Chemical Pesticides' every year and nearly 3 million people suffer from 'Acute Pesticide Poisoning' and some 10 to 20 thousand people die every year from it in both the Developed and the Developing countries.
Studies indicate that there is significant amount of 'RESIDUAL PESTICIDES' contaminating our FOOD Stuff long after they are taken away from Farms for human consumption. Exposures to 'Chemical Pesticides' are linked with serious DISEASES and 'Developmental Disorders' like 'Nervous System Disorders', 'Immune System Suppression', Breast and Other Cancers' 'Reproductive Damages', 'Impairment of Brain Development in Children' and 'Disruption of Hormonal Systems'.
'New highly TOXIC CHEMICALS' e.g. N-NITROSODIMETHYLAMINE (a principal ingredient in ROCKET FUEL), METHYL TERTIARY BUTYL ETHER (a Gasoline additive), and 'ACRYLONITRILE' (used in Textile Industry) have also appeared in the 'Surface and Ground Water' of World;
- e. Some 66,000 tons of 'OZONE DEPLETING CHEMICALS' are also released into the Environment every year due to the various DEVELOPMENTAL ACTIVITIES. The PROTECTIVE 'OZONE SHIELD' in the STRATOSPHERE over the Antarctica is 'Depleting' due to the 'OZONE DEPLETING CHEMICALS' creating 'OZONE HOLES' and exposing the Human Beings to 'Radiation Hazards' (UB-V Radiation). In September 2000, the 'OZONE HOLE' over Antarctica covered more than 28 million Square KILOMETERS. Increased UB-V Radiation can cause suppression of 'Human IMMUNE SYSTEM' making people vulnerable to 'Infectious Diseases'. It can also cause 'Non-Melanoma Skin Cancers' and 'Blindness' from juvenile 'Cataracts' all over the world.
- f. Half of the TROPICAL RAINFORESTS and MANGROVES (Treasure of Pristine BIODIVERSITY) have already been LOST. More DESTRUCTIONS of the 'Tropical RAINFORESTS' are going on in the World due to various DEVELOPMENTAL Activities.
- g. Some 75 billion Tons of 'TOPSOIL' are ERODING every year. Around 2 billion Hectares of SOIL- 15 % of Earth's Land is now classed as DEGRADED.
- h. About 75 % of the MARINE FISHERIES have already been Fished to its Capacity.
- i. More than 1.2 billion People still live on less than 1 Dollar (Indian Rupees 50) a day i.e., much below the 'POVERTY line';

Some Global Summit on SUSTAINABLE DEVELOPMENT

1st World Summit on SUSTAINABLE DEVELOPMENT (WSSD) at Stockholm, SWEDEN for Environmental Protection' (1972)

The first ever Global Conference on 'Human Environment & Sustainable Development' was held in Stockholm, SWEDEN on June 5, 1972. Since then, this day is Observed as the 'World Environment Day' all over the World. More than 75 Nations had participated to discuss the 'Future of Mankind' on Earth in the wake of the growing 'Environmental Pollution' and to develop PLANS to Combat the 'Environmental Problems', develop the Strategies for 'SUSTAINABLE DEVELOPMENT' in harmony with 'NATURE'.

- a. We see around us growing evidence of 'Man Made' 'HARMS' to the 'ENVIRONMENT' in many regions of Earth. Dangerous levels of 'Pollution' of 'AIR & WATER', high 'Disturbances' in the 'Ecological Balance' of the 'BIOSPHERE', 'DESTRUCTION' of 'Valuable RESOURCES' and 'Environmental Problems' highly harmful to the 'PHYSICAL', 'MENTAL' & 'SOCIAL' HEALTH of Human Beings, especially in the 'Man-made' Environments in the 'Living' & 'Working' places.
- b. The 'PROTECTION' & 'IMPROVEMENT' of the 'Human Environment' is a Major Issue in the Modern World which affects the 'Well-being' of People & their 'Economic Development' all over the World. It is the 'Responsibility' of the People & also the 'Duty' of the 'Govts. of Nations to Protect the Environment.
- c. Man is both – 'CREATOR' & 'MOULDER' of his Environment which gives him the 'Physical Sustenance' & the Opportunities for 'Intellectual', 'Moral', 'Spiritual' & 'Social' growth. Man has constantly to sum up on 'Discovering', 'Inventing', 'Creating' & 'Advancing' Favourable Environmental Conditions for SAFE Living in World.
- d. Nations have the 'Sovereign Rights' to use their own 'RESOURCES' for 'Economic Growth & Development' within their own Jurisdiction, but this should never cause any 'DAMAGE' to the Environment of other Nations.
- e. To 'Defend' & 'Improve' the conditions of ENVIRONMENT for the 'Present' & 'Future' Generations for their 'SAFE Living' in World, has become an Imperative GOAL of mankind all over the World.

2nd 'World Summit on SUSTAINABLE DEVELOPMENT' (WSSD) for 'ENVIRONMENTAL PROTECTION at Rio de Janeiro, BRAZIL (1992)

In June 1992, at Rio de Janeiro, BRAZIL Govts. of more than 150 Nations participated in the 'United Nation Conference' on 'ENVIRONMENT & DEVELOPMENT' to Chalk Out the 'Future ACTION Plans' while the World was entering into the 21st Century. 'RIO Earth Summit' was also named as 'Agenda – 21'. These were the Declarations made at the Rio Earth Summit–

- a. Human beings are 'Centre of Concerns' for 'SUSTAINABLE DEVELOPMENT' in World. They are entitled to Live a 'Healthy & Productive Life' in 'Harmony with NATURE'.
- b. WOMENS who are 'Progenitors of World' have a 'Vital Role' in the 'Management & Protection' of Global ENVIRONMENT. Their full participation in the 'Environmental

- Protection' is essential for 'SUSTAINABLE DEVELOPMENT' in the World & for the 'PROTECTION' of Society.
- c. According to the Charter of the 'UNITED NATIONS & INTERNATIONAL LAWS', while the Nations in World have the Sovereign RIGHT to Exploit their 'Own RESOURCES' according to their own 'Environmental Policies', but they have to ENSURE that all their 'DEVELOPMENTAL ACTIVITIES' are taken within their 'Jurisdiction & Control', and they must never cause any 'DAMAGE' to the ENVIRONMENT of other NATIONS. It must also equitably meet the 'Developmental' & Environmental' needs of the 'Present & Future' generations of the Society.
 - d. In order to achieve 'SUSTAINABLE DEVELOPMENT', the 'ENVIRONMENTAL PROTECTION' must constitute an 'Integral Part' of all the 'DEVELOPMENTAL PROGRAMS & ACTIVITIES' in World & never be isolated.
 - e. All Nations & their Society must Cooperate in the essential task of 'Eradicating POVERTY' as an 'Essential Requirement' for 'SUSTAINABLE DEVELOPMENT. Fulfilling the needs of 'DEVELOPING Countries' & those which are 'Environmentally VULNERABLE', must be given Special Priority.
 - f. All Nations must Cooperate as a 'Global Partnership' to 'CONSERVE', 'PROTECT' & 'RESTORE' the 'Ecological & Biological' Properties of the 'Earth's ECOSYSTEM'.
 - g. To achieve the 'Targets' of 'SUSTAINABLE DEVELOPMENT' & give a 'Good Quality of LIFE' to the Society, all Nations must 'Reduce & Eliminate' the 'UNSUSTAINABLE Patterns' of 'PRODUCTION' & 'COMSUMPTION' of Resources.
 - h. All Nations (Developed & Developing) must also Cooperate in the Development of 'INNOVATIVE TECHNOLOGIES' for 'SUSTAINABLE DEVELOPMENT' with 'LOW Use of ENERGY' & 'LOW Emission of POLLUTANTS & GREENHOUSE GASES' & share all the 'SCIENTIFIC KNOWLEDGE' for the 'Benefits & Safety' of the Global Human Society.
 - i. All Nations must also develop 'ENVIRONMENTAL STANDARDS & LEGISLATIONS' to be sincerely followed by the Society for the 'Judicious Use of Essential RESOURCES' (especially AIR, WATER & ELECTRICITY) by the Society & Reducing the Generation of all Human WASTES. Nations must 'Facilitate' & 'Encourage' PUBLIC AWARENESS & PARTICIPATION by making the INFORMATIONS widely available to the Society.
 - j. Nations must also develop 'NATIONAL LAWS' regarding the 'Liabilities' & 'Compensations' for the Victims of 'POLLUTIONS', 'GLOBAL WARMING', 'HAZARDOUS WASTES' & all other 'ENVIRONMENTAL Destructions' affecting the Health of People. Environmental POLLUTERS (Using PETROLEUM AUTOMOBILES & FOSSIL FUELS for ENERGY Production) must also bear the COST of 'Pollution & Environmental Damages'.
 - k. Nations must also Cooperate to promote 'Supportive & Open Systems' for International 'ECONOMIC GROWTH & DEVELOPMENT' with NO Problems of 'Environmental DEGRADATION', benefiting all Nations in the World.
 - l. All Nations in World must immediately INFORM & NOTIFY the other Nations about any 'NATURAL DISASTERS' in their Nations as they may create other 'Sudden Harmful Effects' in the 'Environment' of those Nations.

3rd 'World Summit' on 'Sustainable Development' (WSSD) at Johannesburg, South Africa (2002)

The 3rd WSSD (2002) was held at Johannesburg, South Africa to take stock of the situation about the achievements made towards attaining SUSTAINABILITY in the field of 'Human Development' during the last 10 years since the 2nd WSSD in 1992. The task at Johannesburg was to recapture the momentum of the movement for 'SUSTAINABLE DEVELOPMENT' began at Stockholm, SWEDEN in 1972 & and at Rio de Janeiro, BRAZIL in 1992.

In the 10 years between Rio (1992) and Johannesburg (2002) 'EARTH SUMMITS', Critical Environmental Problems like Emission of 'GREENHOUSE GASES' in World inducing 'GLOBAL WARMING & CLIMATE CHANGE', Loss of Old Primary FORESTS causing 'BIODIVERSITY EROSION', 'OCEANIC PLUNDERS' and 'Piling HUMAN WASTES', lurched from BAD to WORSE. On the SOCIO-ECONOMIC front, the RICH and the Powerful people got RICHER and more POWERFUL, while the POOR people became POORER & WEAKER. The concept of 'SUSTAINABLE DEVELOPMENT' and the highly lauded movement for SUSTAINABILITY in World remained only on paper.

BRUNTDLAND Commission Report on 'SUSTAINABLE DEVELOPMENT' (1987)

The first ever World Conference on 'Human Environment' was held in Stockholm, SWEDEN in June 1972 where representatives from more than 70 Nations Participated and pledged to SAVE the ENVIRONMENT. This may be regarded as the '1st Earth Summit'. The Conference was chaired by Mrs. Gro Harlem BRUNTDLAND the then Prime Minister of Norway who was later entrusted with the task of forming the 'World Commission on Environment & Development' (WCED) in 1987 where she conceived the term 'SUSTAINABLE DEVELOPMENT'. The report of the 'World Commission on Environment and Development' (WCED) was published as 'Our Common Future' in 1987. It redefined the concept of 'SUSTAINABLE DEVELOPMENT' which should encompass three components-

1. A system of 'SOCIO-ECONOMIC DEVELOPMENT' to meet the 'Needs' (but not the 'Greed') of the 'present generation' without compromising with the abilities of the 'future generations' to meet their own needs.
2. A system of stable SOCIO-ECONOMIC & ECOLOGICAL DEVELOPMENT that should improve the total QUALITY of all Living Organisms on Earth (Human Beings, Plants and Animals) on Earth now and in the future too, while maintaining the SOCIAL & ECOLOGICAL INTEGRITY (Natural and Man-made ECOSYSTEMS) of the Earth upon which all life depends.
3. A system of SOCIO-ECONOMIC DEVELOPMENT which can provide good QUALITY of LIFE to all the people (Rich and Poor, Men and Women, Adults and Children) born on Earth, while protecting their basic 'Life-support Systems' (AIR, WATER, SOIL, FLORA & FAUNA) and also safely disposing all the HUMAN WASTES (Domestic, Commercial and Industrial) generated by them (Label et. al., 1987; Goodland & Serafy, 1991).

People's Mandate (Opinion Poll) on Promotion of 'Sustainable Development' in World

Several OPINION POLLS were conducted on the eve of 3rd 'Earth Summit' at Johannesburg, S.A. in 2002 (WSSD, 2002) by 'International Agencies' to know the views of people across world and assess their awareness on the question of 'Environmental Sustainability' built up since the 'Rio Earth Summit' in 1992. 'Market and Opinion International' (MORI) Polled in 30 Countries containing two third of World's population and found that 91 % people in Greece, above 60 % in the U.S., Germany, Russia, France, Italy, Spain, Japan, Mexico, Brazil, Chile, Republic of Korea & China, and about 54 % in India wanted 'LEGAL PROTECTION' of the ENVIRONMENT through 'Legislative Actions' by the Govts. Some 69 % people in U.K. agreed that 'Environmental Degradation' especially due to piling 'Human WASTES' & rising 'POLLUTION' in the AIR is affecting their daily life.

Opinion Poll by the 'Roper Worldwide' found that 39 % people in these 30 Countries were of the view that 'ENVIRONMENTAL PROTECTION & SUSTAINABLE DEVELOPMENT' was of 'Paramount Importance' today. The percentage of people expressing this view was significantly higher in INDIA, ARGENTINA, The PHILIPPINES and GERMANY.

'Gallup Polls' made in the U.S. found that 57 % Americans were more concerned about Pollution of RIVERS, LAKES & STREAMS while 29 % were greatly 'Feared' about 'GLOBAL WARMING & CLIMATE CHANGE'. But still till then U.S. had not signed the 'Kyoto Protocol'. In another Opinion Poll 65 % Americans saw 'Erosion' of BIODIVERSITY as the most 'Serious Problem' facing the humanity in World. Global 'Opinion Polls' clearly confirmed that people worldwide realize the importance of 'ENVIRONMENTAL PROTECTION & SUSTAINABLE DEVELOPMENT' for their 'Existence on Earth' and they put the blame mainly on the Corporate Sectors specially the TRANSNATIONAL CORPORATIONS for all the 'Environmental Problems & Evils' created in World.

16.2 The Strategies for Sustainable Development:

Planning for SUSTAINABLE DEVELOPMENT is like 'Preventing' a Disease to occur in the first place. As 'PREVENTION' is always better than 'CURE' it reduces the chances of individuals sufferings from the DISEASE. So does, ENVIRONMENTAL PLANNING and MANAGEMENT for the benefit of whole Society. It would significantly 'Reduce', if not completely 'Prevent', the risk of ENVIRONMENTAL DAMAGES and the 'Sufferings' of the Society caused due to it such as by the 'TOXIC POLLUTANTS' in the AIR we breathe & the 'NATURAL DISASTERS' due to GLOBAL WARMING & CLIMATE CHANGE. At least, planning & promotion of SUSTAINABLE DEVELOPMENT will 'prevent' any major 'ENVIRONMENTAL DISASTERS' which struck the human society in the past & even today. (Sinha, 1994). Promoting SUSTAINABLE DEVELOPMENT in World will deliver SOCIAL, ECONOMIC & ECOLOGICAL benefits, as it will Conserve RESOURCES, Reduce WASTES, Prevent the Loss of ENERGY and Protect HUMAN HEALTH. The 'World Business Council for Sustainable Development' (WBCSD) was

formed in 1995. It is a Coalition of 120 International Companies that have a shared commitment to Protect the ENVIRONMENT through 'CLEANER PRODUCTION & WASTE MINIMIZATION' in INDUSTRIES. (Schmidheiny et. al., 1997).

There are 'Seven Pillars' of SUSTAINABLE DEVELOPMENT. It is not the issues of 'ECONOMICS' alone. All issues- ECONOMIC, ECOLOGICAL, SOCIAL (Health), CULTURAL (Educational), LEGAL (Legislative), POLITICAL & TECHNOLOGICAL have to be merged into a collective 'Decision Making' for Sustainable Development. They are 'mutually reinforcing'. TECHNOLOGY plays greater role as they drive the 'SUSTAINABLE DEVELOPMENT (Axinn, 1996). Changing the 'DESIGNS' of the Essential PRODUCTS of Human Society (Homes, Automobiles & Consumer Goods) by 'ECO-DESIGNING' from the 'Conventional' to 'Non-Conventional' Products may significantly reduce the use of Valuable RESOURCES of the Earth – 'Raw Materials', 'Water' & 'Energy'.

Earlier only ECONOMY was at the Centre of 'Decision-making' by the Politicians of Nations. They assumed that all ENVIRONMENTAL PROBLEMS could be solved if ECONOMY was sound. This has now become an 'Obsolete Theory'. Now ECOLOGY has to be at the Centre. We have to integrate 'Ecological Thinking' into 'Social' and 'Economic Planning' for promoting 'Sustainable Development'. The DEVELOPMENTAL ACTIVITIES have to be 'Economically Viable', 'Ecologically Compatible', 'Socially Equitable', 'Culturally Acceptable' and 'Politically Justifiable'. Then only it can be ENVIRONMENTALLY SUSTAINABLE. This will require giving up the 'Culture of CONSUMERISM', 'Producing LESS CONSUMERS' (People) that the Earth can Sustain well and also achieving 'Equity in Use of 'RESOURCES' and their 'CONSUMPTION' across the World. 'OVER-CONSUMERISM' and too much of 'PROSPERITY' in one part of the World (in Developed Nations) & 'OVER-POPULATION' and 'POVERTY' in the other part (in Developing Nations), would thwart the spirit of SUSTAINABLE DEVELOPMENT.

The most important SUSTAINABILITY issue today is to SAVE & PROTECT the very 'Life-Support Systems' in World - AIR, WATER, FOOD & SOIL (where we grow Foods) and the GREEN PLANTS. They Protect 'HUMAN HEALTH', Combat 'GLOBAL WARMING & CLIMATE CHANGE', Protect the 'OZONE SHIELD' in the Stratosphere, Prevent DESERTIFICATION, Augment the Production of 'CLEAN Non-Polluting ENERGIES' and 'MATERIAL RESOURCES'. SAFE Management of all 'HUMAN WASTES' by 'Recycling & Converting' most of them into 'Valuable RESOURCES' is also an Important issue to Continue and Maintain the Pace of 'SUSTAINABLE DEVELOPMENT' in World.

What the Global Human Society must SUSTAIN in the World?

1. The Global ECOSYSTEMS and the accompanying BIODIVERSITY with the variety of Plants & Animals Species and their Habitats.
2. The Natural Capital of Earth e.g. the Stock of Productive SOILS, FOREST and the FRESH WATER and all the Non-renewable Resources by preventing their 'Unsustainable Use';

3. The ECOLOGICAL INTEGRITY of Earth and the resilience of ‘Natural Life-Support Systems’ by maintaining an adequate number of Primary Producers.
4. The SOCIAL INTEGRITY of Earth by maintaining an ‘Acceptable Level’ of NON-CONSUMERIST Population (Secondary Consumers) within the Ecological Limits and the ‘Carrying Capacity’ of Earth.

(IUCN, WWF & UNEP, 1991)

Some SCIENTIFIC ACTIONS to Embark on the Path of SUSTAINABLE DEVELOPMENT – ‘DEVELOPMENT Without DESTRUCTION.’

For SAFE LIVING in World

The World needs to plan for ‘SUSTAINABLE DEVELOPMENT’ taking ‘ECONOMY & ECOLOGY’ together and take some ‘Scientific Actions’ to promote the ‘TECHNOLOGIES’ for ‘Economic Development Without Environmental Destruction’ and ‘Protect the Global ENVIRONMENT’ for our SAFE Living in World.

It should be based on the Ethical Principles of ‘SOCIAL EQUALITY’, ‘ECONOMIC PROSPERITY’ with ‘ECOLOGICAL SECURITY’ to achieve the goals of ‘SUSTAINABLE DEVELOPMENT’. ‘Economic Development’ & ‘Environmental Protection’ programs should go hand in hand for achieving the ‘Sustainability’ in the Life of global human society for their ‘Safe Living’ on Earth.

To embark on the path of ‘SUSTAINABLE DEVELOPMENT’, all ‘Developmental Activities’ in the ‘Economic Development Programs’ of World must promote all the Technologies for ‘CLEANER PRODUCTION’ and ensure to take the following ‘Measures & Actions’

1. To use ‘ENERGY’ (& the ‘ELECTRICITY’ generated it) from the ‘Zero Emission’ ‘Renewable Energy’ Resources – SOLAR, WIND, HYDROGEN, BIO-FUEL & GEOTHERMAL Powers in the Production Processes & completely abolishing the use of ‘FOSSIL FUELS’. Also, to improve the ‘Efficiency’ of Use of ENERGY in all Production Processes.
2. To use ‘Less WATER’ & also Improve the ‘Efficiency’ of Use of WATER in the Production Processes, thus also generating ‘Less WASTEWATERS’.
3. To significantly ‘REDUCE’ the ‘POLLUTION’ & emission of ‘GREENHOUSE GASES’ in the Production Processes.
4. To significantly ‘REDUCE’ the generation of all types of ‘INDUSTRIAL WASTES’ especially the ‘TOXIC & HAZARDOUS WASTES’ from the Production Processes;
5. To significantly ‘REDUCE’ the use of ‘CHEMICALS’ replacing by ‘BIO-CHEMICALS’ if possible & completely eliminating the use of ‘TOXIC CHEMICALS’ & ‘HAZARDOUS MATERIALS’ from all the Production Processes.
6. To efficiently use the ‘SCARCE & NON-RENEWABLE’ ‘Natural Resources’ of Earth.
7. To Protect the ‘OZONE Shield’ in the STRATOSPHERE by eliminating the production & use of those CHEMICALS (Chloro-Fluorocarbons & Halons) in World which destroys it.

The Key to Growing & Living 'SUSTAINABLY' & Promoting

'SUSTAINABLE DEVELOPMENT' in World is -

- a. Not to 'PRODUCE Less' (all Agricultural & Industrial Products) but to 'PRODUCE Differently', in a way which is 'Environmentally Friendly' and 'Compatible' (With no use of 'Toxic Chemicals' & Zero Emissions of 'Pollutants' & 'Greenhouse Gases') by embracing the Philosophy of 'CLEANER PRODUCTION';
- b. Not to 'CONSUME Less' (Foods, Water & Industrial Products) but to CONSUME 'Judiciously' and 'Efficiently' within the 'Regenerative Capacity' of the 'Earth Ecosystems' and with minimum generation 'WASTES (both SOLIDS & WASTEWATERS) in Daily Life.

AUSTRALIA has achieved significant progress in promoting 'Cleaner Production' & 'Sustainable Development' in 'MINING & METAL' and in the 'ENERGY INDUSTRIES' especially in the 'COAL Power Plants' by promoting 'CLEAN COAL GASIFICATION Technology'. 'Joint INDO-AUSTRALIAN Bilateral Meeting' on 'CLEAN DEVELOPMENT MECHANISMS' (CDM) was organized in New Delhi, India in 2001.

Hope INDIA will also follow the 'AUSTRALIAN Pathways' of 'CLEANER PRODUCTION' & 'SUSTAINABLE DEVELOPMENT'.

Promotion of 'SUSTAINABLE DEVELOPMENT' Programs & Technologies in all the DEVELOPMENTAL ACTIVITIES of Nations for SAFE FUTURE of Human Society

SCIENCE & TECHNOLOGY came as a 'Mixed Blessing' for mankind. It brought 'PEACE & PROSPERITY', 'COMFORT & FACILITY', 'HEALTH & WEALTH' for mankind through SUSTAINABLE Development by Using the 'NATURAL RESOURCES'. It Provided all the 'Basic Amenities' of Life and fulfilled all Human aspirations for COMFORTABLE LIVING in World with –

1. 'Good and Secured Dwellings' to live, 'Good & Durable CLOTHES to Wear.'
2. Copious amount of 'ENERGY' to Drive all Developmental Activities.
3. Quicker means of 'Telephonic COMMUNICATIONS' & 'Rapid TRANSPORT Systems'.
4. 'NUTRITIOUS FOODS' to Eat & 'CLEAN WATER' to Drink.
5. Developing GENETIC ENGINEERING to 'Genetically Modify' the CROP Plants for giving High 'FOOD PRODUCTIVITY to feed the growing Population in World, also benefiting the Farmers – the 'FEEDERS of Society'.
6. Prompt HEALTHCARE & SANITATION Facilities.
7. Developing System of 'WEATHER FORECAST' to Protect Society from the 'Heavy RAINS', increasing 'COLD & WARM Climates' due to 'GLOBAL WARMING & CLIMATE CHANGES'.
8. An 'Advance WARNING System' for Coping with 'NATURAL DISASTERS'.

When used 'Judiciously and Legitimately' for Human Development, SCIENCE & TECHNOLOGY Saved 'LIFE & PROPERTY', but when 'Misused', it spelt DISASTER. TECHNOLOGIES practically transformed the 'Traditional Human Society' which was more vulnerable to the 'Vagaries of Nature', more dependent for 'Survival on Nature', 'Less Adapted to Survive against all ODDS', to 'Modern Human society' which is much 'Less Vulnerable' to the 'Vagaries of Nature', more 'Fit to Survive' even in the 'Difficult Situations', 'Less Dependent on Nature' for SURVIVAL and more competent to manage their all 'Domestic & Departmental' affairs.

TECHNOLOGY is the 'Backbone' and 'Driving Force' of all SUSTAINABLE DEVELOPMENT Programs & Activities in World for the 'SAFETY & SURVIVAL' of Global Human Society.

Some Important Actions to be Taken by the Government of Nations for Promoting SUSTAINABLE DEVELOPMENT

1). SUSTAINABLE URBAN DEVELOPMENT by Construction of ECO-EFFICIENT HOUSES in CITIES with all FACILITIES for SAFE & HAPPY Living of Human Societies

URBANISATION is growing in World especially in the 'DEVELOPING Nations' as large number of people are moving from the 'RURAL' to 'URBAN' areas for 'SAFE' & 'Happy Living' with good 'ROADS & Facilities for TRANSPORTS', Good availability of 'Clean Drinking WATER' & 'ELECTRICITY' for 'LIGHTENING' the Homes & Streets during the Night Hours removing the 'DARKNESS', Good Facilities for SHOPPING of FOOD Products, Medicines & HEALTHCARE etc.

- a. URBAN DEVELOPMENT has to be 'VERTICAL' & not 'HORIZONTAL' to save Agricultural Lands. Only the 'WASTELANDS' & Poor AGRICULTURAL LANDS must be used.
- b. BUILDING DESIGNS should follow the Ethical principles of 'Conservation of WATER & ELECTRICITY', more use of Natural AIR & SUNLIGHT, Collection & Storage of 'Roof Top RAINWATER' for reuse in CLEANING & WASHING, Reuse of 'Kitchen Wastewaters' for 'Gardening', Reuse of 'Bathrooms & Wash-Basins Wastewaters' for 'Toilet Flushing' saving huge 'CLEAN DRINKING WATER' every day.
- c. By Promoting the Development of 'INSULATED Walls, Roofs, Floors & Windows' in the Houses and Improved 'Electronic Controls' of 'Heating' & 'Cooling' Systems, the ENERGY needed to keep the House 'WARM in Winter' & 'COOL' in Summer can be reduced by 50 % benefiting both, the ECONOMY of the Society & ECOLOGY of Nations.
- d. CITIES should have WIDER ROADS with Separate LANES for the 'Bi-Cycles & Two-Wheelers' & 'Walking Pathways' for the Pedestrians. Roads should have minimum CURVES for smooth Traffic movements with 'Low Emissions'.
- e. Some small TREES should also be planted on the 'ROADSIDES' to work as the 'Natural POLLUTANT Sinks' & provide some 'SHADES' to Walkers & Vehicles especially during the Hot Summer days.

2). SUSTAINABLE DEVELOPMENT for SAVING the 'Fast Depleting' GROUNDWATER Resources of Earth to Provide Enough FRESHWATER to the Global Human Society for Safe Living in World

GROUNDWATER is FAST DEPLETING all over the World but mainly in Asia, Africa & North America threatening for severe 'WATER CRISIS'. Average residents in the Developed Nations use some 400-600 Litres of 'FRESH WATER' every day for Cultural Purposes.

According to United Nation Environment Program (UNEP), within 25 years, half of the World's Population could face HARDSHIP in finding enough FRESHWATER for Drinking, Sanitation & Food Production.

As discussed above, promotion of 'Sustainable Development Technologies' for 'Purification of MUNICIPAL WASTEWATERS' for REUSE in 'Farm Irrigation' (which uses 70 % of the Groundwater) & 'Desalination of SEA WATER' to Convert them into 'DRINKING WATER' will SAVE huge GROUNDWATER of Earth which are used for DRINKING & COOKING and for various purposes by the Society.

Innovative Technological Developments after 1980 for the Production of more 'WATER EFFICIENT' EQUIPMENTS & APPLIANCES (Taps, Showers, Cisterns, Washing Machines & Sprinklers) for Saving Huge WATER Resources in Homes & Institutions During their Use has brought great CHANGES in the World. Installations of 'AAA' Water Efficient TAPS & SHOWERS in Bathrooms, the 'Dual-Flush' CISTERNs in the Toilets & the 'DISH WASHERS' & 'WASHING MACHINES' for Cleaning the used 'UTENSILS' & 'CLOTHES' have reduced the 'Use of Water' significantly.

Installations of 'AAA' Water Efficient TAPS & SHOWERS in Bathrooms & the 'Dual-Flush' CISTERNs in the Toilets have reduced the 'Use of Water' significantly. An 'Efficient Bathroom Shower' only uses 9 (Nine) Litres of WATER every minute, as compared to the general 'Inefficient Showers' which uses 30 (Thirty) Litres of WATER every minute.

The Conventional TOILET FLUSH Cisterns consumes 12 to 15 Litres of WATER every time it is used. The 'DUAL-FLUSH' Cisterns in the modern Toilets saves 6 Litres of WATER each time in 'URINAL FLUSHING'.

These days DISH WASHERS are used in many Homes & Institutions for cleaning the used UTENSILS. The 'Front-Loading' WASHING MACHINE with 'AAA' 'Water Conservation' ratings are more efficient Washing Machines using much less 'WATER & ELECTRICITY'. Studies indicate that the 'Dish Washers' used in big families of World save about 16,000 Litres of WATER every year UNEP Reports (2000 – 2004). Development of 'SPRINKLER & DRIP IRRIGATION' systems in AGRICULTURE saves 40-60 % of FRESH WATER in Farming.

The 'DRIP' & 'SPRINKLER' IRRIGATION System must be also promoted on large scale in the Agricultural Farms of World for more 'Judicious' use of GROUNDWATER.

3). SUSTAINABLE DEVELOPMENT Technologies for PRODUCTION of 'RENEWABLE ENERGIES' - 'Clean SOLAR, WIND, TIDAL, GEOTHERMAL & HYDROGEN Powers, Replacing the 'Toxic FOSSIL FUELS' (COAL & PETROLEUM PRODUCTS) which emits huge 'TOXIC POLLUTANTS & GREENHOUSE GASES', Making the World a 'Dangerous Place' to Live:

According to EA (Environment Australia) Global Energy demand have escalated by 'Ten Folds' since the 19th Century and the demands 'Doubles' every 14 years. Since 1980, USA has 'Conserved ELECTRICITY' 4 times by promoting 'Efficient Energy Use Technology' (EEUT) in HOMES & in use of APPLIANCES thus saving \$150 Billion a year for the Consumers & Industries & also reducing the emissions of Billions of Tons of POLLUTANTS & GREENHOUSE GASES.

India has an estimated 'Renewable Energies' potential of 85,000 MW – WIND Power 45,000 MW, MICRO-HYDRO Powers 15,000 MW & BIOMASS Energy 25,000 MW.

a). Production of 'SOLAR POWER' for ELECTRICITY Generation:

Almost 75,000 Trillion Kilo Watt Hour (TKWh) of SOLAR POWER hits the Earth every day. Mere 0.1 % of SOLAR Energy is sufficient to meet the ENERGY need of the World. Modern SOLAR PANELS generate 260 kWh of ELECTRICITY, PAYING back the Cost of Solar Panels within few years & then it becomes FREE. The best thing is that SOLAR Panels are also MAINTENANCE FREE. China is leading in SOLAR POWER generation. AUSTRALIA is also coming up fast in a revolutionary way for generation of SOLAR POWER supported by the Govt. of Australia. Now, over 10,000 SOLAR PANELS are being installed in Australia every day. Most of them are installed on the ROOFS of the HOUSES. SOLAR PANELS are also installed in the Open Lands around the AIR PORTS. They are also launched as 'FLOATING SOLAR FARMS' in LAKES & RIVERS. The 'SUN CABLE PROJECT' has been developed to transport the 'SOLAR ELECTRICITY' generated in the Northern Territory State of Australia to Singapore by the 'Submarine Cables' under the Seas of Indonesia. Now all the Irrigation Rivers in MANY Nations are also being covered by SOLAR PANELS to produce ELECTRICITY for the Farmers also Saving the loss of Water from the Rivers by EVAPORATION caused by HOT AIR in the Atmosphere, especially in summer days.

Potential for SOLAR Energy in INDIA is also very HIGH. It is estimated to be about 80,000 MW. The THAR DESERT in Rajasthan is called as 'SUN Basket'. A 'Solar Electric Light Company' (SELCO) was created in South India in 1995. Govt. of India must create 'SOLAR FARMS' all over India.

TECHNOLOGIES for 'SOLAR POWER' Generation

The 'SOLAR PHOTO VOLTAIC CELL TECHNOLOGY' (SPVCT) has brought a Revolution in the World and a New Era in the Economical 'LIGHTING & HEATING' devices with significant reduction in the emissions of POLLUTANTS & GREENHOUSE GAS Carbon Dioxide (CO₂). SPVC System is now used on large scales in DOMESTIC, INDUSTRIAL and COMMERCIAL Sectors especially in both URBAN & RURAL areas.

SOLAR PV CELLS are 'Electronic Devices' made from Semi-conductor Materials like SILICON (Si) which is the second most abundant ELEMENT found in the Earth's Crust. PV Cells which convert 'SUNLIGHT into ELECTRICITY' with 15 % efficiency are virtually 'Maintenance Free'. Some 'Non-SILICON' PV Cells has also been developed. They are –

- a. CADMIUM Telluride PV Cells: Japan produced 1 MW of CT PV Cells in 1997 with Energy Conversion efficiency over 15 %.
- b. GALLIUM Arsenide PV Cells: Its Solar Electricity conversion efficiency is 25 %.
- c. COPPER – Indium-Diselenide PV Cells: They exhibit greater promise for Commercial production of SOLAR ELECTRICITY.
- d. TITANIUM DIOXIDE PV Cells: TITANIUM is incorporated for
- e. production of 'Titania Dye Sensitised Cells' (TDSC) by 'Electrochemical Technology'. It uses 'TITANIUM DIOXIDE' (TiO₂) with an 'Organometallic Dye called RUTHENIUM, & an ELECTROLYTE & PLATINUM based CATALYST which is Sandwiched between two 'Transparent & Conductive' ELECTRODES on GLASS. It is almost 100 % EFFICIENT in converting 'SUNLIGHT into ELECTRICITY'. It is also Cheaper & far Superior in Performance than the SILICON SOLAR PV CELLS. It can even work in 'LOW SUNLIGHT' & can be used in 'INDOOR Applications'.

b). Production of WIND POWER for ELECTRICITY Generation

Production of 'WIND ENERGY' grew in World by an average of 29 % a year in the last decade. WIND blows for about 320 days in a year in most part of the World & Wind Velocity of 32 km/hour is enough to generate good amount of ELECTRICITY from the Wind ENERGY. SEASHORES have greater WIND VELOCITY. Cost of Wind Power generation has reduced from 30 Cents /kWh in the 1980's to 8 Cents /kWh in 2000 & became 5 Cents /kWh by 2020.

WIND ENERGY has been harnessed traditionally since ancient times (5000 BC) to 'Propel Boats' in rivers, 'Pump Water' from Wells, and 'Grind Grains'. World's Wind Power resources are estimated to be 53,000 Twh (Trillion Watt Per Hour) every year.

The most promising areas in World for harnessing Wind Power have been found in NORTHERN EUROPE, flat inland regions of NORTH AMERICA, Western Plains in the UNITED STATES specially California, NORTHERN AFRICA, Southern SOUTH AMERICA, and the trade Wind Belts around the TROPICS. Leading countries in Wind Energy Production are GERMANY, DENMARK, SPAIN, UNITED STATES of AMERICA, CANADA, SWEDEN, The NETHERLANDS, UNITED KINGDOM, RUSSIA, INDIA and AUSTRALIA. INDIA being a PENINSULA is Geographically Blessed. It has about 20,000 MW Wind Power potential in Sea Coasts & Deserts.

There is huge potential to harness 'Offshore' Wind Energy all over the World in the COASTAL areas of OCEANS. So are the 'WINDY DESERTS' of World. The Wind Speeds & Velocities in these regions are quite 'Forceful', making the 'WIND FARMS' 50 % more efficient.

AUSTRALIA has large Wind Energy resources in the 'Coastal areas' of Tasmania, South Australia, Western Australia and Victoria. INDIA being a 'Peninsula' also has huge 'Wind Power' potential of about 45,000 MW. High Velocity of WIND blows especially in the Coastal regions of Gujarat and Tamil Nadu. The 'Thar Desert' of Rajasthan in India also has huge Wind Power potential. Govt. of India must also create 'WIND FARMS' all over India.

TECHNOLOGIES for 'WIND POWER' Generation:

'KINETIC ENERGY' of the Wind Power can be converted into ELECTRICITY by the WIND TURBINES. More efficient WIND TURBINES has been developed and they perform very high along the SEASHORES of World. Denmark is generating over 90 % of its ELECTRICITY need through SEASHORE WIND TURBINES.

WIND TURBINES are usually mounted on 'HIGH TOWERS' ranging from 10 to 100 meters in height. Wind Turbines used to generate Electricity consists of a ROTOR, set of BLADES fixed on horizontal axis (like Aircraft Propeller) and connected to an 'ELECTRICITY GENERATOR', either directly or via a 'GEARBOX', a 'Directional System', a 'Protection System' and a 'Tower'.

WIND TURBINES are getting 'Larger and Robust' requiring less maintenance. They can deliver power up to 5MW. Large WIND TURBINES are often grouped together in 'WIND FARMS'. The AEROSPACE TECHNOLOGY for WIND POWER Generation has developed 'Wind Machines' with blades as long as 'Jumbo Jet Wings' with generating capacity as high as 5000 kWh. Large modern Wind Turbines have become very QUIET. Australia has developed a Wind Turbine with 'VERTICAL ROTORS' with 'Sensors' fitted on the Blades to automatically keep on moving in the direction of Wind.

Development of Powerful HIGH STORAGE 'LITHIUM-ION BATTERIES' for Storage & Use of ELECTRICITY Generated by SOLAR & WIND Powers

Australia developed biggest Household BATTERY for STORAGE of Electricity generated from SOLAR & WIND Powers. It uses 'POLYACETALINE' (PA) which is a CONDUCTING PLASTIC replacing the METALS 'COPPER & SILICON'. PA Electrodes in Batteries are also 'Light Weight' with 'High Power Densities' & Longer life than the METAL Electrodes

e). Production of 'NON-POLLUTING' Powerful HYDROGEN FUEL for Both ELECTRICITY Generation & Use in AUTOMOBILES & AIRCRAFTS

Over 90 % of Universe is made of HYDROGEN. Sir J.B.S. Haldane in the 1920's promoted HYDROGEN as a great alternative to the DIRTY OIL & COAL, but the addiction to Cheap 'FOSSIL FUELS' (Coal & the Petroleum Products) in World overlooked its importance for the Global Human Society for SAFE Living on Earth. Man reached Moon in 1969 using HYDROGEN FUEL in SPACE-CRAFT. Australia is also planning to develop 'Hydrogen Powered AIRCRAFTS'.

HYDROGEN can be produced by 'Photolysis of WATER' by using 'SOLAR POWER'. The Cheapest Production of HYDROGEN is also from COAL & PETROL converting the 'Toxic Fossil Fuels' into 'CLEAN BIO-FUEL'. Hydrogen can be extracted from the Hydrocarbons (CHO) of 'Coal & Petrol'.

The 'Los Alamos National Laboratory' in U.S. has worked on 'Zero Emission COAL- to – HYDROGEN – to- Electricity Development Process'. Hydrogen is completely 'Non-Polluting' Fuel. It emits WATER VAPOR & NO_x only. It has highest DENSITY of ENERGY (34 kcal /gm) than COAL (7.8 kcal /gm) & PETROL (10.3 kcal /gm).

'HYDROGEN FUEL CELL TECHNOLOGY' has been developed for best POWER Generation & their Use in Automobiles with NO Emission of POLLUTION & GREENHOUSE GASES.

HYDROGEN can also combine with OXYGEN to produce ELECTRICITY & WATER. It can also be used as an 'Intermediate Compound' in the production of 'SYNTHETIC LIQUID FUELS' to replace the Hazardous 'DIESEL Oil' and also the 'KEROSENE Oil'.

d). Production of ELECTRICITY from 'OCEANIC WAVE & TIDAL POWERS' in World reducing 'POLLUTION' & emission of 'GREENHOUSE GASES'

OCEANS in World have huge sources of CLEAN ENERGY as 'WAVE & TIDAL POWERS'. About 2,000 GIGA WATT (GW) of ELECTRICITY can be produced in 20,000 km of COASTLINE in World. UNESCO puts it 4,000 GW. World Energy Council (WEC) estimates that 2 Trillion Watts (TW) of 'Clean Energy' can be harvested from the World's OCEANS which covers 75 % of the Earth surface. 'Wave Powers' uses the 'Up & Down' motions on the Surface of the Oceans while the 'Tidal Powers' uses the movement of Water with the TIDES below to drive the Turbines.

e). Production of ELECTRICITY from 'GEOTHERMAL POWERS' reducing 'POLLUTION' & emission of 'GREENHOUSE GASES'

It was enhanced in the 1950's & 1960's in the USA & New Zealand near Australia. The Technology is very 'Cost-effective'. Today over 58 Nations in World are using Clean 'GEOTHERMAL ENERGY' Producing over 50 million MW of Electricity every year.

Intense PRESSURE & decay of 'RADIOACTIVE Materials' deep in the Earth generates 'High HEAT' with Temperatures up to 60000C which generally escapes through 'Hot Springs', 'Geysers' & 'Volcanoes'. The HEAT contained in the upper 10 Km of the Earth crust can easily be used to generate STEAM from the WATER to drive TURBINES.

Another source of 'Geothermal Power' Generation is from the 'HOT DRY ROCKS' by CRACKING the Rocks and creating 'Artificial AQUIFERS'. WELLS are Drilled into the Hot ROCKS up to 5 Km and the HOT WATER is pumped at high Pressure to create 'Underground STEAM' & then returned to the Earth's Surface to be used for ELECTRICITY generation.

f). BIOMASS ENERGY- Cleaner & Renewable Energy Resources Produced From PLANTS Products

i). BIO-ALCOHOL ETHANOL: Produced from PLANTS, it is assuming great value in World as an 'Environmentally Safe & Sustainable' Substitute of PETROLEUM Products. Brazil is using it as an 'Auto-Fuel' since 1975. Australia & many other Nations are also using it by 'Blending' with 'Petrol & Diesel'. Mixed with PETROL it increases Energy 'Efficiency' & also reduce 'Pollution & GHGs emissions'.

ii). BIODIESEL: Produced from ORGANIC WASTES, it is 'Clean' & 'Non-Toxic' AUTO FUEL with very 'LOW Emission' of 'POLLUTANTS'.

iii). BIOGAS: Biogas METHANE (CH₄) is a 'Clean Burning' Substance generating very 'High HEAT' upon Combustion. It is produced from ORGANIC Substances in both 'Live & Waste BIOMASS' & even from the 'SEWAGE SLUDGE' by the ANAEROBIC BACTERIA 'Acetogen' & 'Methanogen'. It also works as a 'Greenhouse Gas' if it escapes in the Environment.

4). SUSTAINABLE DEVELOPMENT Technologies to Develop more ENERGY EFFICIENT 'ELECTRICAL APPLIANCES' & 'INSTRUMENTS' Saving Hu ELECTRICITY During their Use

Modern Energy Efficient 'Electrical Appliances' such as 'Automatic Lighting Control System' (ALCS), 'Compact Fluorescent Lamps', 'Low Voltage Tungsten Halogen and 'Sodium Lamps' save 'Huge ELECTRICITY' from 70-80 %. COMPACT FLUORESCENT LAMPS use 70-80 % Less Electricity for giving same 'LIGHT Powers'.

It has 8 times 'Longer Life' than the ordinary 'Light Bulbs' & also prevent 'Emission' of nearly a TON of 'Green House Gases' (GHGs) in its lifetime. Modern 'Air Conditioners' (ACs), 'Fridges & Freezers', 'Washing Machines', 'Dishwashers' use 75 % 'Less Energy' than the Older Models. Modern REVERSE CYCLE AIR CONDITIONERS used for both 'Cooling & Heating' have 'Inverter Type Technology' using 67 % Less Electricity. It has 'Hybrid Aerofoil Fan' that improves the 'AIR FLOW'.

'WATER HEATING' especially for 'Bathing & Hand Washing' in Winter seasons has also become essential for Society. 'GAS HOT WATER System' & 'SOLAR HOT WATER' System has been developed. 'RHEEM PUMP HOT WATER System (using AIR to heat WATER) has been developed which use only 40 % ENERGY. ELECTRIC STOVE with 'Fan Forced Oven' are 30 % more Efficient than the Conventional Electric Stoves. Cooking GAS STOVES are much more ENERGY EFFICIENT as compared to 'ELECTRIC STOVES'. MICROWAVES use 55 % Less ELECTRICITY consequently emitting less 'Pollutants & Greenhouse Gases' than any other STOVES for Cooking or Heating of Foods. Use of 'Energy Efficient Appliances and Instruments in World have Reduced the Emission of Greenhouse Gas Carbon Dioxide (CO₂) in the same proportion. Currently all 'Electrical Appliances' in World have 'Energy Saving Efficiency' as 4.5 STARS. Improvements are in progress to improve the Global 'Energy Efficiency' to 6 STARS soon (UNEP Reports, 2000 – 2004).

5). SUSTAINABLE DEVELOPMENT Technologies for 'Safe Management' of 'HUMAN WASTES' (Both SOLIDS & WASTEWATERS) by Converting the 'Human Wastes' into 'Valuable Resources'

Human Wastes (Solids & Wastewater - Municipal & Industrial) are mounting all over world. Millions of tons of 'SOLID HUMAN WASTES', are being generated all over the World by the Human Society due to the rising 'Population' & 'Culture of Consumerism' consuming of both 'Edible' & 'Non-edible' RESOURCES. They are mostly ending up in the 'WASTE LANDFILLS' every day, creating great ECONOMIC & ENVIRONMENTAL PROBLEMS for the Local Govt. to manage & monitor them (may be up to 30 years) for Environmental Safety. Construction of 'Waste Landfills' incurs 30-40 Million Dollars, before the first load of Wastes are disposed. FOOD & GREEN WASTES disposed in the 'Waste Landfills' emit more Powerful GREENHOUSE GASES (GHGs) – 'Methane' & 'Nitrous Oxides' (22 & 312 times more Powerful than 'Carbon Dioxide') inducing 'Global Warming & Climate Change'.

Promotion of 'VERMICULTURE Technologies' by the EARTHWORMS–Sir Charles Darwin's 'Unheralded Soldiers of Mankind' on Earth to Convert most 'Human WASTES' (both Solids & Wastewaters) into 'Valuable Resources' for the Farmers will be a valuable step towards 'SUSTAINABLE DEVELOPMENT'.

'VERMICULTURE REVOLUTION' is going on all over the World for 'VERMICOMPOSTING' of all 'ORGANIC WASTES' & 'VERMIFILTRATION' of all 'WASTEWATERS' more 'rapidly & efficiently' into a 'Highly NUTRITIVE' 'Organic FERTILIZER' (VERMICOMPOST) & 'Clean Nutritive & Reusable WATER' (VERMIAQUA) to be used in AGRICULTURE FARMS for production of 'Safe Chemical-free Organic Foods' replacing the use of AGROCHEMICALS proving to be 'Slow POISON' for the Farmers in World & also reducing the Use of huge GROUNDWATER (about 70 %) of Earth which are Fast Depleting all over the World.

a). VERMICOMPOSTING of Municipal SOLID WASTES:

The three most voracious 'Waste-eater' Earthworms Species 'Tiger Worms' (*Eisenia fetida*), 'Indian Blue Worms' (*Perionyx excavates*) & the 'African Night Crawlers' (*Eudrillus euginae*) are used in Vermicomposting all over the World if they are available in the Soils. The Red Worm (*Lumbricus rubellus*) and the Red Tiger Worm (*Eisenia andrei*) are also good 'Waste Eaters' & 'Degradors'. They are available almost in all Nations of World. Our studies made in India & Australia have confirmed that the 'Tiger Worms' (*E. fetida*) is most versatile 'Waste Eater' and 'Bio-degrader' Worms. Earthworm act as an 'Aerator', 'Grinder', 'Crusher', 'Chemical Degradator' & as a 'Biological Stimulator'.

They Biodegrade the WASTES by both 'ENZYMATIC & MICROBIAL' actions secreting the ENZYMES ('Proteases', 'Lipases', 'Amylases', 'Cellulases' & 'Chitinases') & excreting the MICROBES (*Pseudomonas*, *Mucor*, *Paenibacillus*, *Azoarcus*, *Spiroplasm*, *Acalegenes* & *Acidobacterium*) from their Gut. They also 'DETOXIFY' & 'DISINFECT' the VERMICOMPOST making them free of 'Chemicals & Pathogens' & SAFE for use by Farmers.

b). VERMIFILTRATION of ‘Municipal & Industrial WASTEWATERS’:

This is also an Eco-Technology for Sustainable Management of ‘WASTEWATERS’ by Waste-eater EARTHWORMS. The three most voracious ‘Waste-eater’ Earthworms Species ‘Tiger Worms’ (*Eisenia fetida*), ‘Indian Blue Worms’ (*Perionyx excavates*) & the ‘African Night Crawlers’ (*Eudrillus euginae*) used for VERMICOMPOSTING of ‘Solid Organic Wastes’ are also used in the VERMIFILTRATION of ‘Wastewaters’.

Earthworms body work as a ‘BIOFILTER’ and they remove the 5 days BOD (BOD₅) by over 90 %, COD by 80-90 %, total dissolved solids (TDS) by 90-92 % and the total suspended solids (TSS) by 90-95 % from Wastewater by the general mechanism of ‘INGESTION’ & ‘BIODEGRADATION’ of Organic Wastes, HEAVY METALS and SOLIDS from Wastewater and also by their ‘absorption’ through Body Walls.

The Earthworms release ‘COELOMIC FLUIDS’ that have ‘Anti-bacterial’ properties and destroy all ‘Pathogens’ in the Wastewater. They also devour the ‘Protozoa’, ‘Bacteria’ and ‘Fungus’ as food from the Wastewater making it completely ‘DISINFECTED’ & ‘DETOXIFIED’.

The resulting VERMIFILTERED WATER is CLEAN enough to be ‘reused’ in INDUSTRIES as Cooling Water. They are also highly NUTRITIVE (rich in NKP) to be reused for FARM IRRIGATION giving higher FOOD Productivity.

The most significant part is that there is ‘NO SLUDGE formation’ in the process as the Earthworms eat the Solids and Excrete them as their VERMICAST which can be used as Vermicompost.

c). ‘MEMBRANE FILTRATION TECHNOLOGY’ for Sustainable Management of WASTEWATERS by CLEANING them into REUSABLE WATER:

A new ‘Membrane Filtration Technology’ called ‘REVERSE OSMOSIS’ (RO) is also being used in World to produce CLEAN Water from the Wastewaters without the use of any CHEMICALS. As the MEMBRANES do not allow ‘MICROBES’ or their ‘ENDOSPORES’ or ‘CYSTS’, to pass through, it also completely ‘DIS-INFECT’ the ‘Wastewater Effluents’. RO can also remove the ‘Dissolved Constituents’, ‘Natural Organic & Inorganic Matters’, Volatile Contaminants like ‘BENZENE’, ‘TRIHALOMETHANES’, ‘TRICHLOROETHYLENE’ & even ‘NITROSODIMETHYLAMINES’ & the other related Organic Compounds.

6). SUSTAINABLE DEVELOPMENT in ‘MINING INDUSTRIES’ Reducing POLLUTION & Emission of GREENHOUSE GASES & Protecting the ENVIRONMENT & also helping in the ECONOMY of Nations

According to IEA (International Energy Agency) there are some Fifty (50) ‘CRITICAL METALLIC MINERALS’ used in all ‘Developmental Programs’ in World but their ‘Mining & Extraction from Earth as their METALLIC ORES’, ‘Processing’ & ‘Production’ of METALS also entails severe ‘ENVIRONMENTAL DAMAGES’.

They also emit huge 'GREENHOUSE GASES' (GHGs). Similarly, 'Mining of COALS' from Earth for their use in COAL POWER PLANTS to generate 'ELECTRICITY' also entails severe 'ENVIRONMENTAL DAMAGES'. They also emit huge 'POLLUTANTS' & 'GREENHOUSE GASES'. Hence 'Clean Coal Technology' has been developed (Discussed Below) to 'Sustainably Use' the 'Huge COALS' Under the Earth without Environmental Destructions.

7). Development of 'CLEAN COAL TECHNOLOGY' to Generate 'Clean COAL GAS' (METHANE)'- Using COAL without MINING

This is done through 'Underground COMBUSTION of COALS' on 'COAL BEDS' & their reaction with HYDROGEN Gas. It is a brilliant new idea to Sustainably Utilize the 'Huge COAL Reserves' of World. It is like 'Using Coal Without Mining'. Australia is pioneering in the technology. It also utilizes 90 % of COAL as compared to HAZARDOUS CONVENTIONAL COAL MINING which only utilize 60 %. This has led to significant reduction in the emission of GREENHOUSE GAS CARBON DIOXIDE (CO₂) and other TOXIC POLLUTANTS. METHANE (also termed as 'NATURAL GAS') generated on the underground COAL BEDS is Piped out & supplied to 'POWER PLANTS' for ELECTRICITY generation.

a). 'COAL GASIFICATION' Technology to Produce 'Clean HYDROGEN' Power from Dirty Coal (Using COAL without COMBUSTION):

All over the World, the Eco-Technologies of 'COAL GASIFICATION & HYDROGEN CONVERSION' for ELECTRICITY Generation are being developed to make the 'DIRTY COAL' more 'CLEANER' and 'SAFER' through the 'COAL GASIFICATION' & 'HYDROGEN CONVERSION' Technologies'. There is 'NO COMBUSTION of COAL' & hence no emission of 'GREENHOUSE GASES' & 'POLLUTANTS'. Nearly all the 'WASTE HEATS' are recycled for 'Electricity' generation. More than twice as much ELECTRICITY are produced Per Unit of COAL as compared to the 'Conventional COAL POWER Plants'.

b). COAL 'MINE DRILLING' Technology (Using COAL without MINING):

Australia has developed an innovative Eco-technology for 'Clean, Safe & Efficient Coal Mining'. The device consists of 'Water-Powered Self Propelling Drill Head'. It is a cost-effective technology that extracts the 'Biofuel METHANE Gas' from the Coal Seams for Electricity generation at the COAL-BED.

c). The 'FLUE- GAS DESULFURIZATION TECHNOLOGY' in Conventional COAL POWER PLANTS:

It has also led to significant reduction in SULFUR DIOXIDE (SO₂) emission which causes ACID RAINS. More efficient 'AIR POLLUTION CONTROL EQUIPMENTS' and Devices such as 'ELECTROSTATIC PRECIPITATORS', 'BAG FILTERS' have also been developed for reducing 'POLLUTION & GREENHOUSE GAS' emissions from the Conventional COAL POWER PLANTS.

8). BIOMINING Technology for Extracting ‘ORES’ & ‘METALS’ from the MINES by Microbes with Less Impact on the ENVIRONMENT’

A New Eco-Technology of ‘BIOMINING’ by using ‘MICROBES’ has been developed for ‘SUSTAINABLE MINING’ of ‘ORES & METALS’. New class of ‘Deep Sea Anaerobic Microbes’ called ‘HYPERTHERMOPHILE MICROBES’ has been discovered for their use in Biomining. It is an ‘Economically Viable & Environmentally Sustainable’ Technologies for Mining & Processing of ‘Precious METAL ORES’. Requirement of WATER & consequent discharge of ‘TOXIC WASTEWATER’ is also significantly reduced.

New RESEARCH done in Australia have also found that ‘REDUCTION of METALLIC ORES’ into ‘METALS’ can be made more efficiently by the use of HYDROGEN GAS. This will produce ‘Zero-Emission’ IRON & STEELS in the World.

9). SUSTAINABLE DEVELOPMENT in FARMING & AGRICULTURE Industries by VERMICULTURE Technology for Production of ‘CHEMICAL-FREE’ & ‘HEALTH PROTECTIVE NUTRITIVE ORGANIC FOODS’ for Society

A ‘Vermiculture Revolution’ is going on all over the World for Vermicomposting of all ‘ORGANIC WASTES’ more ‘rapidly & efficiently’ into a ‘Highly NUTRITIVE’ ‘Organic Fertilizer’ (VERMICOMPOST) to be used for production of ‘Safe Chemical-free Organic Foods’ with ‘no’ dependence on AGROCHEMICALS. Vermicompost is rich in ‘HUMUS’ & essential ‘NUTRIENTS’ especially ‘NITROGEN, POTASSIUM & PHOSPHORUS’ (NKP) & work as a ‘Slow release’ ORGANIC FERTILIZER. NKP are about 50 % higher than present in the ‘Chemical Fertilizers’. Availability of ‘Phosphorus’ is sometimes much greater in Vermicompost. There are also high levels of ‘Beneficial and Biologically Active’ Soil Microorganisms - Actinomycetes, Azotobacter, Rhizobium & Nitrobacter in Vermicompost. Vermicompost is also rich in ‘Plant Growth Hormones secreted by EARTHWORMS. These are - ‘AUXINS’ (for growth of STEMS & LEAVES), ‘CYTOKININS’ (for CELL DIVISION) & ‘GIBBERLINS’ (Flowering Hormones) to induce FLOWERING in Plants.

Use of VERMICOMPOST in the ‘FARMING’ significantly increases the ‘FOOD PRODUCTIVITY’. Study by the Environmental Scientists of ‘Council of Scientific & Industrial Research Organization’ (CSIRO) in Australia found that the Earthworms increased ‘Growth’ of WHEAT CROPS by 39 %, ‘Grain Yields’ by 35 %, lifted ‘PROTEIN value’ of the Grain by 12 % & also resisted from the ‘Crop Pests & Diseases’.

VERMICOMPOST also ‘Protect Plants’ against various ‘PESTS AND DISEASES’ either by ‘suppressing’ or ‘repelling’ them or by inducing ‘Biological Resistance’ in plants to fight them or by killing them through ‘Pesticidal Actions’. Vermicompost contains some ‘Antibiotics’ which help in increasing the ‘Power of Biological Resistance’ among the Crop plants against ‘PESTS & DISEASES’.

As the Earthworm’s body contain plenty of WATER, a ‘Brownish Red’ liquid comes from the body of Earthworms. This is called ‘VERMIWASH’. It is rich in ‘Amino Acids’, ‘Vitamins’, ‘Nutrients’ like NITROGEN, POTASSIUM, MAGNESIUM, ZINC,

CALCIUM, IRON & COPPER and some 'Growth Hormones'. It also contains plenty of 'Nitrogen Fixing' and 'Phosphate Solubilizing' BACTERIA (Nitrosomonas, Nitrobacter and Actinomycetes). It also contains beneficial MICROBES (Chitin and Cellulose degraders). They 'REPEL PESTS' and 'SUPPRESS' the 'Disease Causing BACTERIA, FUNGUS and the SOIL NEMATODES. It significantly reduces the use of Toxic 'Chemical Pesticides' and the 'Insecticides' on the Crop Plants. Use of VERMICOMPOST in the 'FARM SOILS' also increases their 'WATER HOLDING CAPACITY', SAVING large amounts of WATER (about 70 % of the Groundwater) used for Farm IRRIGATION. Being rich in 'CARBON Contents', use of Vermicompost in Farms also 'SEQUESTER' huge amounts of CARBONS back into the Soil combating the growing 'CLIMATE CRISIS' in World induced by the Atmospheric Carbons.

BIOLOGICAL CONTROL of PESTS & DISEASES in Agriculture have become more effective after Scientific Development of the HERBAL PESTICIDES like 'AZADIRACHTIN' & 'PYRETHRIN', and development of 'TRANSGENIC CROPS'. The 'Fermented Solution' of VERMICOMPOST called 'VERMICOMPOST TEA' also works as an effective BIO-PESTICIDES while promoting 'High Growth & Productivity' in Food Crops when sprayed in the Crop Farms.

10). Some Sustainable Development Technologies for Promoting 'SUSTAINABLE TRANSPORT SYSTEMS' in World by Production of 'LOW POLLUTION' & also 'POLLUTION-FREE ECO-AUTOMOBILES', Protecting the Breathing AIR from the 'Toxic Pollutants' for Safety & Survival of Human Society in World:

Promotion of 'Sustainable Transport Systems' in the Cities of World was the Crucial theme of the 'World Environment Day' organised in 2001. Automobiles are Voracious users of 'ENERGY & MATERIALS' & emitter of POLLUTANTS & GREENHOUSE GASES (GHGs) in World. It uses about 30 % of the Global ENERGY & emits 70 % of the Pollutants & GHGs. Some important Sustainable Developments are occurring in the 'Automobile Industries' under the 'World Business Council for Sustainable Development' (WBCSD) for establishing a SAFE & SUSTAINABLE MOBILITY of Mankind in World by Non-Polluting 'SUSTAINABLE TRANSPORT SYSTEMS' by 2030. Both, the United Nations Environment Program (UNEP) and the World Health Organization (WHO) have forced the 'Automobile Industries' all over the world to search all possible ways to make the 'Automobiles Environmentally More Friendly' as the 'Global Transport Systems' is an essential part of 'Human Life' on Earth for 'SAFE Living' and the Civilization cannot exist without it. The Environmental Protection Agency (EPA) of U.S.A. came out with very 'Strict Guidelines' for control of 'Vehicular Emissions' by 100 %.

The World is on a shift to 'High efficiency' SUSTAINABLE ECO-AUTOMOBILES, which will make use of 'Electronic Tuning' and 'Streamlined Bodyworks' of Automobiles. Automobiles Industries are now using 'Light Weight' materials like 'Plastics', 'Ceramics', 'Aluminium' & 'Carbon Fibres' instead of 'Steel'. Such 'ECO-AUTOMOBILES' will be more 'Fuel Efficient' and 'Much Less Polluting', 'More Aerodynamic' in 'Body Construction' to induce less 'Wind Resistance', 'Less Consumption' of Fuels & 'Less Emission' of 'Pollutants' & 'Greenhouse Gases', Capable of running on 'Cleaner' and alternative fuels like 'AUTO-GAS', ETHANOL, HYDROGEN FUEL, and even the SOLAR POWER.

More 'FUEL EFFICIENT', 'QUIETER', 'LESS POLLUTING' & even 'NON-POLLUTING' Automobiles have been Developed in World by producing 'Environmentally Benign' AUTO-FUELS like 'Compressed Natural Gas' (CNG), 'LIQUIDIFIED Petroleum Gas' (LPG) and PETROL added with Non-Polluting 'ETHANOL'. All MODERN generations of CARS of important Automobile Industries like Mitsubishi, Toyota, Ford, BMW, Mercedes-Benz, Honda, Nissan, Volkswagen, manufactured after the 1980s and 1990s have become 25 to 40 % FUEL EFFICIENT due to various 'TECHNOLOGICAL CHANGES' and SUSTAINABLE DEVELOPMENT. 'Fuel Efficiency' in Vehicles also has led to significant reduction in 'Greenhouse Gas CO₂', 'Particulate Matters' and other 'Pollutants' mainly due to installation of 'CATALYTIC CONVERTERS' and use of 'LEAD-FREE' PETROL. Developing the 'Lead Free' PETROL was one of the greatest 'Technological Achievement' towards making the current generations of Automobiles more SUSTAINABLE.

Lowest Molecular Weight 'Bio-Alcohols' METHANOL (CH₃.OH) & ETHANOL (CH₂.CH₃.OH) are finding good values in the modern PETROLEUM INDUSTRY as an 'Environmentally Cleaner & Benign' and an 'Efficient Oil' additive to replace the Dangerous TETRAETHYL LEAD (C₂H₅)₄ Pb. Large numbers of CARS in Brazil are running on pure ETHANOL and others on ETHANOL / PETROL blend of 80 / 20. ETHANOL is being produced on commercial scale from the WASTES of 'Sugar Cane', 'Beet', 'Corn Stalks' and 'Wheat Straws' all over the World. In U.S., Australia & several European Nations ETHANOL is now being blended with PETROL or DIESEL to reduce the amounts of the 'Petrol & Diesel' used and also the emission of the 'Toxic Pollutants'. As mentioned above, 'BIO-DIESEL' has been developed as a 'Cleaner Auto Fuel' for the DIESEL VEHICLES. It is completely 'Non-Toxic' and also 'Biodegradable'. It is almost free of SULFUR and aromatics emissions of CO₂.

The COMPRESSED NATURAL GAS (CNG) made primarily of 80-90 % 'METHANE' (CH₄) is a 'Clean Burning Auto Fuel' with 'Higher Energy' Contents than the OILS. Its use significantly reduces the emission of Air Borne LEAD (Pb) by 99.9 %, Greenhouse Gas CARBON DIOXIDE (CO₂) by 70 % and also the emissions of SULFUR DIOXIDE (SO₂), PARTICULATE MATTERS, CARBON MONOXIDE (CO), HYDROCARBONS (HC) and OXIDES of NITROGEN (NO_x).

Also new Automobiles with 'Less Body & Wheel Weights' and 'Aerodynamic Bodies' to induce 'Less Resistance' to 'Blowing Wind' during driving on roads have been developed which consumes 'Less FUELS'. Higher Resistance' to the 'Blowing Wind Power' during driving Consumes more FUELS. By developing 'LEAD FREE PETROL' a significant reduction in the 'Toxic LEAD (Pb)' from the AIR Pollutants has been achieved. Production and use of 'NATURAL GAS' & 'ETHANOL' as 'Auto-fuel' has also eliminated the LEAD from the Air.

Since 1970 several 'Environmental Technologies' have been developed to modify the INTERNAL COMBUSTION (IC) ENGINES of the current generations of Automobiles primarily by making the ENGINES 'Smaller' and adding 'New Devices' and 'Tune-up' to improve the 'Fuel efficiency', 'Reduce the Emissions' of CO, HC, SO₂, SPM and the Greenhouse Gases (CO₂ NO_x and CH₄) and other 'Toxic Products' significantly.

A Considerable Reduction in the Emission of many 'Greenhouse Gases' - 'Carbon Monoxide' (CO), 'Carbon Dioxide' (CO₂), 'Hydrocarbons' (HC) and 'Nitrogen Oxides' (NO_x) have occurred by modification in the 'IC Engines' of many Automobiles, by installation of 'Catalytic Converters', introduction of 'Direct Fuel Injection' Technology and by 'Lean-Burn Combustion Technologies'.

a). Development of ZERO-POLLUTION ELECTRIC VEHICLES Replacing the Polluting PETROLEUM AUTOMOBILES from World & Saving the Society:

These are 'High-Powered' Battery Operated 'Zero Emission' Automobiles.

This improved technology for 'High Powered' Battery Systems promises to revolutionize the Automobile Industries in World for the Manufacture & Development of 'ZERO POLLUTION VEHICLES' in World.

New Batteries also have less TOXIC HEAVY METALS used in 'LEAD-ACID' Batteries. A new invention is 'SODIUM-SULFUR' Battery which is more EFFICIENT, 'More Compact', 'Longer Life', and Lighter than current models. Another new concept is 'NICKEL-METAL HYDRIDE' Battery that are 'Maintenance Free', have '1000 Cycle Plus life', 'No Memory effect', 'No Over-Charge or Discharge Problems', 'No Use of HAZARDOUS MATERIALS' like CADMIUM (Cd), LEAD (Pb), MERCURY (Hg) and LITHIUM (Li), and have 'Twice' the Capacity of 'Nickel-Cadmium' and 'Lead-Acid' Batteries.

The BRAKES of the Vehicle themselves act as 'Small Generators', feeding ENERGY back into the Batteries. In Japan, radical prototypes of ELECTRIC CARS have been developed with more POWERFUL 'NICKEL-CADMIUM' ELECTRIC BATTERIES fully rechargeable in just 15 minutes. For BATTERY Operated 'Zero Emission' ELECTRIC CARS U.S. is also making BATTERIES that can run Vehicles Longer Distances upon Charging.

b). Development of Extremely-LOW-POLLUTION HYBRID-VEHICLES:

They are developed by combining 'Internal Combustion' (IC) Engine With 'Battery Operated' Electric Motor. Hybrid Vehicles are also 'QUIET' & much 'LESS POLLUTING'. It only uses PETROLEUM Products during 'STARTING' of the Vehicle & then driven on the Electric BATTERIES which are regularly 'Charged' within the Vehicle. They have both, a small INTERNAL COMBUSTION (IC) Engine and an ELECTRIC MOTOR working in tandem. The Hybrid Vehicles have Conventional PISTON ENGINES assisted by an Electric Motor. During driving, the CAR GENERATOR Converts the IC Engine's 'Rotational Motion' into 'ELECTRICAL ENERGY' which keep on CHARGING the BATTERY constantly. The Battery System absorbs POWER in normal driving and specially during 'Braking' and 'Coasting' (Dissipated Energy from the BRAKING ACTION, a system called 'Regenerative Braking') and provides 'Bursts of Powers' for driving on 'Hills & Mountains'. The size of BATTERY required is 'much less' than for the ELECTRIC VEHICLES.

c). Development of ‘Zero-Pollution’ HYDROGEN FUEL VEHICLES:

HYDROGEN is seen as the ‘FUEL of the FUTURE’ Automobiles in World. Man reached Moon in 1969 using HYDROGEN FUEL in ‘Space-craft’. Energy from Hydrogen for the Automobiles can be used either through ‘Combustion’ (like OIL or GAS) in the ‘Internal Combustion (IC) Engines’ to generate HEAT ENERGY and drive the ENGINES or it can be used to generate ELECTRICITY by an ‘Electro-Chemical’ reaction in a ‘FUEL CELL’ to drive the Car Engines.

HYDROGEN is 4.5 times more powerful than PETROL with ‘ZERO EMISSION’ of ‘Pollutants & Greenhouse Gases’. It makes a big promise for a ‘SUSTAINABLE TRANSPORT SYSTEM’ in World. They only emit ‘WATER VAPOR’ and ‘Nitrogen Oxides’ (NO_x). U.S., Germany, Japan, Sweden & China are ahead with Several HYDROGEN POWERED VEHICLES. In India some AUTOS & Mini-BUSES are Operating by ‘HYDROGEN Fuel’ in Delhi. The ‘Indian Oil Corporation’ & ‘Mahindra & Mahindra’ is supporting. Prof. L.M. Das of IIT, Delhi worked on it. Australian Scientists are now also working to manufacture ‘HYDROGEN Powered AEROPLANES’.

All AIR-CRAFTS in Australia will be fully operated on ‘HYDROGEN’ by 2027. All Global Transport Systems operating in the Waterways (SHIPS) and Air (AEROPLANES) will also be fuelled by Hydrogen. HYDROGEN Industries in Australia are also producing LIQUEFIED NATURAL GAS (LNG) for use in the Automobiles.

DECARBONISATION of Global Transport Systems for ‘Zero Pollution’ World can only be achieved by using HYDROGEN & its various ‘Liquids & Gaseous’ products.

HYDROGEN has much more ENERGY content (34 kcal/gram) as compared to the PETROLEUM OIL (8.4 – 10.3 kcal/gram). Almost all Vehicle Manufacturers in World are now switching on to the manufacture of ‘HYDROGEN FUEL CELL CARS’. ‘Hydrogen Fuel Cell’ is already being used as Propellant Fuel in ‘Space Flights’ since 1960’s. Hydrogen & Oxygen are passed over ‘FUEL CELL MEMBRANES’ to create ELECTRICITY which drives the ENGINE. Use of HYDROGEN as a source of Energy to generate ELECTRICITY in a ‘FUEL CELL TECHNOLOGY’ offer distinct advantage over the ‘COMBUSTION TECHNOLOGY’ in both ‘Efficiency’ of Energy conversion and in reduction of ‘Emissions’ which is ZERO. Fuel Cells involve ‘no moving parts’, and hence are ‘maintenance free’. A FUEL CELL can convert 40-65 % of HYDROGEN’s Energy into ELECTRICITY through a Cleaner ‘Electrochemical Reaction’ which is roughly two times more than that of ENERGY generated by Combustion.

d). Development of SOLAR & WIND Powered ‘Zero Emission AUTOMOBILES’:

SOLAR Powered Automobiles are being promoted in many Developed Nations- U.S. Canada, Western Europe and Australia. It will be a ‘ZERO EMISSION’ Vehicle and also most ECONOMIC to drive as the SUN God will pay for the cost of FUEL. Cost of Maintenance of the ‘Solar Vehicles’ will also be much lesser than the ‘Oil or Gas or Battery’ Operated Vehicles. There will be only One-time Cost in the Manufacture of the SOLAR VEHICLES.

World should also explore the possibility of installing 'MICRO-WIND-TURBINES' in the VEHICLES to generate Power for 'Recharging' the BATTERIES while on Board. It will generate huge 'Power' when the Vehicles will be running at a speed of 100 km / hour or more on the Highways. Even at 60-80 km / hour speed of Vehicles in Cities, it can generate enough power to 'Recharge' the Batteries. Wind Power generation has been found to be 'economical' even at 32 km / hour 'Wind Speed'. The 'Micro-Wind-Turbines' can be safely fitted into the front of the Vehicle engine under the Bonnet. Wind hits the front of the Vehicle with a tremendous power while it is moving and can move the 'Micro-turbines' with great speed.

e). Development of 'CATALYTIC CONVERTER TECHNOLOGY' (CCT) in PETROLEUM AUTOMOBILES: Treating the 'Combustion Products' (POLLUTANTS) in the CHAMBER Before Emission:

It was a LEGAL requirement made by UNEP and the WHO and the Environmental Protection Authorities (EPAs) in most DEVELOPED COUNTRIES. Technological developments were made to CATALYTICALLY TREAT the POLLUTANTS generated in the COMBUSTION CHAMBER before it was discharged through the 'Exhaust System' into the Atmosphere by the Tailpipe Emissions. The first attempts used 'Two Catalysts', but since then Automobile Manufacturers have developed the 'Three-way Catalyst' (PLATINUM-PALLADIUM-RHODIUM) that Carry on the Treatment Reactions to Convert the 'Toxic Pollutants' into Carbon Dioxide' (Greenhouse Gas), Water and Nitrogen (INERT GAS). There is also substantial reduction in the emission of 'Fine Particles'.

11). Sustainable Development Technologies for 'RECYCLING' of 'METALS', 'GLASSES', 'PAPERS' & 'CARDBOARDS' & 'TOUGH PLASTICS' for their 'REUSE':

'RECYCLING TECHNOLOGIES' has been developed to get back some of the 'Useful Materials' from the 'Industrial WASTES' for their REUSE by Society & not to be disposed in the 'Waste Landfills'. It also avoids 'Mining of Ores of Metals' & the associated 'Environmental Hazards', Protect TREES from Cutting to make 'PULP' & Saves huge amount of 'FRESHWATER & ENERGY' in their production from 'Virgin Materials' while also reducing emissions of Greenhouse Gases. Production of PLASTICS from 'Synthetic Organic Chemicals' is also a 'Hazardous' process. In the PAPER PULP Industry an Environmentally Benign Oxidant 'HYDROGEN PEROXIDE' is now being used as the 'Bleaching Agent' replacing the dangerous 'CHLORINE'.

12). CLEANER PRODUCTION Technologies for Sustainable Development of Environmentally Benign & Safer Chemical-free SHAMPOOS, WASHING POWDERS, LUBRICANTS, SOAPS, DETERGENT & COSMETICS:

An Environmentally Benign 'Non-ionic' and 'Biodegradable Surfactants' called 'ALKYL GLYCOSIDE' made from SACCHARIDE has been developed to replace the 'Non-biodegradable' 'Anionic ALKYLARYL SULPHONATE' used in SHAMPOOS. 'SODIUM SILICATE' is now used as an Environmentally Benign alternative to the PHOSPHORUS-containing additives in WASHING POWDERS.

All Species EARTHWORMS are also potential source of 'Biological Raw Materials' for production of useful 'Biodegradable & Chemical-free' Industrial Products' such as the LUBRICANTS, SOAPS, DETERGENT & COSMETICS and also RUBBER.

13). The 'DEMATERIALIZATION TECHNOLOGY' for Reducing the Use of Precious MATERIALS & also ENERGY in the Production of Metal, Glass & Plastic CONTAINERS, CANS & BOTTLES:

It is a significant new Technology to promote 'SUSTAINABLEDEVELOPMENT'. It leads to significant REDUCTION in the use of precious 'MATERIALS' in their weight & also in the use of ENERGY (in MW) in all INDUSTRIAL GOODS & PRODUCTS while fulfilling the same Objectives & Services.

It has greatly reduced the use of some Environmental Resources (METALS & GLASSES and also the SYNTHETIC PLASTICS) by more than 20-25 % in the manufacture of CONTAINERS, CANS & BOTTLES and consequently the ENERGY used, and the GREENHOUSE GASES emitted in their manufacture. It also reduces the quantity of WASTES generated after their use and discard. STEEL Beverage CANS have been downsized by 40 % since 1970. It saves Materials & also reduce MINING ACTIVITIES for excavating the MINERAL ORES which has severe impact on Environment.

Technology has discovered new 'Non-Mineral Materials' which will save 'Energy', save 'Weight' & also reduce the 'Environmental Damages' which are caused by 'Minerals-Based Materials'. These are 'CERAMICS', 'GLASS & CARBON FIBERS', Alloys of 'LITHIUM' & ALUMINIUM'. A 'Carbon Fibre Technology' has been developed which produces 'CARBON COMPOSITES'. It has 'DENSITY' which is 'One-Fifth' of STEEL & hence much 'Lighter' in Weight, but in 'STRENGTH' more than ALUMINIUM.

14). Development of 'Eco-efficient NON-MINERAL MATERIALS' which can replace the NATURAL RESOURCES of Earth to be Used in Developmental Activities & also Reduce their MINING:

The CERAMICS, CARBON & GLASS FIBRES & ALLOYS of 'ALUMINIUM & LITHIUM' are new Materials with 'Superior Technical Properties', ULTRA STRONG & LIGHT WEIGHT. Automobiles & Aircraft Industries are using CARBON FIBRES instead of STEEL to reduce Weight & also Improve FUEL EFFICIENCY.

This has reduced their WEIGHT by 25 %. The 'AIRCRAFT INDUSTRIES' in World are now using 'Ultra-Strong Carbon Fibres' instead of STEEL and 'Ultra-Lightweight' Alloys of LITHIUM & ALUMINIUM to reduce Weight of the Aircraft & improve 'FUEL Efficiency'. 'Glass Fibre' has been developed which is highly superior to the mineral based 'Copper' Cable for communication. Similarly, AUTOMOBILE Industries are also using 'Light-Weight' but 'Strong' 'Non-Minerals' Materials like 'Plastics', 'Ceramics', 'Aluminium' & 'Carbon Fibres' instead of 'STEELS'. They are also using alloys of 'Lithium & Aluminium' to reduce Weight & improve 'FUEL Efficiency' (UNEP Reports 2000-2004).

15). 'FERROCEMENT TECHNOLOGY' for 'ECO-DESIGNING' of Products to Reduce the use of MATERIALS & also improve EFFICIENCY.

It was developed in India. It uses 'much less' CEMENT & STEEL, has 'Higher Degree' of TOUGHNESS, DURABILITY, DUCTIBILITY, TENSILE STRENGTH & CRACK RESISTANCE in less than 25 mm of THICKNESS, which is found in 100 mm THICK WALL of Conventional RCC Technology.

16). ECO-EFFICIENT INDUSTRIES for 'Maximising Productions' of 'GOODS & METERIALS' While 'Minimising' the Use of 'ENERGY & RESOURCES & CHEMICALS' & also REDUCING the Generation of Hazardous 'INDUSTRIAL & CHEMICAL WASTES';

INDUSTRIES are the backbones for the DEVELOPMENT of Nations & PRODUCTION of all 'Essential Requirements' of Human Society for Happy Living. Now, these days many 'Modern Industries' are using highly 'TOXIC CHEMICALS' & generating 'HAZARDOUS WASTES'.

Even 'Sugar Refineries' are using some 32 'CHEMICALS' for 'Refining' the WHITE SUGARS made from Sugarcane Juice. Now in World 'BROWN SUGARS' are being produced & used by Society. It uses very little Chemicals. The best option is the production of 'Chemical-free JAGGERY' by heating & drying the 'Sugarcane Juice' into Solids.

Jaggery is also rich in Iron, Calcium, Phosphorus, Zinc & Magnesium with several 'Health Benefits' like raising the 'Memory & Immunity' Power & Energy Levels of Human Body & making the 'Bones' & 'Muscles' stronger. It also supports the 'Nerves Systems'.

ALUMINIUM Industry is one of the major Consumer of ELECTRICITY in World. Development of 'Compressed Air' & 'Fume Systems' known as 'Inert Anode Technology' & 'Wetttable Cathodes' for Aluminium production has improved 'Energy Efficiency' in all SMELTERS by about 30 %. This will Save Cost & also reduce the emission of about 6.3 million tons of 'Greenhouse Gas' (CO₂) every year. In 'IRON & STEEL' Industry a new Technology called 'Radical Iron Smelting Process' has been developed in Australia at Rio Tinto. It will replace the Energy Intensive 'BLAST FURNACE' Technology.

A 'Green Chemistry Movement' is going on in World to develop 'Environmentally Benign Chemicals' to be applied in the 'Chemical Processes' in INDUSTRIES especially in the 'Paper', 'Plastics', 'Textile', 'Dyeing', 'Printing', 'Photography' & 'Electronics' Industries. Plants Based 'BIO-CHEMICALS' are replacing the 'MINERAL-Based Chemicals'.

All over the World, the Toxic 'AGROCHEMICALS' (Chemical Fertilizers & Pesticides) are also being replaced by the 'ORGANIC FERTILIZERS' & 'BIO-PESTICIDES'. It is a 'Win-Win' situation for the 'Industrial Workers' & 'Farmers' and also for the Human Society by protecting the 'ENVIRONMENT' & also the 'HEALTH' of people. SOLAR, WIND & HYDROGEN Powers are also being used in many INDUSTRIES replacing the Fossil Fuels.

The SOCIAL PERSPECTIVES of SUSTAINABLE DEVELOPMENT for ENVIRONMENTAL PROTECTION & the RESPONSIBILITIES of the Human Society

The SOCIAL Perspectives of the ENVIRONMENTAL MANAGEMENT and SUSTAINABLE DEVELOPMENT is as important as the ECONOMIC and TECHNOLOGICAL Perspectives (Lovins et. al., 1999).

SCIENTISTS & TECHNOLOGIST in World has worked hard to Develop & Provide several EFFICIENT EQUIPMENTS, INSTRUMENTS & APPLIANCES which uses much 'Less WATER & ENERGY Resources' for the ECONOMIC BENEFITS of the Global Human Society, also Protecting the ENVIRONMENT for their SAFE LIVING. But it all depends upon the Society how they use them with more HONESTY & SINCERITY. Some of these are -

- a. 'ZERO & Very LOW EMISSION' ELECTRIC & HYBRID VEHICLES & 'LOW-EMISSION' PETROLEUM VEHICLES (Containing ETHANOL); (N.B. People may still use the same PETROL or DIESEL Vehicles. They have to be Educated & Inspired by the Govt.).
- b. ENERGY EFFICIENT BULBS, AIR-CONDITIONERS & APPLIANCES, but what if people do not BUY them as they are more Costly or Carelessly leave them Switched on even during Day time and when not needed.
- c. WATER EFFICIENT TAPS & SHOWERS, but what if people Carelessly take LONGER SHOWER than actually needed, fails to Close the Tap in-between Brushing or Shaving, or leave the Leaking Taps unattended.

Technologists have also provided solutions for Complete 'WASTE MANAGEMENT' 'by 'WASTE REDUCTION', 'REUSE' & 'RECYCLING', but what if the industries choose to DUMP the UNTREATED WASTES because TREATMENT or RECYCLING may be more Costly than their safe DISPOSAL in WASTE LANDFILLS. Similarly, if the Society do not Cooperate in Judiciously SEPARATING the RECYCLABLE WASTES from the NON-RECYCLABLES at Source many 'Recyclable Wastes' will also be disposed in the 'Waste Landfills'.

General Human Nature is to buy CHEAPER PRODUCTS even if it is HARMFUL to the ENVIRONMENT and as long as it meets the SOCIAL & CULTURAL objectives nicely. Hence not only the GREEN SUSTAINABLE TECHNOLOGIES have to be COST-EFFECTIVE, but their Products also have to be CHEAPER too, so that everyone in the Society can afford easily and reasonably to BUY them.

SUSTAINABILITY EDUCATION for the Modern Human Society

ENVIRONMENTAL EDUCATION for SUSTAINABLE DEVELOPMENT is fundamental to the success of all SUSTAINABLE DEVELOPMENT Programs in World. (Fein, 2001). Response of Global Human Society to any ENVIRONMENTAL issues are often slow as compared to the responses to any ECONOMIC issues such as PRICE RISE or even the HEALTH ISSUES due to spread of DISEASES in World.

The Society has to be EDUCATED to 'Demand' and also 'Accept' a particular TECHNOLOGY and the TECHNOLOGICAL PRODUCTS which are 'ENVIRONMENTALLY FRIENDLY', or 'Reject' all those Products which are 'ENVIRONMENTALLY UNFRIENDLY & DESTRUCTIVE'. Then only the INDUSTRIES in World will be encouraged or even compelled to produce 'Environmentally Friendly Products'.

Global Human Society has also to be educated about the Judicious and SUSTAINABLE USE of the 5 Ps (PAPER, PETROL, POTABLE WATER, POWER (Electricity) and PLASTICS in their daily- life. These are the most commonly and most frequently used RESOURCES by the Global Human Society every day and hence their 'Production and Use' has considerable ENVIRONMENTAL IMPACT. Society has also to be made aware about the 'Hidden DANGERS' of ENVIRONMENTALLY UNFRIENDLY PRODUCTS and the 'adverse impacts' of their use on HUMAN HEALTH. Society must know their 'ENVIRONMENTAL RIGHTS & RESPONSIBILITIES', what is GOOD or BAD about the ENVIRONMENT, which SUSTAIN their life on Earth.

Educating for 'MORAL RESPONSIBILITIES' of the Global Human Society Especially the 'Rich Society' for 'SUSTAINABLE CONSUMPTION' of RESOURCES Which Can Lead to Universal SUSTAINABLE DEVELOPMENT

At the root of all the ENVIRONMENTAL PROBLEMS is the 'Unethical Increase' in the 'CULTURE of CONSUMERISM' mostly in the Rich Society of both DEVELOPED & DEVELOPING NATIONS, while the 'Unethical Increase' in the 'Number of CONSUMERS' (Population) in the DEVELOPING NATIONS. There is also a growing tendency for increasing CONSUMERISM in the handful of ELITIST SOCIETIES in the DEVELOPING NATIONS. The Environmental Impact of both this Cultures, are exceeding the 'ECOLOGICAL LIMITS' and the 'CARRYING CAPACITY' (Regeneration of RENEWABLE RESOURCES and accumulation of all WASTES) of the 'Global Ecosystems' with severe Consequences for the Society in future.

UNITED NATION Division of Technology, Industry and Economics (UNDTIE) launched a 'SUSTAINABLE CONSUMPTION PROGRAM' and tried to dispel the misgivings about 'Reducing Consumption' worldwide. It emphasized – 'Sustainable Consumption is not about CONSUMING LESS but it is about CONSUMING DIFFERENTLY, CONSUMING EFFICIENTLY, CONSUMING JUDICIOUSLY, and having an improved QUALITY of LIFE for all, (not for only few people) both in the DEVELOPED and the DEVELOPING Countries. It also means sharing 'Humbly & Honestly' between the RICH and the POOR People. (UNEP-CDG, 2000).

SOCIAL EQUITY, Reduction of POPULATION and Eradication of POVERTY: A Necessary Condition for SUSTAINABILITY in World:

SUSTAINABILITY refers not only to the NATURAL ENVIRONMENT but also to the SOCIAL ENVIRONMENT because both SOCIAL & ENVIRONMENTAL issues are necessarily 'inter-wined'. Some Societies have benefited most by the 'New Technological Development' and by the 'Unsustainable Use of Resources' while others have Suffered.

There is a nexus between 'POVERTY & POLLUTION', between 'POPULATION & POVERTY' and between 'POPULATION & POLLUTION'.

Nearly 930 million of People (CONSUMERS) are being added every year to the World demanding more of all useful RESOURCES, more FORESTLANDS to produce FOOD & FUELWOOD, and more LANDS to make HOMES & live. If this Consuming Population is 'affluent' it would further aggravate the problem of 'Unsustainability'. Hence, we must have a 'Sustainable Level' of 'Human Population' that the 'Global Ecosystems' can reasonably support.

GOOD HEALTH of SOCIETY: A NECESSARY CONDITION for HUMAN SUSTAINABILITY in WORLD

There can be no SUSTAINABLE DEVELOPMENT in World without ensuring for the basic HEALTH SERVICES for PROTECTION of HUMAN HEALTH of all in the Society. The World Health Organization (WHO) reports that 25 % of all 'Preventable Diseases' in human beings are greatly caused due to ENVIRONMENTAL DESTRUCTIONS. Modern HEALTH HAZARDS, caused by the 'Developmental Activities' that lacks 'Environmental Protection & Safeguards', to URBAN AIR & WATER POLLUTION, exposure to AGROCHEMICALS, INDUSTRIAL CHEMICALS and TOXIC WASTES is becoming common all over the World. 'Communicable Diseases', especially HIV / AIDS, CHOLERA, TUBERCULOSIS, MALARIA, and other 'Water Borne Diseases' are posing 'Serious Obstacles' in promoting SUSTAINABLE DEVELOPMENT in many Nations of World. According to the reports of World Health Organization (WHO) in 1997, it is estimated that in this MODERN TECHNOLOGICAL WORLD 3 million People DIE every year due to 'Water Borne Diseases' or from use of 'UNSAFE WATER'. More than 1 billion people globally breathe 'UNHEALTHY AIR', and 3 million people also DIE each year from 'AIR POLLUTION'- two thirds of them are POOR people, mostly WOMEN & CHILDREN. Two million people DIE every year especially in the DEVELOPING & POOR NATIONS as a result of 'Slow Exposure' to INDOOR POLLUTION caused by 'Burning' of WOOD and DUNG CAKES for Cooking & Heating Homes during the WINTER Seasons. Around 90 % of MALARIA cases in the World are caused due to Environmental factors like 'Piling of WASTES' and 'Poor SANITARY Conditions' especially in the Villages of Poor Developing Nations.

The ECONOMIC PERSPECTIVES for 'SUSTAINABLE DEVELOPMENT' & the Responsibilities of the Govt. & Society

Conventional ECONOMISTS and the Ignorant POLITICIANS in the Governments of Nations are not bothering to deduct the COST of 'ENVIRONMENTAL DESTRUCTIONS' (e.g. Creations of WASTES & POLLUTION and their 'Health Impacts', Loss of FORESTS & Important SPECIES of Plants & Animals, Degradation of LANDS & SOILS on Earth etc.) by the Society and the COST of 'ENVIRONMENTAL REPAIR & RESTORATION' (e.g. 'AFFORESTATION', 'WASTE MANAGEMENT' & 'POLLUTION CONTROL', 'SOIL REGENERATION' and 'WASTELANDS MANAGERMENTS', 'WASTEWATER RECYCLING & TREATMENT for 'REUSE' of the CLEAN WATER etc.) from the GNP (Gross National Product) or the rate of ECONOMIC GROWTH of the Nation .

The new Economic Theory is 'ENVIRONMENTAL ECONOMICS' which advocates for 'Judicious Balance' between 'ECONOMY & ECOLOGY' and amalgamation of 'ECONOMIC DEVELOPMENT' programs with 'ECOLOGICAL CONSERVATION' strategies to usher in the era of SUSTAINABLE DEVELOPMENT. The 'New Economic Philosophy' of 'SUSTAINABLE DEVELOPMENT' are also stressing the Govt. of Nations in World to switch over from the 'FOSSIL FUEL' (Coal & Petroleum) based 'ECONOMY' to the 'RENEWABLE & CLEAN ENERGY' (Solar & Wind Power & Hydrogen Fuel) based ECONOMY'.

Global Economists & Planners have to understand that every NATURAL RESOURCE, COMMODITY, GOODS & SERVICES that we use from the World has an 'ENVIRONMENTAL COST' which are the 'Hidden Cost' of ENVIRONMENTAL DAMAGES & REPAIR when the 'RAW MATERIALS' are procured from the Valuable 'RESOURCES' of Earth other than its 'ECONOMIC COST' (the Cost of 'Processing', 'Manufacturing' and 'Trading' of Materials) and only after 'Adding the Two Costs', we will arrive at the 'True Cost' of the Product produced. There may also be 'SOCIAL COST' as well in the form of 'Impaired Human Health' and 'Quality of Life' of the Workers.

ENVIRONMENTAL DAMAGES can occur at both ends of the Cycle – the 'PRODUCTION Cycle' as well as at the 'CONSUMPTION Cycle'. In the 'PRODUCTION Cycle' Environmental Damage is caused by way of DEFORESTATION, EARTH CUTTING, SOIL EROSION & POLLUTION etc. to obtain the 'Raw Materials' by MINING the Earth and process it in the INDUSTRIES, while in the 'CONSUMPTION Cycle', the damage is caused because of generation of huge 'WASTES' once the PRODUCTS are 'Consumed' and 'Discarded' after use by the Society. FOSSIL FUELS, NUCLEAR FUELS, Several METALS, PAPERS & PLASTICS and even the procurement of 'HUMAN FOODS' and 'DRINKING WATER' from the Nature causes great 'Environmental Damages' at both ends of the Cycle.

We only PAY for the 'Economic Cost' of the WATER (Cost of Harnessing and Supply) when we use it in our Homes & Institutions. We do not PAY for the 'Treatment' of the WASTEWATER when we have used it and converted into SEWAGE. We only PAY for the Cost of FOODS grown in FARMS and for its 'Processing and Transport' to the Food Shops & Markets. We never PAY for the damages done to the Environment due to 'Production and Use' of CHEMICAL FERTILIZERS & PESTICIDES. We only PAY for the ELECTRICITY we consume, but not for the 'Environmental Damages' that occurs in the Installation & Operation of 'COAL POWER' or 'NUCLEAR POWER' PLANTS and in the Construction of 'HUGE DAMS' for the production of HYDRO-POWER.

The POLITICAL PERSPECTIVES for SUSTAINABLE DEVELOPMENT & the Responsibilities of the Politicians in the Governments of Nations

'GREENING of Global POLITICS' & 'Educating the POLITICIANS' in World about the 'Protection of ENVIRONMENT' (PROTECT or PERISH) is an urgent requirement today and it must be incorporated in the National and International Agendas of every Nation in the World for 'Appropriate Planning' and 'Decisions Making' on the vital issues of 'SUSTAINABLE DEVELOPMENT' for 'ENVIRONMENTAL PROTECTION'.

At the 'Rio Earth Summit' in Brazil in 1992, the 'arrogant statement' of the then U.S. President George Bush exposed the 'Political Immaturity' of a Head of State of a Great Nation like USA in planning for SUSTAINABLE DEVELOPMENT for the Safety of the Society. He that- 'Conventions Like these are Not going to Compel the U.S. Citizens to give up their Current Life-Styles'. This was a highly 'Disappointing' statement for all participants & then the whole World after it came in the News. U.S. is a great Nation of 'Brilliant People' in World. How a 'Politician' spoke like this.

Wrong POLITICAL DECISIONS taken in some Nations especially in Asia and Africa for 'RAPID RESOURCE EXPLOITATION' for their 'ECONOMIC GAINS' such as for Construction of 'HUGE DAMS' for HYDRO-POWER Generation, Clearing of 'TROPICAL FOREST' for 'Fodder Plantations' and 'Export Earnings', 'Installation of NUCLEAR POWER PLANTS and Dumping of 'NUCLEAR & TOXIC WASTES' has adversely affected the Environment of those Nations.

ENVIRONMENTAL POLICY Decisions would also require imposition of some new 'ENVIRONMENTAL TAXES' like 'Pollution Tax', 'Waste Tax', 'Tree Tax' and 'Logging Tax' etc. and reduction in the regular INCOME TAXES. It also will require to ENHANCE the PRICES of 'Environmental GOODS & SERVICES' (such as WATER & ENERGY Resources) in order to force the Society for their 'Judicious Use' and 'Consumption' in daily life. ECONOMIC INCENTIVES & BENEFITS must be given to the 'RECYCLING INDUSTRIES' in World and to those who are 'SAVING WATER & ENERGY' in 'Industrial Operations' by way of 'Reduction in TAXATION' and 'Reduced Cost' of inputs (RAW MATERIALS, WATER & ELECTRICITY).

16.3 Conclusions & Remarks:

The goals of 'SUSTAINABLE DEVELOPMENT' cannot be achieved unless we have a 'New World Order' with 'EQUITY' at all levels- SOCIAL, ECONOMIC, POLITICAL & CULTURAL. Till the evils of 'POVERTY & HUNGER', 'INEQUITIES and 'DEFICIENCIES' exist in any part of the World, there can be 'NO SUSTAINABILITY' in any Developmental Programs. 'SOCIAL & ECONOMIC EQUITY' is a necessary condition for SUSTAINABLE DEVELOPMENT in World. If the 'Rich get Richer' and the 'Poor becomes Poorer' or 'More in Numbers', that 'Developmental Activities' will never be 'Sustainable' at any time. If Developmental Activities 'Discriminates' against the WOMEN & CHILDREN, of World that Developmental Programs will also not be SUSTAINABLE.

More 'GREEN TECHNOLOGIES' Using 'Less ENERGY & WATER Resources' & Emitting 'No or Low POLLUTANTS & GREENHOUSE GASES' have to be promoted on massive scale for SUSTAINABLE DEVELOPMENT in whole World. ENVIRONMENTAL TECHNOLOGIES have to find solutions for both 'PREVENTIVE' as well as 'CURATIVE' actions for the 'ENVIRONMENTAL DESTRUCTIONS'. It has to Protect the Vital 'LIFE SUPPORT SYSTEMS' of the Planet Earth – the 'AIR', 'WATER', 'SOIL' and the 'BIOLOGICAL ECOSYSTEMS' (Containing Beneficial Plants, Animals & Microbes). It has also to 'Sustainably Manage' all the 'HUMAN WASTES' (both 'Domestic & Industrial) generated by the Society.

It must promise to deliver 'Clean AIR', 'Safe Chemical-free FOODS', 'Clean & Safe Drinking WATER & 'Non-Polluting ENERGY Resources with Zero Emission of GHGs'. It must also assure for 'SUSTAINABLE Dwelling' and providing 'Zero-Emission' 'Sustainable TRANSPORT SYSTEMS' for the Civilization. More 'Appropriate and Sustainable' GREEN TECHNOLOGIES need to be developed in future for 'ENVIRONMENTAL PROTECTION' and for 'Conservation', 'Restoration' and 'Repair' in the 'Priority Areas' of HUMAN DEVELOPMENT to achieve 'Complete Sustainability' for the Human Society.

Opinion Polls made on the eve of 'Johannesburg Summit' in 2002, clearly show that people Worldwide want the INDUSTRIES & COMPANIES in both 'Private and Public Sectors' to bear the responsibility of 'Environmental Destruction' and 'Act Honestly' with 'Greater Responsibility' towards the 'REPAIR & RESTORATION' of the ENVIRONMENT for their SAFE Living in World. Seeing the behaviour of the BIG COMPANIES and CORPORATE SECTORS in World, there is 'Urgent Need' to make them more 'RESPONSIBLE & ACCOUNTABLE' for 'Environmental Destruction'. It has captured 'Public Attention' and 'Interest' all over the World for discussions with them about 'ENVIRONMENTAL PROTECTION' & 'SUSTAINABLE DEVELOPMENT'.

Among the 'PETROCHEMICAL' & 'AGROCHEMICAL' INDUSTRIES of World, one has deliberately 'Thwarted' the Development of 'HYDROGEN FUEL Technology' and the other has been 'Conspiring' against the development of 'Safe & Sustainable Alternatives' to the 'DEADLY AGROCHEMICALS' by promoting 'ORGANIC FARMING' in World using 'ORGANIC FERTILIZERS' especially the 'EARTHWORMS VERMICOMPOST' (Discussed above). This they have been doing for their own 'Vested Interest' to make 'ECONOMIC GAINS' even if the Agrochemicals were 'Harming' the Farmers – the 'FEEDERS of Nations' in World.

According to UNEP, the then Prince of 'Saudi Arabia', the Nation which produced huge 'PETROCHEMICALS' in World, finally realized about the 'DISASTROUS IMPACTS' of the 'Petrochemicals' and requested U.S.A. to give them the Technology for development of 'HYDROGEN FUEL' in the interest of Humanity. Earlier the U.S. FARMERS who started practicing 'VERMICULTURE' in AGRICULTURE by removing the use of 'AGROCHEMICALS' had also to face problems with the Agrochemical Industries. Similarly, we also faced some problems in India, while 'Educating the Farmers' about the use of EARTHWORMS VERMICOMPOST in FARMING. Agents of 'AGROCHEMICAL INDUSTRIES' operate in every Country 'Misleading' the FARMERS about adverse effects of EARTHWORMS on the Farm Soils. Now many Indian & also the Australian & U.S. Farmers (after hearing the Lectures of Prof. Rajiv Sinha in Conferences) have realised the value of the 'EARTHWORMS & VERMICOMPOST' in Farming, whom the great Scientist of World Sir Charles Darwin had called 'Friends of Farmers' for giving 'HIGH PRODUCTIVITY' of 'Health Protective ORGANIC FOODS'.

Earlier 'ECOLOGY' was sacrificed at the altar of 'ECONOMY'. It was an incentive to 'GAIN more' from all 'Developmental Programs' even it 'POLLUTED' the Environment. 'SUSTAINABILITY' for all was Compromised with 'PROSPERITY' for a few in World (WB, 2004).

‘POLLUTER-PAY-PRINCIPLE’ has to be enforced in the matters of ‘WATER & ENERGY’ Pricing and in the matters of ‘WASTE Generation’ by Society. There has to be a ‘WASTE & POLLUTION TAX’ added up with the CONSUMER PRODUCTS, WATER and the AUTO FUEL at the source. Governments of Nations must develop ‘Rules & Regulations’ for the INDUSTRIES to ‘Produce and Manufacture’ ‘DURABLE GOODS’ and not the ‘DISPOSABLE’ ones.

All ‘Planning and Policies’ for Development of appropriate ‘ENVIRONMENTAL TECHNOLOGIES’ for SUSTAINABLE DEVELOPMENT have to be ‘ECONOMICALLY VIABLE’ and also ‘SOCIALLY ACCEPTABLE’. All ‘POLITICIANS and Decision Makers’ in World have to be EDUCATED about the benefits of ‘Sustainable Development’ technologies. They have also to be Educated about the ‘Hidden Cost’ of a particular ‘Developmental Activity’ and their ‘Product’ such as the ‘FOSSIL FUELS’ and ‘PLASTIC BAGS’ which are apparently ‘Cheap’ at its face value, but are proving ‘Very Costly’ in terms of ‘Environmental Protection’ for ‘Human Sustainability. The Convenient but ‘Non-biodegradable’ PLASTIC BAGS used in the Groceries, cause great HEALTH HAZARD during ‘Manufacture’ and also during their ‘Recycling’. They must be ‘BANNED’ all over the World.

FINAL WORDS SUSTAINABILITY in Human Society with ‘Good Quality’ of Life for all in World Can be achieved in Two Ways

- a. By Inspiring & Persuading the people to ‘Behave ETHICALLY’ towards ENVIRONMENT, ‘Reduce CONSUMPTION’, and have a ‘Simpler Life-Style’;
- b. By Embracing the Philosophy of ‘SUSTAINABLE DEVELOPMENT’ with appropriate TECHNOLOGIES that allow people to enjoy the same ‘Good Quality of Life’ with ‘High Standard of Living’, but at a significantly lower ‘Environmental Cost’. (Schumacher, 1973).

A SUSTAINABLE FUTURE for the Global ‘Human Society’ will be Determined-

- a. Not by the Megawatt of ENERGY which will be produced, but by the fact that ‘How they will be Produced’ and from ‘What Sources’.
- b. Not by the QUANTITY of FOODS that will be Produced, but also by the QUALITY of the Foods (Nutritive Values) and that how they were Produced – Organically or Chemically?
- c. By how soon we get rid of those DEVELOPMENTAL MATERIALS & TECHNOLOGIES whose Production, Application and Utilization entails heavy Environmental Damage from the beginning to the end of the Production Cycle.
- d. By how soon we are able to ‘REDUCE’ all those ‘HUMAN WASTES’ successfully & ‘RECYCLE’ some of them into Valuable RESOURCES.
- e. By how soon we are able to develop SAFE & BENIGN alternatives to those thousands of ‘TOXIC CHEMICALS’ used in various DEVELOPMENTAL Activities.
- f. By how soon we are able to Commercialize the ‘HYDROGEN FUEL TECHNOLOGY’ for our AUTOMOBILES & all other RENEWABLE ENERGIES like SOLAR & WIND Powers for ELECTRICITY generation.

- g. By how soon we Switch over completely to 'ORGANIC FARMING' to produce 'CHEMICAL-FREE' & 'Health Protective' ORGANIC FOODS for the Civilization.
- h. By how soon we are able to arrest the dangerously growing menace of SOIL EROSION, BIODIVERSITY EROSION, DESERTIFICATION and LAND DEGRADATION.
- i. By how soon we are able to arrest the exploding 'HUMAN POPULATION' (CONSUMERS on Earth) and the 'Culture of CONSUMERISM'
- j. By how soon we Learn to live a 'SUSTAINABLE LIFE-STYLE' by Embracing the Philosophy of 5 P's (Judicious use of PAPER, PETROL, POWER, POTABLE WATER & PLASTICS) and 5 R's (Refuse, Reduce, Reuse, Recycle & Responsibility about Waste) in daily life.

(Seymour & Girardet, 1987; Milbrath, 1989)

SCIENCE & TECHNOLOGY has provided 'Environmentally Sound' alternatives for promoting 'SUSTAINABLE DEVELOPMENT' in many cases but there is a Sad Lack of necessary 'POLITICAL WILL' to implement it because there is fear of resistance from the mighty 'Industrial Lobby' and their 'Political Friends' who want to continue with the 'Obsolete' and 'Destructive' Technologies for their own 'POLITICAL & ECONOMIC GAINS'. It is highly disappointing that 'Man Stepped on MOON in 1969 by using 'Hydrogen Fuel' in the Rocket but have Not been able to COMMERCIALIZE the use of HYDROGEN FUEL as a 'Viable & Sustainable' Alternative to the 'Destructive Petroleum Oil' for their Use in Global AUTOMOBILES'.

According to Norman Myers (1994) in 1984 Sir Gerald Durrell had said - 'At the Present rate of Development & Progress, Unless Something is done QUICKLY, ENVIRONMENTAL DISASTERS Stares Us in our Face. SOIL EROSION, DESERTIFICATION & POLLUTION have become a LOT. It is a weird form of SUICIDE, for we are BLEEDING our PLANET EARTH to DEATH. We are led by 'SABRERATTLING POLITICIANS' Who are IGNORANT of BIOLOGY, beset by SECTARIAN GROUPS noted for their 'NARROW-MINDNESS' and 'INTOLERANCE', surrounded by POWERFUL People of COMMERCIAL INTERESTS whose only interest in NATURE is often to Gain Something from it'.

There is sufficient Scientific Evidence to indicate that the World is going on the WRONG PATH of DEVELOPMENT. It is leading to ECONOMIC, ECOLOGICAL, SOCIAL & POLITICAL DETERIORATION and the worst 'MORAL DEGRADATION' in the name of 'DEVELOPMENT of Human Society'. It has given birth to 'Violent Societies', 'Violence' against both MAN and NATURE.

There are more ACCIDENTS, CRIME, DELINQUENCY, DRUGS, ALCOHOLISM & DEADLY DISEASES than ever before. Mankind will PERISH if the PROTECTION of the ENVIRONMENT does not become an 'Integral Part' of all TECHNOLOGICAL DEVELOPMENT, PLANNING & MANAGEMENT. We must seek lessons from History. The 'Flourishing Civilizations' of the past perished not at the hands of any 'Cruel Enemy', but due to 'Human's Own Activities' such as 'Clearing of FORESTS', 'Overuse of SOIL' and 'Lack of Awareness' for DEVELOPMENT compatible with the ENVIRONMENT (Meadows et. al.,1992).

Making ECONOMIC DEVELOPMENT Programs less dependent upon the 'FOSSIL FUELS' and more dependent on 'RENEWABLE ENERGY' resources, 'Less ENERGY & MATERIAL Intensive' and more 'Equitable' in its SOCIAL & ECONOMIC impacts on Global Level is the need of the hour. A 'SUSTAINABLE HYDROGEN FUEL ECONOMY' in place of 'FOSSIL FUEL ECONOMY' must be established if an 'Environmentally and Economically Sustainable' World is to be left to our Children and Grandchildren in Future.

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