

## **12. 'GLOBAL WARMING & CLIMATE CHANGE' -The DISASTROUS Problems of ENVIRONMENTAL DESTRUCTIONS Caused by the Emission of GREENHOUSE GASES from all DEVELOPMENTAL Activities in World: Actions to be Taken by the Govt. & Society of Nations for Their MITIGATION & SAFE Living in World**

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### **Abstract:**

*GLOBAL WARMING & CLIMATE CHANGE in World is being induced due to high Emission of 'Greenhouse Gases' (Carbon Dioxide, Methane & Nitrous Oxides) from 'COAL Power Plants' (20 %), 'PETROLEUM Automobiles' (30 %), 'WASTE LANDFILLS' (23 %) & Modern CHEMICAL Agriculture (33.3%). Rest is emitted from the 'WASTEWATER Treatment Plants', 'Water DAMS',*

*'MINING & Extraction of METAL ORES' from Earth, 'DEFORESTATION' of Earth' & Operation of 'ELECTRONIC EQUIPMENTS'. It is a kind of FEEDBACK from the Earth's 'DETERIORATING Environmental Conditions' caused due to the 'WRONG DEVELOPMENTAL Activities' promoted by the Govt. of Nations. It is considered as an 'Apocalyptic Peril' Compared with the 'Weapons of Mass Destruction'.*

*Some 16 million Tons of Greenhouse Gases (GHGs) are emitted every 24 hours from all the 'Developmental & Human Activities' in World. The Global average 'SURFACE TEMPERATURE' has increased over the 100 years period from 1906 to 2005 by about 0.74 ° C. It has risen more in the lowest 8 km of the Atmosphere in the last 4 decades. The Temperature of the Earth is gradually 'rising' by 0.3° C every decade. They will have Serious Consequences for the Human HEALTH & Security, Livelihoods, and FOODS & WATER Supply. They are also causing several NATURAL DISASTERS like 'Oceanic Swells', 'Cyclones', 'Tornados', 'Hurricanes' & 'Storms' which are increasing in 'Frequency & Magnitude' all over the World. It will also affect the Human 'IMMUNE SYSTEM' increasing the HUMAN DISEASES in World.*

*The 'UNITED NATION CONVENTION' on 'Mitigating CLIMATE CHANGE' was signed by more than 150 Nations in the World at the 'Rio Earth Summit' in 'RIO de JANEIRO' on 5<sup>th</sup> June 1992 which is observed as the 'World Environment Day'. All Nations in the World have to set some Targets for reducing CARBON Emissions to 'NET ZERO' & reaching 'CARBON NEUTRALITY' through all their 'DEVELOPMENTAL PROGRAMS'. The Brilliant Scientists of 'CLIMATE COUNCIL' of Australia are working hard to totally remove the Emissions of 'Greenhouse Gases' (GHGs) from the World. According to them the Target for REDUCTION of GHGs EMISSIONS must be 75 % by 2030 & 100 % by 2035 for the Safe Living of Global Human Society.*

*To combat the 'GLOBAL WARMING & CLIMATE CHANGE' rapid 'DECARBONISATION' (Removal of CARBON DIOXIDE from the Atmosphere) of World is highly necessary. And this will be only possible by promoting the 'Low-Cost' 'RENEWABLE ENERGY' Systems (especially the SOLAR, WIND & HYDROGEN Powers) for 'Electricity Generation' all over the World by 100%.*

*Development of 'Zero-Emission' ELECTRIC & HYDROGEN FUEL Vehicles, Energy Efficient 'Electrical Appliances & Instruments', Vermicomposting of all ORGANIC WASTES by the EARTHWORMS & Use of VERMICOMPOST for ORGANIC FARMING will Divert Huge ORGANIC WASTES from the WASTE LANDFILLS & will also Produce 'CHEMICAL-FREE' ORGANIC FOODS' for the SAFETY of Society while Sequestering the Atmospheric CARBONS Back into the Soil.*

*VERMIFILTRATION of WASTEWATERS by the EARTHWORMS for their REUSE in 'Irrigation' Saving Huge Groundwater of Earth, BIOMINING of METAL ORES, and REFORESTRATION of Earth by TREES can also prevent Emission of huge Greenhouse Gases & also Sequester CARBONS of the Atmosphere into Trees.*

**Keywords:**

*Global Warming – An Invitation to Natural Disasters; Technologies for Net Zero-Emission of Greenhouse Gases; Replacing Fossil Fuels by Solar, Wind & Hydrogen Fuel; Replacing Agrochemicals by Organic Fertilizers; Replacing Petroleum Automobiles by Zero-Emission Electric & Hydrogen Vehicles; Production of 'Zero Emission Bio-Diesel' from Petro-Crops; Converting Human Wastes & Wastewaters into Valuable Resources by Earthworms; Development of Energy Efficient Electrical Appliances & Instruments; Reforestation & Development of Technologies for Sequestration of Atmospheric Carbon Back into the Plants; Biomining of Metal Ores With Low Emission of GHGs.*

**12.1 Introduction:**

GLOBAL WARMING & CLIMATE CHANGE induced due to Emission of 'Greenhouse Gases' (Carbon Dioxide, Methane & Nitrous Oxides) is an 'Apocalyptic Peril' Compared with 'Weapons of Mass Destruction'. Molecule to molecule 'Methane' is 22 times & 'Nitrous Oxide' is 312 times more powerful in absorbing SOLAR RADIATIONS than the 'Carbon Dioxide'. 'Global Warming & Climate Change' is a kind of FEEDBACK from the Earth's 'DETERIORATING ENVIRONMENTAL CONDITIONS' caused due to the

‘WRONG DEVELOPMENTAL Programs’ Promoted by the Govt. of Nations & the Unsustainable Activities of the Human Society. Some 16 million Tons of Greenhouse Gases (GHGs) are emitted every 24 hours & over 7 billion Tons of GHGs are being released every year into the Atmosphere from all the ‘Developmental & Human Activities’. (Anonymous (2022). Since 1992 (Rio Earth Summit), emissions of GREENHOUSE GASES have increased by 100 million tons a year. All Greenhouse Gases absorb intense ‘SOLAR RADIATIONS’ of Various Wavelengths WARMING up the ATMOSPHERE.

The Global average ‘SURFACE TEMPERATURE’ has increased over the 100 years period from 1906 to 2005 by about 0.74 °C. It has risen more in the lowest 8 km of the Atmosphere in the last 4 decades of the 20<sup>th</sup> Century. The Temperature of the Earth is gradually ‘rising’ by 0.3° C every decade. Reports of the ‘Intergovernmental Panel on Climate Change’ (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 (1/2<sup>0</sup>) a degree rise will have Serious Consequences for the ENVIRONMENT affecting the Human HEALTH, LIVELIHOODS, FOODS & WATER Supply, HUMAN Security & Infrastructure. While 2°C WARMING will be 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.

The Global CLIMATE Strike on 20<sup>th</sup> Sept. 2020 saw over 6 million people around the world PROTESTING for Immediate CLIMATE ACTION by the POLITICIANS of World. Over 30,000 Passionate people raised their voices and stood up in Brisbane also.

Greenhouse Gases are also emitted from the submerged ‘Rotting PLANTS & VEGETATIONS’ in the Water Reservoirs. Global Emissions of GREENHOUSE GASES has steadily increased in World in the last 32 years since the ‘RIO CONVENTION’ in 1992. All Greenhouse Gases absorb intense ‘SOLAR RADIATIONS’ of Various Wavelengths WARMING up the Global ATMOSPHERE. The World is already suffering from the DEVASTATING effects of ‘GLOBAL WARMING & CLIMATE CHANGE’ which are causing unprecedented FLOODS, BUSHFIRES with highly increased SIZE & INTENSITY and repeated CORAL BLEECHING all over the World.

## **12.2 GREENHOUSE GASES (GHGs) Inducing GLOBAL WARMING & CLIMATE CHANGE:**

### **A. CARBON DIOXIDE (CO<sub>2</sub>):**

It is considered to be the main Culprit Greenhouse Gas. It is being released into the atmosphere on massive scale every day (over 7 billion tons every year) through both Natural and Anthropogenic sources. Acc. to Isabelle Grant (2022), approximately one-third of all the global CO<sub>2</sub> emissions since 1850 have come from the loss of CARBON from the

'GREEN PLANTS' and the 'SOILS' in the Terrestrial Ecosystems of the Earth due to massive 'MOWING & TILLING' of the FARM SOILS by the Farmers to grow Crops. And most of the remainder CARBON has come from the use of FOSSIL FUELS in COAL

POWER Plants & PETROLEUM AUTOMOBILES which is estimated to be  $5,600 \times 10^6$  mt/year. Human beings also emit 'Carbon Dioxide' every day through RESPIRATION which are about 320 kg every year. DEFORESTATION, burning of 'Fuel-Woods' and the decay of 'Organic Matter' release one-third of CO<sub>2</sub> in World. (Houghton, 1990). CO<sub>2</sub> recorded to be 280 ppm by Volume in the 'Pre-Industrial' era (1750-1800) rose to 300 ppm in 1896. It now stands at 390 ppm. It is currently rising by 0.5 to 1 % every year.

#### **B. METHANE (CH<sub>4</sub>):**

It is emitted from the production & distribution of 'Natural Gas', 'Waste Landfills', 'Sewage Treatment Plants', 'Coal Mining', 'Rice Fields', 'Wetlands', all 'Ruminant Animals' & burning of 'Biomass'. It is 20-25 times more 'Powerful' than Carbon Dioxide in absorbing the 'Infrared Solar Radiation' & hence has more potential to induce 'Global Warming' even at 'low concentration'. However, Methane degrades rapidly in the atmosphere as compared to Carbon Dioxide.

#### **C. NITROUS OXIDE (N<sub>2</sub>O):**

It is emitted from 'Combustion Process', use of 'Chemical Fertilizers' & 'Deforestation'. It is also released by the Bacterial Actions from SOILS, especially in the Humid Tropics, by many 'Factories' & 'Power Stations' and also from the exhaust of VEHICLES.

It is roughly 300 times more 'Powerful & Effective' GHGs than the Carbon Dioxide & remains for longer time in the Atmosphere. Its concentrations would increase for more than 200 years even if the Emission rates were to freeze at the current levels.

NITROUS OXIDE & METHANE are particularly of great concern because they absorb Solar Radiations at Wavelengths between 700 & 1300 nm.

#### **D. CHLOROFLUOROCARBONS (CFCs):**

Although the CFCs (CFC-11 & CFC-12) are 'low' in the atmosphere, they are roughly 12,000 and 16,000 times more powerful 'INFRARED' absorber & 'HEAT' trapper than the CO<sub>2</sub>. They are 'longed lived' and are increasing in the Atmosphere. The decisions taken at 'Montreal Protocol' in Canada in 1989 to limit the production of CFCs will 'Slow' it, but cannot totally 'Eliminate'.

#### **E. SULFUR HEXAFLUORIDE:**

It is a Serious & Dangerous GHG that has 'Warming' potential 24,000 times greater than CO<sub>2</sub>. It has now been replaced by the Environmentally 'Benign' Chemical HYDROFLUOROCARBON.

### **12.3 Some Main Sources of Emission of High GREENHOUSE GASES in World:**

#### **A. COAL POWER PLANTS:**

They emit about 20 % of total GHGs worldwide. Every Kilowatt (kW) of ELECTRICITY Produced from the COAL Power Plants emits Several Kg of GREENHOUSE GASES (GHGs) & POLLUTANTS. Studies indicate that about 800-1000 gm of CO<sub>2</sub> are generated for every Unit (kWh) of ELECTRICITY produced.

#### **B. PETROLEUM AUTOMOBILES:**

The AUTOMOBILES alone emit more than 700 million Tons of CARBON every year in various 'Gaseous Forms' which includes all the 3 GHGs CARBON DIOXIDE (CO<sub>2</sub>), METHANE (CH<sub>4</sub>) & NITROUS OXIDE (N<sub>2</sub>O). They account for about one-fifth of total GHG emissions worldwide & close to 30 %. About 4.3 tons of GHGs are emitted every year by an average Petroleum CAR. Petroleum Automobiles emits much more POLLUTANTS & GREENHOUSE GASES than the COAL POWER PLANTS. They are responsible for inducing over half the problems of 'GLOBAL WARMING & CLIMATE CHANGE' leading to the growing 'CLIMATE CRISIS' in the World. Australia's per capita CO<sub>2</sub> emission from Automobiles is HIGHEST in World. (Sinha, Rajiv K. 1993).

#### **C. MODERN CHEMICAL AGRICULTURE:**

They emit about 33.3 % of GHGs from the Production & Use of AGROCHEMICALS & due to Aggressive SOIL TILLINGS. Australia emits over 500 million tons of 'Carbon Dioxide' from Agriculture Farms every year. Acc. to Australian Greenhouse Office, Australia has 473 million Hectares (mha) of Farmlands & emitted 537 million Tons of CO<sub>2</sub> in 2009.

#### **D. WASTE LANDFILLS & WASTE DUMPING GROUNDS:**

They generate more POWERFUL GHGs than the Carbon Dioxide. It is mainly due to the disposal of ORGANIC WASTES (Foods & all Green Wastes). Our Studies at Griffith University, Brisbane indicated that about 78,000 tons of FOOD WASTES are disposed in the LANDFILLS in Brisbane every year. UNO-HABITAT reported in 2009 that the WASTE LANDFILLS emit huge amount of GHGs (3640 mg CO<sub>2</sub>-e /m<sup>2</sup>/hour). This must be same from the 'WASTES DUMPED' on the Open Lands in many Developing Nations including India. Acc. to Australian Greenhouse Office (2007) in 2005, Waste Landfills in Australia emitted some 17 million tons CO<sub>2</sub>-e (Equivalent) of GHGs. Waste Landfills & the Waste Dumping Grounds in World continue to be the Second largest source of emission of GHG METHANE which accounted for 23 % in 2007.

(N.B. If the ORGANIC WASTES are simply DUMPED on the Open Lands as in India & in many DEVELOPING Nations, they emit more Greenhouse Gases than that from the Technologically Developed WASTE LANDFILLS in which the Wastes are Mechanically Disposed, Crushed & Covered by SOILS).

### **E. Conventional WASTEWATER TREATMENT Plants:**

All Conventional 'Wastewater Treatment Plants' use Toxic Chemicals & huge ELECTRICITY (emitting Greenhouse Gas CARBON DIOXIDE) for 'AERATION & CHURNING' of Wastewater. They also emit Powerful GHGs 'METHANE & NITROUS OXIDES' due to the Microbial Degradation of Organic Matters in the Wastewater.

### **F. MINING & EXTRACTION of METALLIC ORES from Earth:**

According to IEA (International Energy Agency) there are some Fifty (50) 'CRITICAL METALLIC MINERALS' used in all 'Developmental Programs' in World. Their 'Mining & Extraction' from the Earth as their METALLIC ORES & 'Processing' & 'Production' of METALS from them also entails severe emissions of huge 'GREENHOUSE GASES'. Traditional 'STEEL MAKING' process generate around 7 % of the global 'Greenhouse Gas Emissions'. China produces & uses more than half of the World's IRON & STEELS. Most of the Iron ORES are supplied by Australia. China's Steel Industries are responsible for about 4 % of the total Global emissions of GHGs.

### **G. DEFORESTATION & Removal of TREES from EARTH:**

FORESTS Cover large areas of Earth by GREEN TREES which Protects the Environment & Society by absorbing the 'CARBON DIOXIDE' (CO<sub>2</sub>) from the Atmosphere by the Biomechanism of PHOTOSYNTHESIS occurring in the 'Green Leaves' in the SUNLIGHT & releasing 'OXYGEN' (O<sub>2</sub>) back into the Atmosphere, essential for breathing & survival of life on Earth. Due to the highly growing POPULATIONS in World large areas of FORESTS are being removed from the Earth to use the DEFORESTED Lands for Development of HUMAN HABITATS & also Agriculture FARMS for 'Residing & Feeding' People. Dismantled TREES with their Green LEAVES also emit huge 'Carbon Dioxide' as they DRY.

### **H. STAGNANT WATERS in WATER DAMS:**

Water Dams are constructed on the RIVERS & CANALS with high FLOWING WATER to produce 'Zero-Emission' 'HYDRO-ELECTRICITY'. They are mostly located in the FORESTED areas of World. But the STAGNANT Water in 'DAMS' also generate GHGs 'Carbon Dioxide & Methane'. This is due to the 'DECAY' of the 'Organic Matters' in the LEAVES & BRANCHES of the Forest TREES when they break during the DAM Construction or due to the high WIND Velocities along the Rivers & Canals & fell in the Stagnant Water of the DAM.

### **I. Modern ELECTRONIC EQUIPMENTS:**

Electronic Equipment are being developed all over the World in modern times to rapidly promote several 'Developmental Activities', give 'Knowledge' to the People & also Communicate with Society. They Generate up to 150 kg of GHG per year when in 'STANDBY' mode & more when in Operation.

#### **12.4 Scientific PREDICTIONS on the Devastating Impacts of GLOBAL WARMING, CLIMATE CHANGES and EXTREME WEATHER Conditions on the ENVIRONMENT & HEALTH of People:**

A. Increase in the 'Intensity and Frequency' of NATURAL DISASTERS (Oceanic Swells, Cyclones, Tornados, Tropical Storms & Hurricanes). They are increasing in frequency & magnitude in World & returning with 'Greater Force' Damaging Life & Properties. Perhaps the most 'Uncertain and Frightening' Environmental consequences are the changing of 'Ocean Circulation Patterns'.

B. Melting of 'POLAR ICE CAPS' & Rise of 'SEA LEVELS' Submerging many Coastal Habitats in World;

C. Impairment of 'Human IMMUNE SYSTEM' & Increase in HUMAN DISEASES; Recent report informed that CLIMATE CHANGE is also affecting Good SLEEP of People & causing SLEEPLESSNES in some 10 % people in Australia.

D. High increase in the TEMPERATURES of LANDS & OCEANS. The Global average 'SURFACE TEMPERATURE' has increased over the 100 years (1906-2005) by about 0.74 °C. The Temperature of the Earth is gradually 'rising' by 0.3° 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 20<sup>th</sup> Century in the lowest 8 km of the Atmosphere. Reports of the 'Intergovernmental Panel on Climate Change' (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 (1/2<sup>0</sup>) a degree rise will have Serious Consequences for HEALTH, LIVELIHOODS, FOOD & WATER SUPPLY, HUMAN SECURITY, INFRASTRUCTURE & the ENVIRONMENT. While 2°C WARMING will be DEVASTATING for the Global Human Society.

E. Increase in 'RAINFALL & FLOODING' in One Region of Earth & Severe DROUGHT in Other. Heavy Rainfall and Extreme Weather conditions are badly affecting Human HEALTH and that of Plants & Animals on which we rely. They are also affecting the ROADS & the TRANSPORT Systems.

F. They are also affecting the Global AGRICULTURE, degrading the FARM SOILS, reducing the growth of Food CROPS & also the WATER for Irrigation.

G. At least 19 ECOSYSTEMS in Australia have shown signs of COLLAPSE or NEAR COLLAPSE. It must be in THOUSANDS all over the World. They are also destroying the INDIGENOUS PLACES in Australia & all over the World.

H. Destruction of 'WILD PLANTS & ANIMALS', 'CROP Failures', increase in 'PESTS & DISEASES' in CROPS & Loss of 'FERTILE FARMLANDS' leading to Hunger & Starvations in World. About 1,385 PLANT SPECIES and 533 ANIMAL SPECIES were

listed as 'Threatened' under the EPBC Act of Australia. This also included 21% of all Australian Mammals. It also threatens to destroy most of the World's CORAL REEFS (Breeding Places of FISHES).

### **12.5 SOCIAL & ECONOMIC Consequences of 'Global Warming & Climate Change':**

It 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.

Studies at the 'World Health Organization' (WHO) on the 'HEALTH IMPACTS' of 'Global Warming & Climate Change' have indicated that 'Prolonged Periods' of very 'HOT & HUMID' Weather Conditions due to 'Global Warming' can lead to a 'Depression' of the 'Human IMMUNE SYSTEM' and in the 'Response' of Human Beings (WHO, 1998). Diseases like 'Diarrhea', 'Dysentery', 'Measles', 'Dengue Fever' & 'Encephalitis' may also develop. Prolonged COLD & WET AIR can cause worsening of chronic RESPIRATORY DISEASES such as 'Tuberculosis', 'Whooping Cough', 'Asthma' & 'Bronchitis'. Recent researches have also indicated that it can also affect the 'MENTAL HEALTH' of the Society.

Global Emissions of GREENHOUSE GASES has steadily increased in World in the last thirty (30) years since the 'RIO CONVENTION' in 1992. The World is already suffering from the DEVASTATING effects of 'GLOBAL WARMING & CLIMATE CHANGE' causing the 'Unprecedented FLOODS all over the World; BUSHFIRES with highly increased SIZE & INTENSITY; and repeated CORAL BLEECHING. It is trashing the hopes of preserving the 'GREAT BARRIER REEF' in Australia which is highly attractive place for the National & International VISITORS from all over the World.

### **12.6 Responsibilities of Global Human Society to Combat the 'GLOBAL WARMING' & 'CLIMATE CRISIS' for SAFE LIVING in World:**

People can also reduce POLLUTION & Emission of 'GREENHOUSE GASES' in their Day-to-Day Activities to Combat the 'GLOBAL WARMING' & 'CLIMATE CRISIS' in World. They must take these ACTIONS in their Daily Life.

- A. AVOID using AIR-CONDITIONERS unless extremely necessary. Use Ceiling and Pedestal FANS. They generate less than 1 kg of Greenhouse Gas (GHG) every 10 hours. Air-conditioners generate more than 12 times this amount of GHGs in same time;
- B. Care to 'Switch Off' all LIGHTS & FANS when you are leaving the room even for a short while. Switch off all 'ELECTRONIC EQUIPMENTS' from wall. This can reduce Pollution and millions of tons of Greenhouse Gases over lifetime;
- C. AVOID using LIFTS for at least going 'One Floor Up' or 'Two Floors Down' unless necessary or carrying loads. This can SAVE HUGE ENERGY and reduce GHGs over lifetime;



- D. AVOID Cutting TREES & Branches with GREEN LEAVES if not very essential.
- E. VERMICOMPOST all FOOD & GREEN WASTES at home & divert them from their disposal in the WASTE LANDFILLS. Every 1 kg of 'Food & Green Wastes' diverted from Waste Landfills prevents 1 kg of 'Greenhouse Gas' emissions equivalent to CO<sub>2</sub>. As mentioned above, in 2005 Waste Landfills in Australia emitted some 17 million tons CO<sub>2</sub>-e (equivalent) of 'Greenhouse Gases' equivalent to the emissions from 4 million Petroleum CARS. This must be happening all over the World.

### **12.7 TARGETS of Nations for Reducing CARBON Emissions to 'NET ZERO' in World:**

All Nations in the World have set some Targets for reducing CARBON Emissions to 'NET ZERO' & reaching 'CARBON NEUTRALITY' through all their 'DEVELOPMENTAL PROGRAMS'. According to Dr. Ross Garnaut, the Arithmetic of 'ATMOSPHERIC PHYSICS' requires all Developed Nations of World to reach the NET-ZERO target by as early as 2045 for the SAFETY of Society.

Only a few DEVELOPED Nations, along with GERMANY and other EUROPEAN Nations have yet committed to achieve that goal by 2045. That would also inspire & compel most DEVELOPING Nations of World who are planning for NET-ZERO Emission by 2060 to reduce it to 2045. China & Russia has kept 2050. (Garnaut, 2022).

It is highly DISAPPOINTING that the Indian Govt. has kept the Target for 'Net Zero Emission' by 2070 which will be very 'HARMFUL' & 'DISASTROUS' for the Indian Society.

All Brilliant Members & Environmental Scientists of 'CLIMATE COUNCIL' of Australia namely Prof. Will Steffen; Prof. Lesley Hughes; Dr. Amanda McKenzie, Dr. Tim Flannery; Dr Martin Rice; Dr. Paul Sinclair; Dr. Basha Stasak; Dr. Kelly O'Shanassy; Dr. Gavan McFadzean; Dr. Emily Kain; Dr. Isabella Morand; Dr. Christian Slattery; Dr. Hilary Bambrick; and Dr. Alix Pearce are working hard & inspiring the Governments in AUSTRALIA & all over the WORLD to keep the Target of 75 % REDUCTION of GHGs EMISSIONS by 2030 & 100 % by 2035.

Hope the Australian Govt. would accept the Views of the brilliant members of CLIMATE COUNCIL of Australia & work to reach the NET-ZERO emissions target by 2035 for the SAFETY of Australian Society. We also believe that it must be 100 % by 2035 or at the most by 2040 for all DEVELOPED & DEVELOPING Countries in the World including China, Russia & India.

In the meetings of Prime Ministers & Foreign Ministers (in May, June & July 2022) with the Heads of the Govt. of JAPAN, INDIA, UNITED STATES & INDONESIA, and at the Heads of the Govt. Meeting of NATO in EUROPE and at the G20 meeting in INDONESIA & the SOUTH PACIFIC FORUM, and in the Foreign Minister's multiple Visits to Countries in the SOUTH PACIFIC, it was declared that Global Failure in holding the TEMPERATURE increases to around 1.5<sup>0</sup>C would DESTABILIZE the INDO-PACIFIC Neighbourhood.

In the year of the 'GLASGOW CLIMATE Conference' many Australian BUSINESS Organizations & INDUSTRIES declared their intention soon to operate their Works & Businesses with 'NET ZERO' Emissions of Greenhouse Gases. A few of them announced plans for major 'Zero Emission' Projects to export ELECTRICITY, HYDROGEN & Zero-Emissions GOODS to the World. All FARM Business Organizations in Australia including the 'National Farming Federation' and the 'MEAT & LIVESTOCK Australia' have goals of 'NET-ZERO' emissions by or before Middle of this Century. Virtually all of them had accepted the goal of NET-ZERO emissions by 2050 before it was accepted by the Coalition Govt.

**'HAGUE Declaration' for the 'International Cooperation' to Combat the CLIMATE CRISIS & PROTECT the Global Environment (1989):**

Meeting of some 24 Nations, including the G-7 Nations (U.K., U.S.A., Canada, France, Germany, Italy & Japan) emphasized the need for 'INTERNATIONAL COOPERATION' to PROTECT the Global ENVIRONMENT, especially from the rising 'GLOBAL WARMING' & the 'CHANGING CLIMATE' in World.

**'RIO Earth Summit' on Declaration about Reduction of 'CARBON EMISSION' & 'ENVIRONMENTAL PROTECTION in World (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 21<sup>st</sup> Century.

At the Rio Earth Summit, the whole WORLD was seen to be divided into two 'Eco-Political Blocks' of 'North & South' on the issues of 'CARBON EMISSION'. The 'Arrogance and Ignorance' of the Politicians of some DEVELOPED NATIONS refused to meet the obligations of 'Rio Convention'.

These were some of the Declarations made at the RIO EARTH SUMMIT to Reduce Emissions of GREENHOUSE GASES & Combat the CLIMATE CRISIS–

- 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';
- 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 WASTES' & Emission of GREENHOUSE GASES'.
- 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'.

- All Nations in World, must immediately INFORM & NOTIFY the other Nations about any 'NATURAL DISASTERS' (which are mainly caused due to GLOBAL WARMING & CLIMATE CHANGE) in their Nations & which may create other 'Sudden Harmful Effects' on the 'Environment' & 'HEALTH' of People in those Nations.

### **Kyoto Protocol on 'Greenhouse Gas' Emission Reductions (1997):**

After the Rio Convention on 'Climate Change' in 1992 the parties met at Kyoto, JAPAN in 1997 to establish 'Legally Binding Emission Reduction' targets for 38 Industrialized Nations which accounted for 61.6 % CO<sub>2</sub> emissions in 1990. Under the 'Kyoto Protocol', Industrialized Nations were required to reduce emissions of SIX (6) GREENHOUSE GASES by around 5.2 % below 1990 levels by the years 2008 to 2012. It officially came into force on 16<sup>th</sup> February 2005 after RUSSIA ratified it. The total NATIONS ratifying the Protocol is now 156.

### **The 'UNITED NATION CONVENTION' on 'Mitigation of CLIMATE CHANGE' Induced by GLOBAL WARMING (1994):**

POLITICIANS, SCIENTISTS & ENVIRONMENTALISTS from all over the World who met at Rio de Janeiro, Brazil in 1992 formulated a draft proposal 'CLIMATE CONVENTION' to reduce the 'Greenhouse Gases' mainly the Carbon Dioxide (CO<sub>2</sub>) from both the INDUSTRIES & the AUTOMOBILES back to 1990 levels by 2000 by phasing out the use of FOSSIL FUELS in them. The treaty was adopted and signed by over 150 Nations including all the Industrialized Nations except the U.S., on 5<sup>th</sup> June 1992 & entered into force on 21<sup>st</sup> March, 1994. It has since been ratified by 189 Nations including Australia & India. The Unfortunate part is that since the 'Rio Earth Summit', the Global CO<sub>2</sub> emissions have increased by an average 100 million tons a year (UNEP Report, 2002).

### **12.8 SCIENTIFIC ACTIONS To be Taken by the Govt. of Nations for MITIGATION of 'GLOBAL WARMING & CLIMATE CHANGE' in World:**

Global Environmental Scientists along with the Physical, Chemical, Geological & the Biological Scientists are doing their Jobs as their Moral Duty but it all depends upon the Politicians in the Govt. whether they would Promote those Technologies Developed by the Scientists & Technologists.

#### **A. PRODUCTION of 'Clean & Economic 'RENEWABLE ENERGIES' – The 'SOLAR, WIND, TIDAL, GEOTHERMAL & HYDROGEN Powers, Replacing the 'Highly Polluting & Greenhouse Gas Emitting' FOSSIL FUELS (COAL & PETROLEUM PRODUCTS) from World:**

Global ENERGY DEMAND has escalated by 'Ten Folds' since the 19<sup>th</sup> Century and it is 'Doubling' every 14 years. Only the 100 % promotion of Clean 'Zero Pollution' & 'Zero Greenhouse Gas Emission' RENEWABLE ENERGIES in the World will rapidly MITIGATE the 'Global Warming & Climate Change'. (UNEP Report, 2006).

**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. They are also MAINTENANCE FREE. Most of them are installed on the ROOFS of the HOUSES. SOLAR PANELS can also be installed in the 'Open Lands' around the AIR PORTS & Agricultural FARMS or as a 'FLOATING SOLAR PANELS' in LAKES & RIVERS. Now, over 10,000 SOLAR PANELS are being installed in Australia every day. Potential for SOLAR Energy in India is also very HIGH. It is estimated to be about 80,000 MW. The 'SOLAR PHOTO VOLTAIC CELL TECHNOLOGY' (SPVCT) has brought a Revolution in the World.

**b. Production of WIND POWER for ELECTRICITY Generation:**

World's Wind Power resources are estimated to be 53,000 Twh (Trillion Watt Per Hour) every year. 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. 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. WIND TURBINES can also be installed around the AIR PORTS & Agricultural FARMS. They are getting 'Larger and Robust' requiring less maintenance. 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. The Large Modern Wind Turbines have also become very QUIET.

COST of Wind Power generation has also significantly REDUCED from 30 Cents /kWh in the 1980's to 8 Cents /kWh in 2000 & became 5 Cents /kWh by 2020. INDIA being a PENINSULA is geographically blessed. It has about 20,000 MW Wind Power potential in Sea Coasts & Deserts. AUSTRALIA has large Wind Energy resources in the 'Coastal areas' of some States. INDIA being a 'Peninsula' also has huge 'Wind Power' potential of about 45,000 MW.

**c. 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 FOSSIL FUELS. Man reached Moon in 1969 using HYDROGEN FUEL in SPACE-CRAFT. 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'. The 'Los Alamos National Laboratory' in U.S. has worked on '*Zero Emission COAL- to - HYDROGEN - to- Electricity Development Process*'. 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 POLLUTANTS & GREENHOUSE GASES. (Jotzo, Frank, 2023; Longden, et.al. 2023).

**d. Production of ELECTRICITY from 'OCEANIC WAVE & TIDAL POWERS' in World reducing Emission of 'GREENHOUSE GASES':**

OCEANS in World have huge sources of 'Zero-Emission' 'WAVE & TIDAL POWERS'. About 2,000 GIGA WATT (GW) of ELECTRICITY can be produced in 20,000 km of COASTLINE in the World. World Energy Council (WEC) estimates that 2 trillion Watts (TW) of 'Clean Zero-Emission Energy' can be harvested from the World's OCEANS which covers 75 % of the Earth surface.

**e. Production of ELECTRICITY from the 'GEOHERMAL POWERS' of Earth reducing the 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 'GEOHERMAL ENERGY' Producing over 50 million MW of Electricity every year.

**f. BIOMASS ENERGY- Cleaner & Renewable Energy Resources Produced from the PLANTS Products for Powering the AUTOMOBILES:**

- **BIO-ALCOHOL ETHANOL:** Produced from PLANTS, it is assuming great value in World as an 'Environmentally Safe & Sustainable' Substitute of PETROLEUM Products.
- **ii. BIO-DIESEL:** Produced from ORGANIC WASTES & PETRO-CROPS. It is 'Clean' & 'Non-Toxic' AUTO FUEL with very 'LOW Emission' of 'Pollutants & Greenhouse Gases'.
- **iii. BIOGAS:** Biogas METHANE (CH<sub>4</sub>) is a 'Clean Burning' Substance generating very 'High HEAT' upon Combustion. But it also works as a 'Greenhouse Gas' if it escapes into the Environment.

**B Development of 'CLEAN COAL GASIFICATION TECHNOLOGY' to Generate 'Clean COAL GAS' (METHANE):**

It is like 'Using COAL without MINING'. This is done through 'Underground COMBUSTION of COALS' on 'COAL BEDS' & their reaction with HYDROGEN to produce NATURAL GAS (METHANE). Methane is then Piped Out & Supplied to the 'POWER PLANTS' for ELECTRICITY generation.

As mentioned above 'Clean HYDROGEN Gas' can also be produced by 'COAL GASIFICATION' Technology converting the 'Dirty Coal Power' Plants into 'Clean CPP'. (Longden, et.al. 2023). Australia is Pioneering in the Technology of CCPP. This has led to significant reduction in the emission of GREENHOUSE GASES and other TOXIC POLLUTANTS.

### **C. Production of 'LOW or NO POLLUTION' ECO-AUTOMOBILES' in World:**

Automobiles are Voracious users of 'ENERGY & emitter of POLLUTANTS & GREENHOUSE GASES (GHGs) which are about 70 % in the World. Promotion of 'Sustainable Transport Systems' in the Cities of World was the Crucial theme of the 'World Environment Day' organised in 2001. The 'World Business Council for Sustainable Development' (WBCSD) has decided for establishing a SAFE & SUSTAINABLE MOBILITY of Mankind in World by 'Non-Polluting' & 'Zero-Emission' 'SUSTAINABLE TRANSPORT SYSTEMS' by 2030.

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' with 'Zero-Emission of Pollutants & GHGs'.

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), 'BIO-DIESEL' and 'PETROL added with ETHANOL'.

'Fuel Efficiency' in Vehicles also has led to significant reduction in 'Greenhouse Gases'. A Considerable Reduction in the Emission of many 'Greenhouse Gases'- 'CARBON MONOXIDE' (CO), 'CARBON DIOXIDE' (CO<sub>2</sub>), 'HYDROCARBONS' (HC) & 'NITROGEN OXIDES' (NO<sub>x</sub>) have occurred by modifications in the 'INTERNAL COMBUSTION (IC) ENGINES' of many Automobiles by installation of 'Catalytic Converters', introduction of 'Direct Fuel Injection' and 'Lean-Burn Combustion' Technologies.

#### **a. Development of Zero-Pollution ELECTRIC VEHICLES Replacing the Polluting PETROLEUM AUTOMOBILES will make a 'Pollution-Free' World:**

These are 'High-Powered' 'ELECTRIC BATTERIES' Operated 'Zero Emission' Automobiles. This improved technology for production of 'ZERO POLLUTION' 'ELECTRIC VEHICLES' promises to revolutionize the Automobile Industries in World. The BRAKES of the Vehicle themselves act as 'Small POWER GENERATORS', feeding ENERGY back into the Electric Batteries.

#### **b. Development of SOLAR & WIND Powered Zero-Pollution VEHICLES:**

They are being promoted in many Developed Nations. It will be a 'ZERO EMISSION' Vehicle and also most ECONOMIC to drive as the SUN God will provide the 'SOLAR POWER' to re-charge the Batteries & drive the Vehicle. World is also exploring the possibility of installing 'MICRO-WIND-TURBINES' in the VEHICLES to generate Power for 'Recharging' the Electric BATTERIES while on Board.

### **c. Development of Zero-Pollution HYDROGEN FUEL VEHICLES:**

HYDROGEN is seen as the Clean 'FUEL of the FUTURE' for the AUTOMOBILES & also for ELECTRICITY generation in World. (Jotzo, Frank, 2023). 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.

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.

### **D Development of more ENERGY EFFICIENT 'ELECTRICAL APPLIANCES & INSTRUMENTS' Saving Huge ELECTRICITY During their Use & also Reducing the Emission of Greenhouse Gases:**

Modern Energy Efficient 'Electrical Appliances' such as 'Automatic Lighting Control System' (ALCS), 'Compact Fluorescent Lamps' (CFL), 'Low Voltage Tungsten Halogen and 'Sodium Lamps' save 'Huge ELECTRICITY' from 70-80 %. CFL 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' & highly reduce the Emissions of GHGs. Microwaves use 55 % Less ELECTRICITY consequently emitting less 'Pollutants & Greenhouse Gases'.

### **E. VERMICOMPOSTING of all ORGANIC WASTES by the EARTHWORMS & their Use in promotion of ORGANIC FARMING Will also Divert Huge amounts of ORGANIC WASTES from their Disposal in the WASTE LANDFILLS Significantly REDUCING the Emission of Powerful GREENHOUSE GASES:**

ORGANIC WASTES are about 70 % of all 'Human Wastes' generated in the World. They must never be disposed in the WASTE LANDFILLS or dumped on the 'Open Lands' which are being done in many 'Developing Nations'. They must be VERMICOMPOSTED by the EARTHWORMS which converts them into 'Valuable RESOURCES' (ORGANIC FERTILIZERS) for the Farmers giving 'High Productivity' of 'Nutritive & Chemical-free' ORAGANIC FOODS benefiting both – the 'ECONOMY & ECOLOGY' of Nations.

EARTHWORMS act as an 'Aerator', 'Grinder', 'Crusher', 'Chemical Degradator' & as a 'Biological Stimulator'. They Biodegrade the Organic 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. Earthworms also 'DETOXIFY' & 'DISINFECT' the VERMICOMPOST by releasing 'COELOMIC FLUIDS' that have 'Anti-bacterial' properties. They also devour the 'Protozoa', 'Bacteria' and 'Fungus' as their food from the 'Organic Wastes' making the VERMICOMPOST free of 'Chemicals & Pathogens' & SAFE for use by the Farmers. The three most voracious 'Waste-eater' Earthworms Species are 'Tiger Worms' (*Eisenia fetida*), 'Indian Blue Worms' (*Perionyx excavates*) & the 'African Night Crawlers' (*Eudrillus euginae*).

**F. Promotion of ORGANIC FARMING by 'Earthworms VERMICOMPOST' for Production of 'CHEMICAL-FREE' & 'HEALTH PROTECTIVE NUTRITIVE ORGANIC FOODS' for Society, also Sequestering the ATMOSPHERIC CARBONS Back into the Soil & Reducing the Emission of GREENHOUSE GASES Generated in the Production & Use of AGROCHEMICALS in Farms:**

VERMICOMPOST produced by Vermicomposting (Biodegradation) of ORGANIC WASTES (Foods & Green Wastes) by the Waste-eater Earthworms contains large amounts of CARBON Contents produced by the process of PHOTOSYNTHESIS occurring in all 'Green Plants' on Earth induced by the SUN Rays. Being rich in 'CARBON', use of Vermicompost in Farms also 'SEQUESTERS' huge amounts of Atmospheric CARBONS back into the 'Farm Soil' as 'Soil Organic Carbon' (SOC) improving their Natural FERTILITY while also mitigating the 'CLIMATE CRISIS' by removing the Carbons from the ATMOSPHERE.

**G. VERMIFILTRATION of Municipal WASTEWATERS (Sewage) by the EARTHWORMS 'Purifying' them into CLEAN NUTRITIVE WATER for their REUSE in 'Farm Irrigation' & also Diverting them from the Cost-Effective 'SEWAGE TREATMENT PLANTS' will Significantly REDUCE the Emission of Powerful GREENHOUSE GASES & also SAVE Huge 'Groundwater' of Earth which is 'Fast DEPLETING' all over the World:**

This is a 'Self-Promoted'; 'Self-Regulated', 'Self-Enhanced', 'Low-Power' & 'Zero-Waste' Eco-Technology for 'PURIFICATION' (Disinfection & Detoxification) of 'WASTEWATERS' into 'CLEAN WATER' (useful for IRRIGATION) 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 'Organic Wastes' are also used in the VERMIFILTRATION of 'Wastewaters'. Emission of Powerful GREENHOUSE GASES Methane (24 times more powerful than the Carbon Dioxide) & Nitrous Oxides (312



times more powerful than the Carbon Dioxide) and also Ammonia (NH<sub>3</sub>) which creates FOUL ODOR in the Conventional Wastewater Treatment Plants due to the Microbial Degradation of Solids in the Wastewaters & the Slurry. (Luth, P. et. al., 2011).

## **H. BIOMINING Technology for Extracting ‘ORES’ & ‘METALS’ from the MINES by MICROBES with Less ‘Emission of Pollutants & Greenhouse Gases’:**

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. New RESEARCHES 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. (Venkatraman et.al. (2022).

## **12.7 Arresting CLIMATE CHANGE by CARBON SEQUESTRATION Technologies:**

Carbon Dioxide is proving to be the major contributor (55 %) in enhancing GLOBAL WARMING as it is being generated on ‘Massive Scale’ as compared to other GHGs Methane & Nitrous Oxide. It is essential to arrest its emission at Source. Alternative is ‘Sequestration of Carbon in SINKS’. PLANTS on Land (FOREST) or in Oceans (PHYTOPLANKTONS) remove vast amounts of CO<sub>2</sub> from atmosphere by the Bio-chemical Process of PHOTOSYNTHESIS. It is all due to the Green Pigments ‘CHLOROPHYLL’ in their Leaves which promote Photosynthesis. It occurs in the Sunlight & absorbs huge amounts of CARBON DIOXIDE (CO<sub>2</sub>) from the Atmosphere & releases them back into the Atmosphere as OXYGEN (O<sub>2</sub>) after using the CARBON for production of ‘Carbohydrates’. A considerable portion of the atmospheric CO<sub>2</sub> taken in the process of Photosynthesis remains in the ground as ‘Soil Organic Matter’. About 58 % of it is locked as the ‘Soil Organic Carbon’ (SOC). (Post *et al.*, 2001). This is termed as ‘Soil Carbon Sequestration’. The global pool of SOC is about 1,550 Pg C (1 Pg = 1,000 million Metric Tons).

Green Plants are Natural ‘CARBON SINKS’ on Earth. Long-term storage of Carbon can be made in the ‘Forest’ & ‘Oceans’. Underground storage of CO<sub>2</sub> in the ‘Geological Structures’ of Earth (Active & Depleted Oil & Gas Reservoirs; Deep Aquifers; Coal Seams & Beds; Mined Salt Domes or Rock Caverns) can also Sequester huge Carbons from the Atmosphere. They are good options and also Environmentally Safe. Nature has provided two Other huge ‘CO<sub>2</sub> Sinks’ on Earth in the form of ‘Vast Oceans’ and the ‘Tropical Rain Forests’. About half of the Carbon injected into the Atmosphere is being absorbed by Ocean. It holds 60 times as much Carbon as there is in the Atmosphere.

REFORESTRATION of Earth by Large TREES Can SEQUESTER Huge Amounts of CARBON from the Atmosphere by Photosynthesis. Large TREES have greater ‘CARBON SEQUESTRATION’ Potential as the production of BIOMASS in Plants are directly linked to the QUANTITY of CARBON (as Carbohydrates).

AGAVE Tree (*Agave tequilana*) grows in Australia naturally in atmospheric Temperatures above 38<sup>0</sup> C. They are adapted to survive in 'Extreme HEATS' and also for long times without RAIN. One million hectares of 'Agave Trees' can SEQUESTER about 4.6 million tons of CO<sub>2</sub> per annum for production of BIOCHAR as well as BIO-OIL for Energy generation. (Roxburgh et.al., 2006). Same are the Environmental Properties of EUCALYPTUS Trees. They are adapted to survive in 'High Temperatures & Heavy Rainfalls'. Australia is blessed to have huge 'FORESTS of Eucalyptus Trees'. India also got them from Australia to plant in the DESERT regions of Rajasthan.

Another novel idea of 'Carbon Sequestration' is to grow 'PETRO-CROPS' - *Jatropha curcus*, *Euphorbia* spp., *Calotropis procera*, *C. gigantea*, *Jojoba simmondsia* & *Pongamia* spp. etc. which can be grown even in the Deserts & Wastelands. They produce 'LATEX' and fix huge amount of 'Carbon Dioxide' in them to produce HYDROCARBONS (C-15). Their Hydrocarbon containing 'Milky Latex' is processed to produce 'Clean BIODIESEL'. Their use in Automobiles will result in 'Net Zero Emission' of CO<sub>2</sub>.

## **12.8 Political ACTIONS to be Taken by the Govt. of Nations to Set 'Zero-Emission Target' for Combating the CLIMATE CRISIS:**

Most Nations have decided for 'ZERO EMISSION' of GHGs by 2050 & some to 2060 & 2070 which are NOT appropriate for SAFETY of Society. It must be done by 2035 as decided by the 'Climate Council of Australia', or at the most by 2040. Most Nations in the World have set some Targets for reducing CARBON Emissions to 'NET ZERO' by 2050 & reaching 'CARBON NEUTRALITY' through all their 'DEVELOPMENTAL PROGRAMS'.

An important question is that to limit the DAMAGES & PROTECT the World from the CLIMATE CHANGES, will all Nations have to reach the Target of 'CARBON NEUTRALITY' a decade (10 years) or may be 15 years earlier than the Current Targets which are 2040 for the DEVELOPED Countries. It is 2050 for China & Russia & 2070 for India.

### **12.8.1 AUSTRALIAN Initiative to Combat CLIMATE CRISIS:**

The CLIMATE COUNCIL of Australia with several 'Brilliant Scientists & Members' are fighting for the 'Protection of Environment' & 'Safety of Society in Australia' by inspiring the Govt. of Australia to keep the target for 'Reduction of GHGs EMISSIONS' at least by 75 % before 2030 & 100 % by 2035 & NOT 2050 for the SAFETY of Society.

We also AGREE with them & helping them to obtain their mission of 2035 successfully. This can only be achieved if our 'Automobile Industries' switch over to 100 % Production & Sell of ELECTRIC VEHICLES. This would also SAVE Australians from Various Human DISEASES. Australian CONSERVATION FOUNDATION (ACF) is also working hard to protect the ENVIRONMENT & SOCIETY of AUSTRALIA. They regularly organize a 'Show Ground' & invite people to learn what they should do to PROTECT the ENVIRONMENT for their SAFE LIVING in AUSTRALIA. They keep all 'ELECTRIC VEHICLES', 'SOLAR PANELS' & Small 'WIND TURBINES' (to be used in Homes).

Australia can supply the World the 'ZERO-EMISSIONS GOODS & SERVICES' that would significantly reduce the Global Emissions of GREENHOUSE GASES by around 8 %, much more than the European Nations (including United Kingdom) and more than twice of Japan & India doing these Services for World. Australian technologies & programs of Sustainable Development in the production of GOODS & SERVICES would significantly improve the World's Chances of stopping the 'Increases' in the 'GLOBAL ATMOSPHERIC CARBON'.

### **12.8.2 INDIAN Initiative to Combat CLIMATE CRISIS:**

India is the 6<sup>th</sup> largest producer of 'Greenhouse Gases' in World, contributing almost 3 % of the World's total Carbon Emissions including METHANE from RICE FIELDS & CATTLES Rearings. It is also a signatory to the CLIMATE CONVENTION & has ratified the KYOTO PROTOCOL. It also has a vast 'Carbon Sink' in the form of its RAINFOREST in the Silent Valley of Kerala & in the North-East India. It also has great potential to grow 'PETRO-CROPS' like *Jatropha curcus*, *Calotropis gigantea*, *Euphorbia* Spp. in their vast Thar Desert & can also produce the Cleaner BIODIESEL for their Automobile Industries.

According to a study in 2002 the people of Powerguda village in India planted 4,500 Native Trees (*Pongamia pinnata*) on the edges of their agricultural lands. They absorbed some 147 tons of 'CO<sub>2</sub>' over the 10 years. *Pongamia* SEEDS also yield Valuable OILS. India must also commit to reduce the Target of 'Net-Zero Emissions' of GHGs from 2070 to 2035 for the Safety of Society. People of India should also take ACTIONS & INSPIRE the Govt. for this.

Development of Global Environment Facility (GEF) in 1991, Jointly implemented by UNEP, UNDP & the 'World Bank' to FUND the 'Environmental Projects' in the 'Developing Countries' had four main objectives to PROTECT the Global ENVIRONMENT. Among them was also the 'REDUCTION of GREENHOUSE GASES' & 'MITIGATION of GLOBAL WARMING'.

### **12.9 Conclusions & Remarks:**

Global Warming has already begun and there are sufficient Scientific evidences to confirm it. Six of the eight (8) WARMEST years occurred in the 1980s and 1990 was the HOTTEST year in history. Oceanic Swells, Tropical Cyclones, Tornadoes, Torrential Rains & Tropical Storms are increasing in both 'Frequency & Intensity' all over the world. Scientist fear that the breakup of ICE SHEET in the West Antarctic would dump huge amount of Freshwater into the Ocean raising the Sea Levels by as much as several meters over the coming Century. Rise in Sea Level may repeat the 'Cyclone TSUNAMI' in more Devastating ways.

The United Nation Environment Program (UNEP) had warned way back in 1996 - '*At this rate of Environmental Destruction whether this Civilization would be able to see 2050 is a question mark*'. Hence, our Target for NET ZERO EMISSION (100 %) of 'Greenhouse Gases' from main Sources (Coal Power Plants & Petroleum Automobiles; Waste Landfills; Chemical Agriculture; & Sewage Treatment Plants) must be 2030, at the most 2035 but NEVER 2050 for our SAFE LIVING in World.

To Combat the 'GLOBAL WARMING & CLIMATE CHANGE' rapid 'DECARBONISATION' (Removal of CARBON DIOXIDE from the Atmosphere) of World is highly necessary. This will only prevent the pending DANGEROUS impacts of 'GLOBAL WARMING & CLIMATE CHANGE' on World. And this will be only possible by promoting the 'Low-Cost' 'RENEWABLE ENERGY' Systems (especially the SOLAR, WIND & HYDROGEN Powers) for 'Power Generation' all over the World.

The Lower COSTS of 'RENEWABLE ENERGIES' & their further REDUCTION in COST in World are leading to significant REDUCTION in the Emissions of GREENHOUSE GASES even in Nations which do not have any POLICIES to take necessary actions to STOP the 'CLIMATE CHANGE'. (Malte, Meinshausen et.al., 1923). In the book '*The Superpower Transformation*' edited by Dr. Ross Garnaut it is mentioned that the 'Russian Invasion of Ukraine' & the resulting 'Ukraine Crisis' also 'Hastened & Accelerated' the global transition to RENEWABLE ENERGY development. Although, invasion of any Nation in World is not acceptable to the people in World. 'Safe Living' of Human Society in World is more important.

The World as a whole will need to achieve NET-ZERO Emissions of GREENHOUSE GASES by 2035 for SAFETY & SURVIVAL of Global Human Society. The 'UNITED NATIONS CLIMATE CHANGE CONFERENCE' in 2021 (COP26) adopted text that strengthened their focus on limiting GLOBAL WARMING to 1.5<sup>0</sup>C. Earlier, the 'Global Target & Policies' to limit the Global Warming was aimed at 2<sup>0</sup>C which is no longer regarded as 'SAFE & SUFFICIENT' for the Global Human Society. To keep the Target to 1.5<sup>0</sup>C will necessitate faster reduction of emissions of Greenhouse Gases before 2030. All Nations of the World will have to reach the NET-ZERO Emissions targets in order to keep the goal of GLOBAL TEMPERATURE alive as 1.5<sup>0</sup>C.

With New Technologies for using BIO-BASED Materials to produce BIO-FUEL, BIOCHAR & BIOCHEMICALS, the World could highly reduce 'Global NET Emissions' of CO<sub>2</sub>. According to the information given in the Book '*The Superpower Transformation*' of Ross Garnaut (2023), Australia is reducing NET Emissions' of CO<sub>2</sub> by almost 670 million Tons every year for several decades by using BIO-BASED Materials.

The Govts. of Nations have to take the necessary 'Political & Scientific Actions' to 'MITIGATE CLIMATE CHANGE', but the Global HUMAN SOCIETY should also be EDUCATED to take the Following Actions in their Daily Life –

- Judiciously Use the 5 P's (PETROL, POWER, PAPER, PLASTIC & POTABLE WATER) & also ELECTRICITY in Everyday Life. Their Production & Supply to People use huge ENERGY Emitting 'Greenhouse Gases' (GHGs).
- Judiciously Use the DRINKING WATER. Save & never Waste them in Daily Life. Groundwater of Earth is FAST DEPLETING from all over the World. Only its Judicious use can SAVE the Society. Higher use of WATER also generates huge WASTEWATER (Sewage) whose Management by Conventional 'Sewage Treatment Plants' also emits Huge & more Powerful GHGs.
- Embrace the 5 R's Rules (REFUSE, REDUCE, REUSE, RECYCLE & RESPONSIBLE) for all Human WASTES. Disposal of all ORGANIC WASTES in the

Technologically Developed ‘Waste Landfills’ also Emit ‘Greenhouse Gases’ as studied by our students. Reduction of WASTES is essential for ‘Safety’ & also ‘Economic Prosperity’ of the Society.

- VERMICOMPOST all ‘FOOD & GREEN WASTES’ at home Converting them into ‘Valuable Products’ (Organic Fertilizers) for use in Gardens & also diverting them from their Disposal in the ‘Waste Landfills’ incurring huge Cost & also emitting huge & powerful ‘Greenhouse Gases’, benefiting both – the ECONOMY & ECOLOGY of Nations.
- Give up SMOKING if you Smoke. Also avoid BURNING of COALS, WOODS & CATTLE DUNG CAKES for Cooking & Heating. All SMOKES in the Breathing AIR harm both, Human HEALTH & the ENVIRONMENT by generating huge Carbon Dioxide & Methane.

### **12.10 References & Additional Readings:**

1. Anonymous (2022): Report on ‘Annual Carbon Dioxide Emissions Worldwide from 1940 to 2020’; Statista.com,<https://www.statista.com/statistics/276629/global-CO2-emissions/>
2. Bhaskar, A. et.al. (2022): Decarbonizing Primary STEEL Production: Techno-Economic Assessment of a Hydrogen Based Green STEEL Production Plant in Norway; *Journal of Cleaner Production*; p. 131339;
3. FAO (2002): *A Win-Win War on Climate Change*; Pub. Of Food & Agriculture Organization, Rome, Italy.
4. Follett, R. (2001): Soil Management Concepts and Carbon Sequestration in Cropland Soils; *Soil and Tillage Research*; Vol. 61: pp. 77-92.
5. Garnaut, Ross (2008): *The Garnaut Climate Change Review: Final Report*; Cambridge University Press, Port Melbourne, Australia.
6. Garnaut, Ross (2022) (Ed): *‘THE SUPERPOWER TRANSFORMATION: Making Australia’s Zero-Carbon Future’*; Published by LATROBE, University Press, Collingwood, VIC, Australia.
7. Grant, Isabelle (2022): ‘LAND CARBON’; In the BOOK Edited & Published by Ross Garnaut in 2022; Pages 240 – 271;
8. Gifford, R.M. et.al. (1990): Australian Land Use by Primary Production of VEGETATION & CARBON POOLS in Relation to ‘Atmospheric Carbon Dioxide’ Concentration; In R.M. Gifford & M.M. Barson (eds) – *‘Australia’s Renewable Resources: Sustainability & Global Change’*; Bureau of Rural Resources Proceedings, No. 14, AGPS, Canberra.
9. Griscom, B.W. et.al. (2017): ‘Natural Climate Solutions’; *Proceedings of the National Academy of Science*; 114 (44); pp. 11645-50
10. Griffiths, S. et.al. (2021): Industrial Decarbonization via Hydrogen: A Critical & Systematic Review of ‘Developments’, ‘Socio-Technical Systems’ and ‘Policy Options’; *Energy Research & Social Science*; 80, 2021; P. 102208.
11. Gupta, N.C., Jain, V.K., and Bansal N.K. (1995): Carbon Dioxide (CO<sub>2</sub>) Reduction Potential Through Non-Conventional Energy Sources in India; *Energy*; Vol. 20, No.6; pp. 549-553.
12. Houghton, R.A. (1990): The Global Effects of Tropical Deforestation; *J. of Environmental Science and Technology*; Vol. 24: pp. 414-424.

13. IPCC (2001): *Climate Change: The Scientific Basis*; 3<sup>rd</sup> Assessment Report of the Intergovernmental Panel on Climate Change; Cambridge University Press; pp. 739 – 768.
14. (IEA) International Energy Agency (2021): *Net Zero by 2050*; Flagship Report, May 2021.
15. IUCN, WWF, and UNEP (1991): *Caring for the Earth: A Strategy for Sustainable Living*; Earthscan, U.K.
16. Jones, C.D. et.al. (2019): The Zero Emissions Commitment Model Inter Comparison Project (ZECMIP) Contribution to C4MIP: Quantifying Committed Climate Changes Following Zero Carbon Emissions; *Geoscientific Model Development*; Vol. 12; pp. 4375-85.
17. Jotzo, Frank (2023): HYDROGEN; Chapter written in the BOOK of Ross Garnaut – ‘The Superpower Transformation – Making Australia’s Zero-Carbon Future’; Pages 196 – 218.
18. Jufeng Zeng et.al. (2017): BIOCHAR Compound Fertilizer Increases Nitrogen Productivity & Economic Benefits (For Farmers), But Decreases Carbon Emissions in Maize Production; *Journal of Agriculture, Ecosystem & Environment*; 241, pp. 70-8;
19. Knutson, T & Tuleya R. (2004): Impact of CO<sub>2</sub> – induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization; *J. of Climate*; Vol. 17-18; pp. 3477-3495.
20. Lal, R. and Bruce, J. (1999): The Potential of World Cropland Soils to Sequester Carbon and Mitigate the Greenhouse Effect; *J. of Environmental Science and Policy*; Vol.2; pp. 177-185.
21. Lal, R. et.al. (2004): Soil Carbon Sequestration Impacts on Global Climate Change and Food Security; *Science* 304 (1623);
22. Longden, T. et.al. (2023): CLEAN HYDROGEN: Comparing the Emissions & Costs of ‘Fossil Fuels’ versus ‘Renewable Electricity’ Based ‘Hydrogen’; *Applied Energy*, 306, p.118145.
23. Luth, P. Robin, P. Germain, M. Lecomte, B. Landrain, Y.S. Li, D. Cluzeau (2011): *Earthworms Effects on Gaseous Emissions (Methane, Nitrous Oxides & Ammonia) During Vermifiltration of Animal Wastewater*; UMR Eco-biology, CNRS – Rennes 1 University, France.
24. Lehmann, J. et.al. (2021): BIOCHAR in Climate Change Mitigation; *Journal of National Geoscience*, 14; pp. 883 -92.
25. Leng, R., T. Preston & S. Inthaapanya (2012): BIOCHAR Reduces Enteric METHANE & Improves GROWTH & Feed Conversion in Local ‘Yellow’ Cattle Fed Cassava Plants Root Chips & Fresh Cassava Foliage; *Livestock Research for Rural Development* 24;
26. Matthews, H.D. & K. Caldeira (2018): Stabilizing Climate Requires Near-Zero Emissions; *Geophysical Research Letters*; 35 (4);
27. Mackey, B.G. et.al. (2008): *Green Carbon: The Role of Natural Forests in Carbon Storage*; Australian National University (ANU), Canberra.
28. Malte Meinshausen et.al. (2023): ‘The Diminishing CARBON BUDGET and Australia’s Contribution to Limit ‘CLIMATE CHANGE’; In the Book edited by Dr. Ross Garnaut –‘The Superpower Transformation’; Published by La Trobe University Press, Australia.

29. Ogden, J.M., Williams, H.R. et al. (2001): *Towards a HYDROGEN Based Transportation System*; Paper for 'Carbon Mitigation Initiative'; Princeton Environment Institute, U.S.A.
30. Ogden, J.M., Williams, H.R. et al. (2001): *Towards a Hydrogen Based Transportation System*; Paper for Carbon Mitigation Initiative; Princeton Environment Institute, U.S.A.
31. Pretty, J., Ball, A., Xiaoyun, L. and N. Ravindranath (2003): 'The Role of Sustainable Agriculture and Renewable-Resource Management in Reducing Greenhouse Gas Emissions and Increasing Sinks in China and India'; In I. Swingland (ed). *Capturing Carbon and Conserving Biodiversity: The Market Approach*; pp.70-89; Earthscan Pub., London, UK.
32. Pandey, D.N. (2002): Carbon Sequestration in Agro-forestry Systems; *Climate Policy*; Vol.2; pp.367-377.
33. Patel M. (2006): WIND & SOLAR POWER SYSTEMS: Design, Analysis and Operation, 2<sup>nd</sup> ed, *Published by CRC Press*, Florida, USA.
34. Paul, J. Burke et.al. (2022). Contributing to Regional Decarbonization: Australia's Potential to Supply 'Zero-Carbon' Commodities' to the Asia-Pacific (Nations): *Energy*; Page 248;
35. Patterson, D.J., and N.A. Henein (1972): *Emissions from Combustion Engines and Their Control*; Ann Arbor Science, Ann Arbor, MI, p.197.
36. Polgase, P. et.al. (2011): *Opportunities for Carbon Forestry in Australia: Economic Assessment & Constraints to Implementation*; Council of Scientific & Industrial Research Organization (CSIRO), Canberra.
37. Post, W. et al. (2001): Monitoring and Verifying Change of Organic Carbon in Soil; *Climate Change*; Vol. 51; pp. 73-99.
38. Pratikorn, Sriphirom (2021): Effects of BIOCHAR on Methane Emission, GRAIN Yield & SOIL in Rice Cultivation in Thailand; *Carbon Management* 12(2).
39. Qiong Nan et.al. (2021): Exploring Long Term Effects of BIOCHAR on Mitigating Methane Emissions from Paddy Soils: A Review; *Biochar* 3; pp. 125-34.
40. R. An et.al. (2001): Potential of Energy Savings and Carbon Dioxide Emission Reductions in China's IRON & STEEL Industry; *Applied Energy* 226; pp. 162-80.
41. Ralph Chami et.al. (2019): *Nature's Solutions to CLIMATE CHANGE*; IMF, December 2019.
42. Roxburgh, S. et.al. (2006): 'Assessing the Carbon Sequestration Potential of Managed Forests': A Case Study from Temperate Australia; *Journal of Applied Ecology*, 43 (6), pp 1149-59.
43. Schaefer, F and Revan Basshuysen (1995): *Reduced Emissions and Fuel Consumption in Automobile Engines*; Springer-Verlag; New York and SAE International.
44. Sinclair, Jan (1991): Global Climate Change Has Already Begun; *Our Planet*; UNEP Publication; Vol.3; No.2; pp.14-15.
45. Steinburg, M. (1994): Fossil Fuel Decarbonization Technology for Mitigating Global Warming; *International Journal of Hydrogen Energy*; Vol. 24; pp. 771.
46. Sinha, Rajiv K. (1993): Automobile Pollution in India and its Human Impact: A Case Study on Traffic Policemen in Jaipur City of India; *The Environmentalist* (U.K.); Vol. 13; No.2-3.
47. Sinha, Rajiv K. (1997): *Climate Change by Global Warming, Ozone Depletion and Acid Rains*; In Self (ed.) 'Environmental Crisis and Human's at Risk', INA Shree Publication, Jaipur, India; ISBN 81-86653-04-X; p.385 (Foreword by Pt. Sunderlal Bahuguna).

48. Todd A. Ontl & Lisa A. Schulte (2023): 'Soil Carbon Storage'; *Nature Education Knowledge* 3 (10), p.35.
49. UNEP (2006): Renewable Energy; *Our Planet*; UNEP Pub., Vol. 16, No. 4; United Nations Environment Program, Nairobi, Kenya.
50. Venkatraman, M. et.al. (2022): 'Zero-Carbon Steel Production': The Opportunities & Role for Australia; *Energy Policy* 163; p. 1 12811.
51. WWI (2005): *Unnatural Disaster: The Lessons of Katrina*; World-watch Institute, Washington, D.C.
52. Zhang D. et.al. (2016): BIOCHAR Help Enhance MAIZE Productivity & Reduce Greenhouse Gas Emissions Under Balanced Fertilization in a Rainfed Low Fertility Lands; *Journal of Chemosphere*; 142; pp. 106-13.
53. Zhang, X. et.al. (2021): A Review of LOW-CARBON Emissions Projects of STEEL Industry in the World; *Journal of Cleaner Production*; p. 306.