India - Zero Emissions Climate Action Plan

By Dr. Hari Lamba

(Proposed)

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India Climate Update

Supplement to the Proposed India Climate Action Plan, October 23, 2021

Next to China and the US beginning to start reducing emissions immediately, the biggest action that can occur that will lead to the success of COP 26 is for India (and the rest of the world) to agree to start immediately transitioning out of COAL ! As of this time, India has not agreed to even a year when it will start peak its emissions.

But India, like the rest of the world, needs to start reducing its greenhouse gas emissions immediately!! It has had 30 years since 1992 to increase its use of fossil fuels, so that in 2017, its total emissions were 5% of the world total and its per capita emissions were 2 tons of carbon dioxide equivalent (TCO2e). If India were to follow the path of China and continue to expand its energy use based on coal, then the global climate change efforts will be defeated!

There are several reasons why it makes good sense for India to adopt something like my proposed Climate Action Plan that follows or something of that magnitude!

First, it makes **ECONOMIC** sense. Solar energy is much cheaper than coal and so can deliver more energy at less cost. India can become a larger producer of low-cost Solar PV (photo-voltaic) panels in a way that will be good for its industry. It can also store large amounts of renewable energy in battery systems and in green hydrogen, which again helps its economics and energy sufficiency. Recently the Prime Minister has proposed a bold National Hydrogen Mission to use green hydrogen in a big way.

Second reason is the **HEALTH** of its population. Coal is resulting in a very high level of air and water pollution. Major parts of India essentially often become like a gas chamber that hurts the health of its population in a big way.

The third reason is to **DISASTER PROTECTION** by not suffering from devastating worsening climate related natural disasters that it is increasingly suffering from (like the rest of the whole world) – wildfires, floods, landslides, heat, drought and cyclones.

It took hundreds of millions of years of dense coniferous forests to get buried in order to form the coal seams, By sequestering carbon in the ground, the atmosphere cooled and life became favorable for our species and life as we know it.

Note: For piecharts, the column on the right items start at the 12 O'Clock position and go clockwise. For proposed plan, Coal is zero at the top, and Renew Storage at top left.

The Proposed Energy, Climate & Ecosystem Transformation Plan For India

Current Situation for India

India has suffered and will be affected by Climate Change. At the same time, there are some significant actions that it is taking, but much more that it can do to help with the national, regional and global solutions to Climate Change.

First the impact of Climate Change.

The Impact of Climate Change on India

India is feeling the impact of Climate Change already through increasing temperatures, droughts, massive rains and floods, landslides caused by heavy rains, melting glaciers, water shortages, cyclones, and coastal storms. The Indian Meteorological Department (IMD) says that these events are increasing in both frequency and severity. About 2,400 people in India have lost their lives during 2018-2019 due to extreme weather related events such as cyclones and floods.

Heatwaves: Data released by IMD indicate that from 1901-10 period to the 2009-2018 period, average temperatures in India rose by about 0.6 degrees Celsius (about 1.1 degrees Fahrenheit). However, there are other analyses and reports that indicate that average temperatures may rise by about 4 degrees Celsius by the end of the century. Heatwaves are becoming more common, and in Delhi the number of days that crossed 35 degrees Celsius in the period 2009-2018 increased to 1,613 days from 1009 days in the period 1959-68. Other major cities such as Mumbai, Bengaluru and Hyderabad have had similar heat waves. Although the cities see higher temperatures than the rural areas because of the heat island effect (a higher level of concrete in the cities), the rural areas suffer more from the heat waves as very few people there have air conditioning, and so they have a higher level of fatalities. As with heat waves in recent years, this was accompanied by drought and water shortages in many

parts of the country. The city of Chennai, in southern India with a population of about 9 million, ran out of water in June 2019 as the monsoon was delayed and the reservoirs that previously supplied water ran dry. It had been recorded that for many years, in order to make Chennai into a "modern" hub with a high level of information technology, all wetlands had been paved over for new building developments making the situation worse.

What the heatwaves mean for the Himalayan region is harsher conditions in the hills and mountains. The Himalayan glaciers have begun to melt, and a number of glacial lakes have appeared as a result, together with the possibility of massive floods if these lakes suddenly release their water. Even more troublesome is the prospect for the supply of water in the northern Gangetic plane and for the Indus rivers going west through Punjab and Kashmir to Pakistan, that rely on snow melt to provide water for the rivers during the summer months. **When the glaciers are gone, there is the prospect of all of the rivers of northern India running dry in the summer months before the monsoon arrives.**

Catastrophic Rains, Floods and Landslides: As with other parts of the world, the increased global temperatures have led to increased evaporation in oceans, which come down in concentrated locations as very severe rains. India has been no exception. Next to the heat waves, the major effect on India of Climate Change has been the change of the Monsoon season, which usually lasts from June to September. As summer approaches, the winds from the southwest pick up moisture from the Indian Ocean, the Arabian Sea and The Bay of Bengal. They provide initial rains mainly in the western part of the peninsula, get contained by the Himalayan mountains and head northwest and provide rain over the Indo-Gangetic plain all the way to the north. Then as the winds shift, the monsoon retraces its path and provides rain along its path, and then after moving over the Bay of Bengal, provides a second period of rains over the peninsula.

However, Climate Change is disturbing this pattern in an unfavorable way. The changing weather patterns are often delaying the monsoon, worsening the heat wave and drought situations and then, because there is excess moisture, leading to very heavy rains and floods. In 2019, the rains were the heaviest on record and the retreat of the monsoon, which is normally by September end, got delayed to October 10. Although the average amount of rainfall is about the

same, the rainfall is often heavier and more concentrated with more centimeters or inches of rain in shorter times, and often leads to catastrophic flooding events. The UN Office of Disaster Risk Reduction has said that in India, from 67 flood events in the 1996-2005 period, the flood events increased to 90 during the 2006-2015 period. A 2017 study showed that there was a three-fold increase in extreme rain events from 1950 to 2015.

Examples of extreme rain and flood related events are many. As early as 2005, the Indian state of Maharashtra was hit with heavy rains and floods. The city of Mumbai was hit with 944 mm (37.17 inches) of rain in a 24 hour period on July 26, 2005, and torrential rain continued during the next week. Inadequate drainage capabilities with little development of drainage projects, building developments that caused water retention and drainage issues, and the destruction of mangrove swamps for "development" only made things much worse. Five years later, during three hours of the early morning of August 6, 2010, in the area of Ladakh in northern India, the capital city of Leh and surrounding areas were hit with heavy rains that led to flash floods, debris flows and mudflows (landslides) in which at least a few hundred people died, including some foreign tourists. Some places received as much as 250 millimeters (mm – or 9.8 inches) of rain, and within one three hour period, rain fell at a rate as high as 150 mm per hour (5.9 inches/hour), with gushing water and mud as high as 10 feet (about 3 meters) in some places. Leh and some of the surrounding areas were totally devastated. Similar to Ladakh, the northern state of Uttarakhand was hit with heavy rains, flashfloods and landslides in 2013, that were described as a century scale event that led to largescale devastation. **I had vacationed in Leh earlier in the year, and had enjoyed the beauty mountainous ecosystems of Ladakh, and so was very saddened by the environmental destruction of Leh by a Climate Change related disaster. For those who wish to see the beautiful places of the world, we need to start doing it in zero or low carbon modes, if these places are not to be destroyed.**

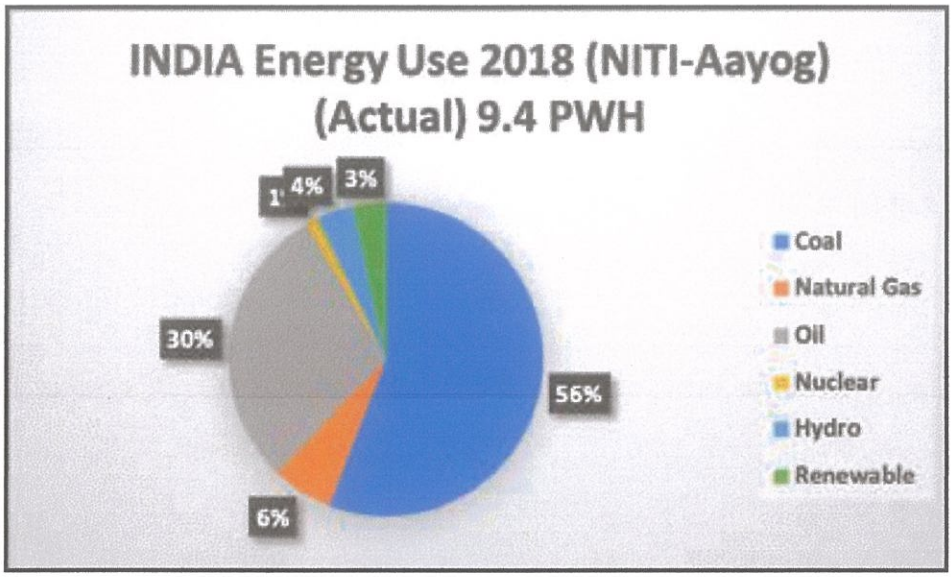
Tropical Cyclones (what elsewhere may be called typhoons or hurricanes) have been worsening with Climate Change. The east coast of the peninsular part of India is more prone to cyclones from the Bay of Bengal, as compared with the west coast from the Arabian Sea. The Indian Government's National Cyclone Risk Mitigation

Project (NCRMP) reported that from 1891 to 2002, about 300 cyclones hit the east coast and about 50 cyclones hit the west coast. The east coast is also subject to storm surges of 3 to 12 meters (varying with location) and is also prone to tsunamis. In 2004, the ocean floor near Indonesia lifted by as much as 40 meters with a magnitude 9.1 quake leading to a tsunami that killed about 100,000 people in the city of Banda Aceh in Indonesia, and killing more on the shores of Thailand, India and Sri Lanka. The east coast of India, and the Bay of Bengal nations in general, need effective strategies and measures for emergency alerts to tsunamis, and effective disaster reduction strategies for cyclones, especially as these get worse with Climate Change.

In June 2008 India announced a National Action Plan on Climate Change (NAPCC) which took up eight national missions on water, sustaining the Himalayan ecosystem and developing knowledge on Climate Change, solar PV, energy efficiency, sustainable habitats, sustainable agriculture, and greening India (reforestation). Since most of the programs were with different ministries of the government and because they were not funded adequately, they remained with little to some effectiveness. The exception was the National Solar Mission, which was much better funded. The goal of the solar program was to establish 20 GW (giga watt or 20,000 MW – mega watt) of capacity by 2022, which was later increased to 100 GW. As of July 2018, the nation had an installed capacity of about 21.8 GW, so it had already met the goal of 20GW. However, in order to meet its goal of 100GW by 2022, India would have to add about 20GW each year. Roof top solar did not receive any special attention, funding or enablement, and so it remained very small (Down to Earth Article, 2018). [44]

India's Current and Projected Energy Use

India's energy consumption in 2018 grew very fast at an annual rate of 7.9%, and at 5.8% of total global consumption, India was the second largest energy consuming nation after China and the US.



INDIA'S ENERGY CONSUMPTION IN 2018

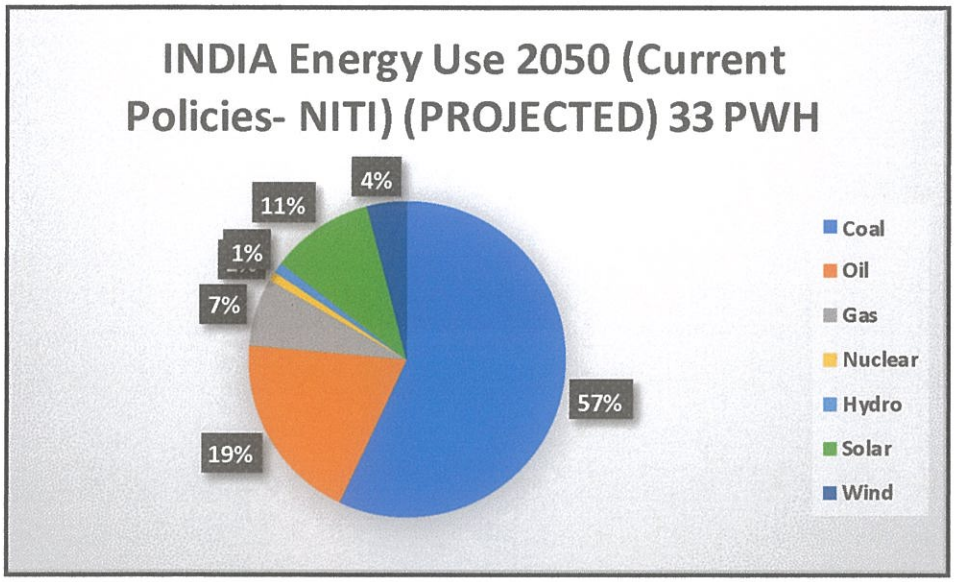
India's energy consumption in 2018 was about 809 Mtoe (Million tons of oil equivalent) or 9.4 PWH (petawatt hours – or about 9,400 billion kilowatt hours) in electrical energy terms. As can be seen, India's energy needs were met 56% by coal, 6% by natural gas, and 30% by oil.

India is very heavily reliant on imports, and in 2018 imported about 46% of the energy it used. It imported about 31% of its coal, 53% of its small consumption of natural gas, and as much as 86% of its oil (petroleum). India also has a world class refining capacity, so that in 2015, even as it imported about 195 Mtoe of oil, it imported refined products like gasoline or petrol and diesel of about 23 million tons, and exported refined products of about 55 million tons. Its reliance on imports is only expected to grow, so that by 2030, its energy imports will be about 53% of its consumption. **In 2018, the nation generated 1.55 PWH (or about 1,550 billion KWH) of electric energy, out of which about 66% was with coal and a total of 80% was with use of all fossil fuels.** Although solar and wind together generated about 6.5% of its electricity, this is still small compared to what it does with coal and oil. [45]

The World Energy Outlook for 2018 by the International Energy Agency and the International Energy Outlook for 2019 by the US Energy Information Agency, as well as India's own information, are projecting that **India will have the fastest growing energy consumption of any nation in the world,** and given the size and higher growth rate

of its economy, will be the second largest contributor (about 18%) to increasing global energy demand by 2035 (after China), and will consume more energy than the US by 2040. While wind and solar power are projected to grow in a big way, India is planning a significant increase in its nuclear power program, increasing the share of nuclear in electrical energy generation from about 4% to about 9% in the next 25 years. India has five nuclear power plants under construction and plans to add another 18 reactors by 2025, the second highest addition in the world. According to current policies, however, because of its high coal reserves, India is projected to continue to rely heavily on coal for its energy use, and continue to use coal significantly for electric power generation even up to 2050. India is aiming to do what China did from 2000-2019 – base its fast energy growth a lot on coal by using its domestic coal reserves. This will only add to a worsening of Climate Change as India's carbon dioxide emissions will grow. In 2017, India's GHG emissions were 2,380 MTCO2e (millions of metric tons of carbon dioxide equivalent), compared with China at 12,450 MtCO2e.

We now look at India's overall energy and electric consumption projections for 2050, as pieced together from the World Energy Outlook 2018 and the plan published by the Government of India. [26]



INDIA'S ENERGY CONSUMPTION PROJECTED FOR 2050

India's energy consumption is projected to rise rapidly if its economic growth rate stays comparable to today. The strategy for a very

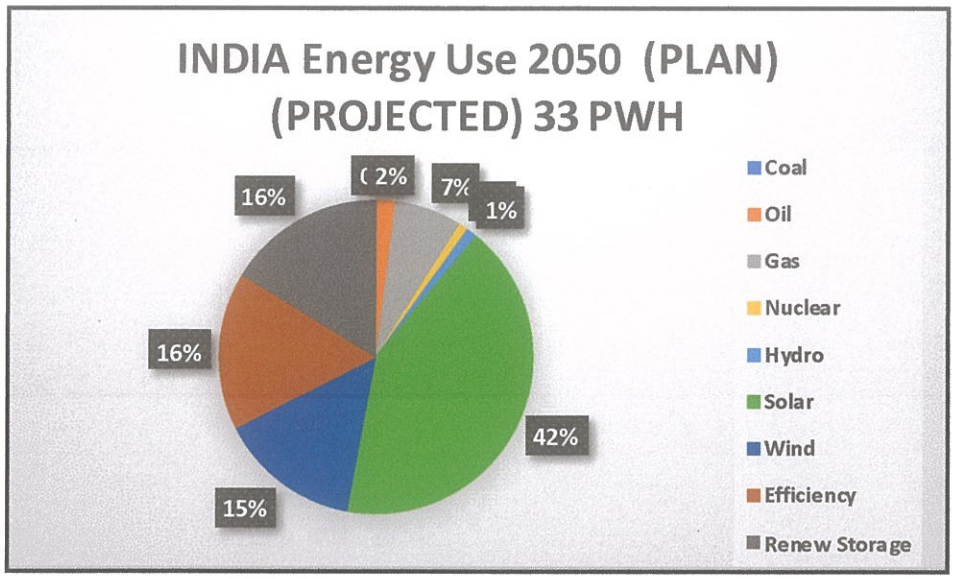
high reliance on coal becomes apparent (57%), with fossil fuels still dominating the energy consumption at about 83%. A big quantitative jump in renewables (solar and wind) is overshadowed percent wise by fossil fuels.

India's energy use is projected to more than triple from about 9.4 PWH in 2018 to about 33 PWH in 2050, becoming about equal to that of the US, and getting to be a close second to China (41-44 PWH). If this happens and since most of this is with coal, India's greenhouse gas emissions will grow to about China's level today, which are about 12,450 MtCO2e (million metric tons of carbon dioxide equivalent).

The Energy, Climate and Ecosystems Plan for India

The high level of the India's planned use of coal and oil use are clearly not favorable for Climate Change, and are not in India's interest, in both health and economic terms. The plans projected above clearly show the heavy reliance on fossil fuels by India, which plans to use its large coal reserves to power its economic growth, very similar to what China has done from 2000-2018, with some significant growth in nuclear energy and renewables. This strategy has clear disadvantages for India. Its reliance on imports of oil and natural gas are not good for its trade position. Its high expenditures on new nuclear reactors when even its thorium based technologies have not matured makes little sense. Its reliance on coal is not only meaning a very high level of pollution for all its citizens similar to China, but it means a massive increase in its greenhouse gas emissions, which only hurts India as it is one of the nations that is most vulnerable to Climate Change, as has been documented above.

So the Plan, as it has done for the world and for the US and China, proposes a massive replacement of all its coal fired power plants to renewable plus storage energies, an electrification of all sectors of its economy, the vast expansion of a durable, reliable and smart electrical distribution network, a big expansion of roof top solar by significant changes in its policies, a big expansion of small scale solar/bioenergy farms, a massive reforestation and afforestation effort, a massive enhancement of its land based wetlands combined with water harvesting, and the construction and rejuvenation of large scale coastal ecosystems, like its famous Sundarbans ecosystems to the east.



INDIA ENERGY USE PROJECTED FOR 2050 BY THE PLAN

The 2050 Energy Plan for India's shows a similar tripling of energy use (considering energy efficiency enhancements of about 16%). Fossil fuels are down to about 9%, and solar and wind have expanded to about 57% of the total. About 16% of the nation's energy needs are projected to be from non-carbon storage fuels produced from renewable energy (Renew Storage). With this, India will essentially be free of energy imports and its greenhouse gas emissions will be very low.

So here is the Plan description for India.

Energy, Climate and Ecosystem Plan for India

1. Energy use will grow from 9.4 PWH (petawatt Hours) in 2018 to 33 PWH by 2050. India has a very high solar energy resource, and with the low cost of solar electricity (demonstrated to be about US $1 per watt), solar energy will be India's mainstay.
2. ALL of the coal fired and natural gas electric power plants and captive or otherwise diesel generating sets will be **replaced** by a combination of renewable energy (mainly solar PV) and battery storage power plants, with evening night power provided initially by small natural gas plants and later by storage fuel power plants. It will benefit much from

improvements in health, cleanliness and beauty that the absence of coal brings.

3. ALL coal use in industry will be **replaced** by electricity based methods and the added electricity generated by Renewable energy (mainly solar PV), supplemented by use of storage fuels in applications that cannot be electrified.
4. With a high solar resource, solar-electric highways and roadways make a lot of sense, and will be implemented countrywide. Low carbon transportation modes need interlinking, from pedways and bikeways, linked to mass transit rail and bus lines, linked to high speed rail and all other modes.
5. India will need to engage in the technical and infrastructure programs to electrify its industry, transportation, and buildings, and produce the added electric power with use of renewable energy (mainly solar PV). India will need to expand its electric transmission lines 4 to 5 fold to meet the needs of full electrification of its economy.
6. India will participate in an advance RDD&D (Research, Development, Demonstration and Deployment) consortium for the development of green methods that use renewable energy electricity to produce and use storage fuels like ammonia and hydrogen, and develop the needed infrastructure for their use.
7. India needs to develop high speed rail throughout the country so as to replace much of the airline traffic, so that transportation within the country, both over long distances and within cities is "green" and zero carbon. This will massively reduce emissions from the burning of jet fuel for aviation. India should encourage and cooperate with South Asian, Middle Eastern and Southeast Asia countries in developing a high speed rail network that traverses this part of Asia, going all the way through Burma to Southeast Asia.
8. India has begun some reforestation. As part of the Global Plan to add 1 billion hectares (Chapter 6), India needs to bring the total to 30 additional million hectares in the non-mountainous regions. However, in the Himalayan region (hills and mountains) it needs to cooperate with Nepal and Bhutan to reforest and afforest the entire region, an added 20 million

hectares. This will do much to improve the micro-climate of the Himalayan region, and be combined with wildfire mitigation strategies during the hot dry summers.

9. India needs a massive program for coastal ecosystems along the lines of the global Blue Carbon initiative and add mangrove swamps, salt marshes and sea grasses. India's coastline length is about 7,500 kilometers (about 5,400 kilometers on the mainland, for the Bay of Bengal, Arabian Sea and Indian Ocean), and about 2,100 kilometers along its islands.
10. India then needs to cooperate with and collaborate with the rest of the world through the UNFCCC process and otherwise, so that the global Climate Change Action Plan can succeed. US, the European Union, China and India, as the biggest greenhouse gas emitters, should cooperate in this process to help the rest of the world, even as they aggressively implement their own plans.

Non-Carbon Storage Fuel Technologies for India

India, with its high level of solar insolation (which means that India receives a larger number of hours on the average of full sunlight), has solar panels that generate a significant amount of electricity. Instead of just 1,500 KWH (kilowatt hour or energy unit) generated on the average every year by 1 kilowatt (KW or 1,000 watts) worth of solar panels in temperate areas, solar panels of this size generate 2,000 KWH or more during the year. Also, considering that the cost of solar panels and total solar systems have been rapidly dropping, and will continue to drop, it makes a lot of sense for India to use some of its arid land areas to produce large amounts of "Green" hydrogen and ammonia, and store it and use it locally to produce electricity when the sun is not shining, or transport it to other power plants, or to the solar electric charging stations where it can be used as fuel for vehicles, to replace gasoline (petrol) and diesel and coal.

India already uses ammonia for agriculture in significant commercial quantities. As of January 2019, India's ammonia production capacity will grow from 15.6 million metric tons per annum (mtpa – million tons per year) in 2017 to 25.5 mtpa in 2022, about a 10.3% compounded annual growth rate (this compares with 175 mtpa of ammonia consumed globally). In 2017, about 93% of India's con-

sumption was used for urea and ammonium phosphate fertilizers. Imports as a percentage of consumption is expected to decrease from 15.8% in 2017, to 8.1% in 2022. [46]

So, the Plan is proposing, as for the Global Plan and as for other nations, that India invest heavily in every way in the green production of non-carbon storage fuels, as a way of storing renewable energy, (mainly solar PV energy), and making these gaseous and liquid fuels available on a commercial scale in transport, in generating electricity and in powering industry. In storing renewable energy in the form of storage fuels, India and the world will totally overcome the issue of the variable nature of renewable energy generated electricity and make it available as and when and where needed. India needs to cooperate globally with all the nations that are active in this area, even in the RDD&D (Research, Development, Demonstration and Deployment).

Being the biggest nation in South Asia, it should also cooperate with all the other nations of South Asia in meeting their own and global Climate Change goals – as all the needs of the region will be similar.

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[44] "India's National Action Plan on Climate Change needs desperate repair," Down to Earth Article, October 2018. https://www.downtoearth.org.in/news/climate-change/india-s-national-action-plan-on-climate-change-needs-desperate-repair-61884

[45] "India's Energy & Emissions Outlook," NITI-Aayog, 2019. https://niti.gov.in/sites/default/files/2019-07/India's-Energy-and-Emissions-Outlook.pdf

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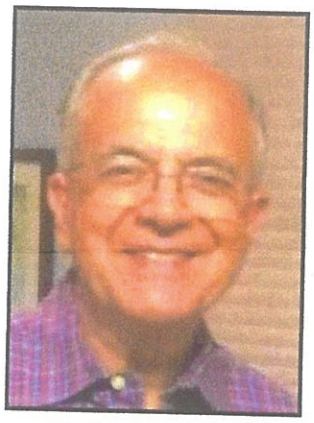
Contents of "Brighter Climate Futures" Book

ABOUT THE AUTHOR



The author Dr. Harinder (Hari) Singh Lamba, has experience in engineering, business and ecology. He has a Ph.D. in engineering from the University of Illinois at Urbana-Champaign, with about 40 years of experience in industry, both in engineering product development and in advanced technology. He migrated from India to the USA in 1970 with a bachelor's degree in Aeronautical Engineering. He was one of the founders of the Earth Summit Network, an informal organization formed in Chicago in 1991-92 to educate the local public about the Earth Summit, or the United Nations Conference on Environment and Development (UNCED) that was held at Rio de Janeiro, Brazil in 1992, where the original global warming treaty was signed. Since then he has been active in non-profit groups, talking about and making presentations on Climate Change.

Through his volunteer work and through self-education, he has also developed a good understanding of environmental (ecological), developmental (technical, economic, industrial and financial) and political (democracy) issues. **Because of his background, he has the unique ability to understand all aspects of the Plan and its solutions needed in energy, climate, economic development and ecosystems.** He has published a number of technical engineering papers and has technical patents. He is the author of a number of books including, "Rethinking Progress – Towards a Creative Transformation of Global Society," and a "Personal Climate Change Handbook," 2016, a 40 page book that is available on Amazon. ~~See below for a list of the author's books.~~ The author's aim in this activity is to see the Plan accepted, and something like the Plan implemented globally in a timely and effective manner.