Feature Article

Carbon Net-Zero by 2050: Benefits, Challenges and Way Forward

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Abstract

In accordance with the Paris Agreement, to which Sri Lanka is a Party to, global temperature rise must be kept well below 2°C relative to pre-industrial levels and efforts to limit the temperature increase to 1.5°C above pre-industrial level must be pursued. In response to this, countries who signed the UNFCCC, including Sri Lanka, submitted their Nationally Determined Contributions (NDCs) in 2016 which will come into force during 2021-2030. However, according to Emissions Gap Report 2021 (UNEP 2021), climate pledges combined with other mitigation measures put the world on track for a global temperature rise of 2.7°C by the end of the century which is above the goals of the Paris climate agreement which intended to keep the global temperature rise well below 2°C. Therefore, in order to address this alarming situation, many countries including Sri Lanka have given pledges to become carbon neutral by 2050. This means that the emissions from economic sectors will be reduced as per the NDC scenario and even beyond while increasing the carbon sequestration.

In this equation, plants play a unique role as they are the only organisms which can absorb atmospheric carbon dioxide in the photosynthesis function. According to the Third National Communication of Sri Lanka, forests/trees will contribute to 11.5% of the Green House Gas (GHG) emission reduction which is projected by all sectors in the country by 2030. It is required to increase this contribution to a much higher level in order to achieve carbon neutral status. In this context while drastically reducing the deforestation almost to zero, it is required to increase the tree cover in the country including natural forests and trees outside forests which includes home gardens, urban forests and avenue plants, coconut plantations, shade trees in tea lands etc.

Keywords: Climate change, Green House Gas, Net-Zero, Carbon-neutral, Forestry

1. What Is Net-Zero

Net-zero has become the rallying cry for the fight against climate change. It represents a viable target that scientists agree is necessary if the world is to avoid the most dramatic impacts of climate change. The idea of net-zero is often oversimplified, but in reality, it has many nuances and can be challenging to achieve. Net Zero status can be achieved by balancing emissions of carbon dioxide with its removal or by eliminating emissions from society. We must reach net-zero by 2050 in order to meet the global net-zero target of limiting warming to 1.5°C by 2100. It requires bold climate action to limit global warming. Adoption of Net Zero by 2050 move is a crucial and timely requirement to implement Nationally Determined Contributions (NDCs) submitted by the parties to the Paris Agreement for mitigating the greenhouse gas emissions that cause climate change and for adapting to climate impacts.

Before industrialization, the global environment had enough carbon sinks, or areas that would capture carbon dioxide emissions, to balance its natural production of greenhouse gases.

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This is causing environmental degradation in natural systems and leading to widespread climate change. As a result, global governments are working together to limit warming and reach net-zero carbon emissions. The transportation and energy sectors are the main targets for these policies because they account for a majority of carbon emissions (IEA, 2021). However, this change is happening in every aspect of the economy. To achieve net-zero emissions by 2050, serious action needs to be taken now. The global transition towards low carbon was already off track many decades ago. Now, we need ambitious policies and pledges to help shift the trend. Infrastructure needs to be built, economies need to be overhauled, and supply chains and industries that have not been changed in decades must be optimised. Net-zero is a win-win solution, an ambitious goal, and it requires collaboration and strong action.

Whether the world is up for the deployment challenge is an open question. A wave of countries pledged to go net zero following the Paris Agreement. According to the International Energy Agency these commitments of the countries now cover 70% of global emissions, and yet they still fall short of what is needed to limit warming to 2^{o}C by 2100. They reiterated that even if the pledges made were successfully implemented, it would leave roughly 22 billion metric tons of CO_2 emissions in 2050, resulting in a temperature rise of roughly 2.1^{o}C. Global emissions from fossil fuels were 34 billion metric tons in 2020. While it's useful to have this scenario on how we could reach a 1.5^{o}C target, it is important to emphasize that it is going to be a huge lift and will require much more political will by countries all around the world than has been evidenced to date (IEA, 2021).

1.1 How to achieve Net Zero Status?

According to UN, if everyone had access to clean, affordable energy, the road to a carbon neutral world – net zero emissions by 2050 – would be faster as energy production and consumption is the highest emitter of GHGs to the atmosphere. UN had launched a roadmap for clean energy transition during COP 26 Climate Change Conference in 2021 held in the UK. By 2025, the roadmap envisage that investments in the order of $35 billion and $25 billion needs to be invested into improving access to electricity and clean cooking, respectively. The roadmap also calls for subsidies for fossil fuel consumption to be re-directed towards renewable energy and energy efficiency. The world's annual investment in renewables and energy efficiency must over the same time frame. It also emphasized that by 2030, the coal power plants be phased out completely for member countries of the Organization for Economic Co-operation and Development (OECD), and phased out globally by 2040 (Koons, 2022).

Some of the other important milestones in this journey are; increase the share of electric automobiles since still it accounts for 5% of global automobile sales and it will need to represent 60% of new automobile purchases in 2030, increase the share of annual renewable installations, which hit a record 280 gigawatts last year, will need to exceed 1,000 GW. The Global Roadmap aims to achieve Sustainable Development Goal 7 – one of 17 Sustainable Development Goals established by the UN General Assembly in 2015. It pledges to "ensure access to affordable, reliable, sustainable and modern energy for all" by 2030.

1.2 Net-Zero In Asia

Asia's economic success over the past 5 decades has been coupled with remarkable achievements in reducing poverty and improving the quality of life. But the region's economic growth has also resulted in a significant increase in global warming greenhouse gas emissions. Asia's share of worldwide emissions increased from 8.7% in 1973 to 28% in 2010, and is expected to increase to 40% by 2030 if present industrial production and energy consumption growth rates continue (ADB, 2015). Asia needs to switch to a less polluting pattern of production and consumption while maintaining the growth and social development it requires. Energy consumption, the burning of fossil fuels in particular, is the main source of human-induced greenhouse gas emissions—the main cause of climate change. But energy is also a fuel for growth, particularly for the rapidly developing economies of Asia. The challenge

for developing Asia is to maintain economic growth while reducing the carbon content of energy and increasing the efficiency of resource use. The way in which Asia manages its future developmental activities in a low-carbon resource-efficient way is critically important, as the world increasingly looks to Asia for its growth. Asia can also be a model for measures to mitigate climate change. In achieving low carbon growth, pricing, including carbon taxes, tradable emission permits, incentives for climate friendly technology innovations, standards, and regulations—all of these instruments are helping emerging economies to tackle climate change and accelerate green growth.

However, an effective economic strategy to deal with climate change is not only about identifying the best tools; above all it is about combining and deploying the various available instruments in a coherent way. Low-Carbon Green Growth in Asia demonstrated that Asia has already started doing this to meet individual developmental needs while still achieving the overall objective of ambitious emission reductions. While these policies are replicable and can be scaled up, better regional cooperation is clearly needed (ADB, 2015).

1.3 Net-Zero in Sri Lanka

Sri Lanka is a small island nation located in the Indian Ocean with a physically diverse geography and tropical climate. Total land area is about 65,610 square kilometers and a total population of the country is 21.7 million. Being a topical island nation, Sri Lanka has been identified as a highly vulnerable country to the adverse effects of climate change such as temperature rise, rainfall variability, extreme weather events and sea level rise critically affecting almost all the economic sectors of the country. Occurrences of natural disasters due to extreme weather events such as prolonged droughts, flash floods and landslides deprive lives and livelihoods of people. Sri Lanka was ranked in 4th, 2nd and 6th positions as a most vulnerable country in 2016, 2017 and 2018 respectively according to the Global Climate Risk Index. About 74 percent of disasters took place between 1990 - 2018 were due to adverse impact of climate change, such as floods (58%), landslides (5%), storms (7%), and drought (4%). Damage due to flooding between 1990 - 2018 was estimated over USD 2 billion and half of which occurred in 2016 (MOE, 2022). The damages occurred in many sectors, namely, human settlements, health and nutrition, education, food security (agriculture, livestock and fisheries), industry and commerce, irrigation, water and sanitation, transport, power supply, employment and livelihood, and environment. Disaster risk in Sri Lanka is now mainly due to hazards and climate change. Flooding remains as the key hazard in many parts of the country. Similarly, droughts have had widespread adverse impacts over the country in 2016 – 2017. The drought experienced in 2016 -2017 which was considered to be the worst such event in the past 40 years (MOE, 2022).

Over the last decade, the country has shifted from a predominantly rural-based economy to an urban-based economy, geared towards manufacturing and services. The resulting economic growth has led to an increased demand for energy investment and use, which in turn has led to increased air pollution, GHG emissions, and growing economic vulnerability to volatile fossil fuel supplies and prices. The country had seen a steady growth in GHG emissions in several sectors.

According to Sri Lanka's Third National Communication on Climate Change to the UNFCCC, the energy sector represented the largest share of total national GHG emissions - 83% in 2016. This comprised of non-renewable power generation (electricity), transport and industry. The agriculture sector comprising paddy cultivation and livestock represented 8% each of the total emissions. This was followed by the IPPU (Industrial Processes and Product Use) 4% and waste (MOE, 2022).

Sri Lanka has taken several positive steps to response to challenges posed by climate change. Despite the fact that its GHG emissions is about 0.05% of the total GHG emissions in the world, it has committed to reduce the GHG emissions substantially by adhering to the Paris Agreement by submitting Nationally Determined Contributions to include targets for reducing GHG emissions focusing on seven priority sectors, namely; energy, transport, industry, waste, forestry agriculture and livestock which include 4% unconditional and 10.5% conditional with respective to Business-As-Usual (BAU) scenario

during the period of 2021-2030. It has introduced national policies, strategies and actions plans such as The National Climate Change Policy of Sri Lanka (2012), National Climate Change Adaptation Strategy for Sri Lanka in 2010, Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation and Mitigation in 2014, the National Adaptation Plan (NAP) and Nationally Appropriate Mitigation Actions (NAMA) for Energy and Transport in order to address climate change induced impacts. It also has committed to make Sri Lanka carbon neutral by 2050 to support the commitments of the NDCs.

With regard to the net zero drive, the country has prioritized the sectors to work on which are the most damaging in terms of GHGs. They are energy sector, transport sector, industry sector, waste sector and agriculture, forestry and other land use sector. In general the following directives had been identified across all the sectors;

- Promote low carbon technologies in all economic sectors through technology transfer and development.
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- To build the capacity of key economic sectors and relevant institutions to address low carbon development pathways and promote green jobs.

The more sector specific directives towards carbon neutral status based on the Low Carbon Development Strategy Sri Lanka by the Ministry of Environment (unpublished) are shown as follows;

2. Energy Sector

Introduce new policies and policy supportive measures: Mainstream low carbon measures in to national planning and development in energy sector; Introduce policy supportive measures such as tax benefits, low-interest national and international financing to expedite the implementation of renewable energy development and energy efficiency improvement programmes.

Improve energy efficiency and energy conservation: Improve demand side management and supply side management measures by promoting energy-efficient equipment; New technologies, and system improvements in a national energy efficiency improvement and conservation programme; Transmission and distribution network efficiency improvement; Reducing energy demand through lifestyle changes.

Promote energy diversification: Enhance renewable energy contribution to the national electricity generation mix by increasing solar PV, wind, hydro and sustainable biomass-based electricity generation; Facilitate the implementation of pilot scale project by using new renewable energy sources; Convert existing fuel oil-based combined cycle power plants to use natural gas and to develop new natural gas plants as alternative to planned coal power plants.

Build an enabling environment for energy development: Strengthen technology innovation and environmental protection as a means to set up a stable, economic, clean and safe energy system; Strengthen the implementation of various laws and regulations on renewable energy.

Promote carbon capture and storage: Develop national carbon emission standards; Engage in viable carbon trading mechanisms to promote the shift towards renewable energy sources; Set up carbon funds to promote investment in low carbon and development.

Use of Technology, research and development: Promoting investment in research and development for technological innovation and increasing public research development and deployment in innovative clean energy technologies; Develop stronger collaborative partnerships with the private sector on largescale research development and deployment projects.

3. Transport Sector

Introduce new policies and policy supportive measures: Introduce new national policy or improve/ amend relevant existing policies to promote low carbon sustainable transport modes; Introduce carbon pricing instruments (carbon tax/emission trading system) for reduce GHG emission and enhance the trend of carbon market.

Establishment of energy efficient and low carbon sustainable transport systems: Improve traffic light management; Improve parking management; Introduce intelligent transport management system: Shift fright to efficient modes.

Promote public passenger transport and well managed public transportation network: Rapid transport for passenger transport; Encourage and foster the use of non -motorized transportation; Encourage increasing investment into public transport; Improve road and railway transport infrastructure and facility; Develop and improve walking and cycling infrastructure; Making island water transport modes more attractive for users; Enhance park and ride system; Improve last mile connectivity.

Management of Fuel Quality Standards (FQS) of vehicles: Manage the FQS to minimize environmentally harmful emission and improvement of energy efficiency in vehicles; Reducing carbon intensity of fuels by substituting petroleum-based products by low carbon/zero carbon emission fuels (natural gas, biofuel etc;).

Encourage and promote electric mobility and low emission hybrid vehicles: Encourage and promote to use of electrified or hybrid vehicles; Facilitate the infrastructure development for use of those vehicles and increase tax concessions for electrical and hybrid vehicles.

Improve vehicle fleet efficiency: Improve efficiencies of existing vehicle fleet; Promote the import of fuel-efficient vehicles; Introduce programmes to change driver behaviors.

Change life styles for avoiding/reducing travel: Encouraging teleworking, and remote working and further promotion of Government online services as a means to reduce and avoid the need to travel specially to and from specific 'traffic hotspots', and during peak hours; (In this strategy consider the teleworking/ remote working possibility as a GHG reduction measure, addressing the dependency of productivity and transport. In order to support this further, government will be looking into promoting and incentivizing further remote working amongst the workforce and the enhancement, improved provision of online services).

Modernizing and upgrading of suburban railway and road infrastructure development: Electrification of railway lines; Develop new railway lines and expansion of existing railway network; Development of provincial and rural road infrastructure for improved mobility; Expansion of expressway network.

Improve the marine transportation system: Promote Sea transportation; Introduce energy efficient measures for coastal shipping and fishing vessels.

4. Industry Sector

Introduce new policies and policy supportive measures: Introduce new national policy or improve/ amend relevant existing policies to promote low carbon sustainable industries.

Promote clean and green energy sources and fuel switching technologies: Continue fuel-switching to sustainable biomass energy and improve user efficiency in selected appropriate industries/industrial sub-sectors; Develop and promote clean and green energy efficient production technologies.

Enhance cleaner production practices: Enhance the application of Resource Efficient Cleaner Production (RECP) practices in selected industrial sub sectors by promoting energy efficient appliances and technologies such as high-efficient motors, variable frequency drives, efficient chillers & refrigeration technologies; Adopting low carbon RECP technologies and process.

Promote green evaluation systems: Promote green purchasing; Carbon footprint calculations in industries; Green awarding; National green reporting system.

Establish eco-industrial parks and villages and Introduce tri-generation facilities to selected industrial parks: Transform existing industrial parks (IPs) incorporating maximum possible green industrial concepts; Introduce policy and regulatory regime; Including guidelines to ensure all new IPs will be set up as Eco IPs.

Introduce Circular Economy concept to selected industrial sub-sectors and selected industrial zones: Introduce the life cycle approach for greening the supply chain (minimizing transport distances, organic farming etc.); Practice industrial symbiosis concept for industrial parks and industrial sub-sectors; Promote zero-waste concept in industrial parks or industrial subsectors.

Build an enabling environment for low carbon industrial sector: Promote National Green Reporting System (NGRS); Enhance the availability of sustainable biomass for industry use; Facilitate transformational investment and favorable loans through financing institutions linking with green financing; Promote green procurement system: facilitate adopt relevant ISO systems having a focus on GHG emission reduction.

5. Waste Sector

Introduce new policies and policy supportive measures: Introduce new national policy or improve/ amend relevant existing policies to promote the integrated sustainable waste management to achieve the target of waste free country.

Improve ''Circular economy'' practices in solid waste generation sources: Facilitate for the proper waste management to minimize of waste production in industry, government, public and tourists by promoting 3R concept; Economic incentives to promote repair and reuse activities; Digitize office procedures; Exploring economic incentives targeting recycled materials in construction.

Promote a source separation system at the household level and implement a proper collection mechanism: Improve solid waste segregation; Collection mechanism and transportation system; Implement regulatory framework to control high waste generating products.

Use of biodegradable waste for production of organic fertilizers: Limit land filling to non-recyclable, non-compostable and inert material generated through waste treatment processes and improve the compost preparation system for each local authority to manage organic waste.

Enhance and promote energy generation by waste: Introduce energy generation by waste form mechanisms such waste to energy.

Manage industrial/hazardous and clinical waste in a systematic way: Establish institutional mechanisms to prevent hazardous biomedical/healthcare waste entering into the municipal waste management system and into Sri Lanka.

Build an enabling environment for sustainable and low carbon waste management: Introduce a mechanism for waste generation forecasting with a tracking system to monitor the generation; Introduce legislation to make segregation of waste at household level mandatory; Implement "Polluter Pays

Principle" for mixed waste generators; Establish a set of waste prevention guidelines for all functional events; Introduce legislation to prohibit the use of single-use plastics in public events (This measure can be introduced for single-use plastic items that are not already banned); Amend the building regulations to mandate a minimum of 10%-15% recycled materials in buildings; Setting up a waste prevention budget line to incentivize waste prevention initiatives; Provide economic incentives to support society in transitioning towards voluntary prevention and reuse initiatives; Provide economic incentives to support society in transitioning towards voluntary prevention and reuse initiatives; Create new business opportunities for greener products, repair services and secondary markets.

Increase community awareness and motivate to produce less domestic waste: Foster a culture of resource efficiency by encouraging alternative choices that contribute towards sustainable consumption; Changing attitudes towards preventing unnecessary use; and encouraging the repair and reuse of items rather than discarding them early in their economic lifetime.

6. Agriculture, Forestry and other land use

6.1 Agriculture and Livestock sector

Reduce post-harvest losses at every stage: Reduce post-harvest losses at field stage, transportation and delivery end; Promote value addition for fruits and vegetables; Promote/develop post-harvest management with environmentally friendly packages; Introduce proper waste management practices for agricultural waste; Promote to use of crop residues and postharvest losses for production of organic fertilizer.

Promote use of organic fertilizer, pesticides and weedicides: Aware the farmers use of excess amount of chemical fertilizer and promote to use of organic fertilizer/bio fertilizer which will improve the soil fertility; Develop the market for organic food products.

Promote Integrated Pest Management (IPM) practices: Introduce environmentally friendly biodegradable/bio pesticides and biocontrol agents for IPM.

Increase the crop production of unit land area to minimize the land use: Promote Good Agricultural Practices (GAP); Introduce high yield verities; Promote heat, drought, flood and salt tolerant varieties; Improvement water use efficiency.

Reduce food milage to ensure the use of low carbon food products: promote home gardening and introduce new technologies to cultivate different crop verities; Develop and facilitate railway system for transportation of vegetables, fruits and other food products; Encourage/promote use of unprocessed food at always.

Promote use of renewable energy in agricultural and livestock activities in all possible measures: Use of solar PV and wind energy for agricultural practices; Explore and develop small hydro power potential in irrigation water canals for agriculture purpose.

6.2 Forestry and Other Land Use sector

Increase forest cover of Sri Lanka up to 32% by 2030: Identify the lands and degraded lands and promote afforestation, reforestation and forest restoration.

Reduce deforestation and forest degradation: Promote reduction of emissions through deforestation and forest degradation; Support household energy plantations to reduce pressure on natural forests; Promote sustainable management of forests and lands to reduce forest degradation.

Improve quality of growing stock of natural forests and forest plantations: Improve the quality of growing stock of degraded forests and forest plantations.

*Increase river basin management for major rivers of Sri Lanka***:** Multi hazard prioritization of catchment or river basins; Strengthen catchment protection of cascade systems & isolated tanks through tree planting.

Promote growing trees outside the forests (Trees Outside Forests -TROF) to increase the tree cover: Promote urban forestry, tree planting along roadside, religious premises, schools and other Government lands, home gardens.

Introduce and facilitate for the Result Based Payments for conservation of the Forests: Develop or setup National Forest Monitoring System (NFMS), Forest Reference Level (FRL), Monitoring, Reporting and Verification (MRV) system and Safeguard Information System (SIS) for fulfill the requirement for Result Based Payment.

8. Key Challenges and Issues Facing a Low-Carbon Society

Establishing a low-carbon society poses a number of policy challenges and difficulties for emerging and low-income economies. Many studies indicate that significant potential for emission reductions exists in all economies in the order of 25% - 27% per sector (ADB–ADBI 2013), of which only a fraction has been achieved so far. The carbon intensity of developing Asia remains 1.4 - 4 times greater than that of the G7 industrialized countries. The opportunities available for a low-carbon society have remained largely unexploited because of scientific, economic, and geopolitical uncertainties about the following;

- Domestic and international access to financial resources;
- The nature, timing, and extent of local biophysical impacts as a result of climate response;
- The development and costs of new technologies that will reduce reliance on carbon-intensive processes; and
- The level of ambition and the likelihood of international cooperation to reduce carbon emissions

The net zero emissions by 2050 scenario calls for profound transformations in the country's economy that is both decarbonized and able to support a economy which may be twice the size of today's in 2050. Despite the policies, plans, technological and other interventions, net zero emissions in 2050 cannot happen without the consent and active support of people. In part, this involves one-off events that are not counted as behavioral changes but involve a mixture of low carbon technologies and people's engagement, However, behavioral changes – meaning adjustments in everyday life that reduce wasteful or excessive energy consumption – are also needed.

Many developing countries in the region including Sri Lanka have committed themselves politically to low-carbon society objectives but many have yet to match this with the necessary policy actions and financial allocations. However, it is apparent that this is a win: win situation for all and it is imperative to find solutions to the aforesaid challenges by way of policy, strategy, action plans, bi lateral and multi-lateral cooperation, technology transfers, provide easy access to international green funds etc. as soon as possible in order to realize the positive benefits of moving towards carbon neutrality.

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