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Climate Economics Series: Paper 1

Climate Economics and the Changing Dynamics

March 2021

Prof Amitav Mallik Trustee, PIC & TEAM EECC, PIC





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Foreword

ver the years, scientific research has proven that we are creating a big gap between our economic aspirations and environmental well-being. Environmental issues like Climate Change are becoming ever-growing threats not just to India but to Humanity at large. Thus, the responsibility to reduce carbon is equally shared by the government, industry and the civil society. Every citizen is a stakeholder and an actor in addressing socio-environmental issues. Humanity needs to focus on finding solutions which will help to simultaneously achieve economic progress and environmental stability and more importantly, better quality of life for the present and future generations!

Mankind is already struggling in a 'Climate Challenged World with multiple simultaneous disruptions. It is estimated that every 1 USD invested on climate action today will provide over 5 USD benefits by 2030. The actions needed for ensuring the earth's environmental stability, on which all our activities and systems are based, are many compounding issues like climate change, ecosystem restoration (oceanic and terrestrial), agriculture, biodiversity loss and social equity. This paper, however, focuses on the economic and developmental priorities that need to be updated to achieve climate action along with human and environmental well-being.

To bring forth the urgency of these issues, the EECC Group (Energy, Environment and Climate Change) of PIC organized a virtual two-day conference on 22nd and 23rd January 2021. It was convened by Prof. Amitav Mallik, who leads the EECC, PIC group. It brought together 17 speakers with diverse experience and expertise, over 4 online sessions. Dr. Rajiv Kumar, Vice-Chairman, NITI Aayog and MP Vandana Chavan, Rajya Sabha, delivered special addresses at the Conference. The concluding remarks were given by Dr. Vijay Kelkar, Vice-President, PIC. It was organized in collaboration with Climate Collective Pune, Ecological Society and Indian Network on Ethics and Climate Change (INECC). This paper includes the key take-aways from the conference.

We can foster human ambitions without jeopardizing environmental health and security if we make the right decisions within this decade. The Post Covid-19 economic recovery presents a great opportunity for a major 'course-correction' towards a more Resilient and Green Economic Strategy. This alone can support economic progress without further damage to the stability of our environment and systems. Citizens, industry and governments need to unite to identify the changes needed to achieve Environmentally Responsible Development. In this paper, we propose that India should adopt an Integrated Econo-Enviro Framework to define as well as plan development.



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Introduction

When the term of the modern society and science is based on predicting the future and ensuring stability and progress of the human activities for the future. It is, however, having a boomerang effect with our current activities, making the future more and more uncertain due to anthropogenic Climate Change and environmental degradation. The future holds more uncertainties, reduced predictability, increased incidences of epidemics and pandemics like Covid-19 and increasing impacts of environmental degradation. The Covid-19 pandemic has pushed us to think about the economic costs of talking only about growth without considering social and environmental concerns.

Climate change is leading or fuelling various disasters and extreme events at a pace even faster than scientists predicted. Cities are becoming heat islands and energy guzzlers, producing enormous amounts of waste and air pollution, being callous about impacting biodiversity and compromising the quality of life. Climate change is now an economic, developmental and social concern; and most of all an existential concern for several people world-wide. Although there are some efforts to reduce emissions from citizens and industries, in addition to government actions, a lot more needs to be done. As stated by Dr. Rajiv Kumar, VC, NITI Aayog, at the PIC conference, "The (climate) emergency is upon us and we don't have the luxury of retrofitting it afterwards, so our development model has to create this balance between these three – Energy, Environment and Economy, going forward."

Thanks to technology and innovations, we can now have combined capacity for sustaining economic performance and reducing climate risk simultaneously. The earth environment is getting warmer and at this rate, it will cross the 2-degree Celsius mark, which is not acceptable for economic progress. Further Global Warming will certainly destabilise the environment irreversibly. The consequent disaster management and economic recovery will entail huge economic costs. Every USD invested today on climate action will provide over 5x USD benefits by 2030. Environment and economics are now intrinsically inter-connected to human health and wellbeing, particularly for the young generation of today and in the future. If earth environment is not stabilised quickly, it will shrink the comfort zone of mankind.

The climate-economic impacts will be different for different nations and their people, causing extreme and uneven societal stress leading to chaos, conflicts and even wars. Post COVID-19 economic recovery presents a great opportunity for a major course correction in moving towards a more resilient and green economic strategy. This alone can support economic progress without further damage to the environment. Investing in new technologies and practices can significantly

reduce the upfront costs of sustainable infrastructure, benefitting both advanced and emerging economies.

The responsibility to reduce carbon is equally shared by the government, industry and the civil society. Every citizen is a stakeholder and therefore, awareness about climate change must be spread throughout the society and at every level. The triple conjunction of Energy, Environment and Economics must turn into a mass movement. Our way of development must recognize that 'Man lives in nature and must not try to conquer nature.'

The earth environment has been the bedrock of modern economy and acts as a sink for human emissions and waste. Mostly economic models are designed considering that although human activities will exploit resources, they cannot exceed earth's bio-capacity. However, by considering resources as infinite in a finite world, we are now exceeding the ecological and planetary boundaries. The negative impacts on environment are costing us economically with far-reaching socio-economic impacts on development, leading to growing threats like climate change. Focusing on the standard of living (in the short-term) at serious environmental costs is hugely degrading ecosystems necessary to sustain human well-being, at a fast pace.

This paper aims to build up the narrative for inclusive green economic development and explores ways in which it can gain momentum. Chapter 1 deals with imperatives for transition in India's economic models and the country's environmental vulnerabilities. Chapter 2 deals with alternative development models and shift in decision making to achieve green development. Chapter 3 proposes greener energy future to meet our energy demands in a sustainable manner. Chapter 4 recommends reforms in decision-making to achieve Green Development goals for India. This paper makes a case for a strategic shift needed in development priorities to ensure sustained economic growth and progress.



Chapter 1

Environment and Economy Interdependency

Chapter 1. Environment and Economy Interdependency

urrently, the top five global economic risks are all related to environment – Extreme weather conditions, Climate change failure, Natural disasters, Biodiversity loss, and Human-caused natural disasters. The global average temperature is set to rise by 30°C by 2100. Climate change is striking harder than expected. Mankind is already struggling in a climate challenged world with multiple simultaneous disruptions – both environmental and economic. The vital role of natural ecosystems and biodiversity in maintaining economic and social stability is becoming clearer now. Our way of development must recognize that man lives in nature and must not try to conquer nature.

We need to realise that nature is a supplier of services and raw materials, an inspiration for design and our greatest ally in securing human needs. This is not just from an understanding of the ecological view but also from a huge body of economic evidence as well. Poor environmental quality affects economic growth and well-being by lowering the quantity and quality of natural resources and environmental health. Rightly designed environmental policies can curb negative feedbacks from the economy on the environment (and vice-versa). To achieve this, the Indian economic model must emphasize on 'rational demand' without chasing 'unlimited consumption'.

1a. The New Reality of Climate Economics

Natural disasters alone caused up to \$225 billion global economic losses in 2018, at just 1°C warming. Sea level rise and warming can exacerbate negative impacts of atmospheric pollution, environmental degradation and diseases. Climate change is fuelling increase in frequency and intensity of extreme weather events like forest fires, floods, heat waves, droughts, cyclones, etc. across the globe. These non-linear catastrophes have far-reaching impacts and hence, all damages caused by them can neither be predicted nor be controlled.

The global economy has grown enormously ever since the industrial revolution and has led to exploiting all the natural resources exponentially. By 2030, cities are expected to cover three times as much land as they did in 2000, with many expansions occurring in key biodiversity hotspots. Today, we don't have the luxury to spoil nature and retrofit it in the future like we have done for such a long time. We need to build a lifestyle of balance, satisfaction and care for the nature. To tackle Climate Change, global greenhouse gas (GHG) emissions must peak in 2020 and the world must cut emissions by 7.6% every year in this decade to increase the chances of keeping global warming below 1.5°C. This implies that the carbon budget, is at 495 gigatonnes (GT) of CO2 from 2020



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onwards, which is 48% smaller for staying well below 2°C and 65% smaller than the 2°C budget.

The earth environment is on the way to becoming warmer than by 2 degrees Celsius, which can destabilize the earth environment irreversibly. Governments, industries and communities will have to drastically reduce GHG emissions and build ecological resilience going forward. Institutions and communities that don't adapt to the climate-challenged world may get exposed to serious operational, financial and socio-economic consequences. Environmental issues can only be addressed by acknowledging the rights of nature. The world needs to urgently develop long-term low carbon strategies to achieve social ambitions without overusing the earth's resources.

India is the only major economy likely to achieve its '2°C compatible' Paris commitments if no new coal-based power plants are added. Although it ranks 9th in the Climate Change Performance Index, India's geographic location, high density of population and poor infrastructure makes it extremely vulnerable to climate-induced economic disruptions. India ranked 5th in the global climate vulnerability ladder and suffered an economic loss of \$37 billion in 2018 alone due to climate change. The social cost of carbon for the Indian economy is up to \$210 billion/year and about \$86/tonne CO2 emissions. India also ranked a lowly 168th among the 180 countries in Environmental Performance Index 2020. Hence, raising climate ambitions and rapid environmental restoration will richly favour both India's economic resilience and economic aspirations.

1b. India's Climate Vulnerabilities

India is climate vulnerable due to its geographic location and economic dependence on climatesensitive sectors like agriculture, fisheries, etc. Climate change is causing irregular precipitation and rapid ice-melting in the Himalayas, which occupy 16% of India's total area and are known as the 'Third Pole' due to their immense ice-cover. A 2°C temperature rise will make the Indian monsoon highly unpredictable. All the human settlements along the Indian coastline, spanning 7516.6 km, are increasingly facing impacts of sea level rise and extreme weather events. The per capita availability of fresh water in India is expected to drop below 1000 m³ by 2025 due to population growth and climate change.

Additionally, forests are highly disturbed and over five million hectares (mha) are in a degraded state in India. Although some continual increase in forest cover from 65 million hectares (mha) in 2001 to 70.8 mha in 2017 is seen, 29,534 hectares of forest land was diverted for non-forestry purposes in just four years, from 2015-19. The forest cover increase seen is largely due to compensatory plantations which cannot support local biodiversity or provide the ecosystem services associated with native ecosystems. Just tropical forests in India can provide about \$2355

Int.\$/ha/year (2007 price levels) worth of ecological services like carbon sequestration, ecological resilience and climate adaptation. Thus, India can adapt and mitigate climate change simultaneously by restoring and expanding our land, water and oceanic natural ecosystems.

Agriculture in India is vulnerable because of changing climate. Higher temperatures tend to reduce crop yield and also increase the risk of pest and weed. Rain-fed agriculture in India is also getting affected because of irregular precipitation pattern and changes in water availability. Yields from rice, which is the main crop of India is experiencing larger decline due to extreme weather conditions. Climate change is affecting the agricultural sector in India negatively and on the other hand, the demands for food and other agricultural products are rising because of growing population and expectations for improved standards of living. To manage this situation, India needs to take suitable policy actions with scientific interventions.

Some climate impacts are now inevitable. The recent spate of disasters in 2020 like Cyclone Amphan, Cyclone Nisarg, locust attacks and the Chamoli glacier burst are eroding our economic, natural and human capital. India had the highest number of people, 2.678 million, displaced by disasters and extreme weather events in 2018. Secondly, over 363 million people live under the poverty-line in India and carry the greatest climate risk. When exposed to natural calamities, they are seven-times more likely to lose their lives and six-times likely to be injured or displaced, than those in high-income communities. The IPCC 2018 report predicts that if current climate change and land holding trends continue, roughly 600 million people i. e. half the Indian population, could be directly or indirectly impacted due to climate change. Thus, countries such as India, with large populations dependent on climate-sensitive sectors and low adaptive capacity, have to develop and implement climate resilience and adaptation strategies. The governments need to commit to addressing climate action imperatives like emission reduction, green technologies and increasing resilience through governance reforms.

1c. Advantages of Green Development over Business-As-Usual

The ecological footprint exceeded the bio-capacity somewhere in the late 60s or early 70s and this growing bio-deficit over time is increasing vulnerability of the human system and eroding the resilience of ecosystems and economies in the long run. This ever-rising human footprint has given rise to ecological crisis and similarly, increasing carbon emissions have led to the climate crisis. These crises can be directly linked to the drive for 'limitless growth' which drives up resource demand unsustainably. As long as our resource demand grows exponentially, it will be unsustainable and if pollution also keeps rising exponentially, it will create un-survivable conditions. The minimum requirement for long-term sustainability is - our resource demand must flatten and pollution must diminish to make our system sustainable and survivable.

Under the business-as-usual scenario, the world's GHG emissions have roughly doubled since the early 1970s. As a result, atmospheric concentrations of CO2 and GHGs will increase to about 525 parts per million (ppm) and 650 ppm CO2 equivalent (CO2eq) respectively by 2050 and continue to rise thereafter. This could cause mean global temperatures to be about 2°C higher than they were in pre-industrial times in 2050, about 4-6°C higher by 2100 and higher still beyond that. The longer we wait to take action, the more we are going to pay in the long-run. Business-as-usual is clearly not a viable economic option any more. We either decarbonise our economies or we let global warming fire up costs for businesses and societies world-wide.

Climate related events across the globe in 2017 caused total losses of \$320 billion. World Bank estimates that pollution in India is costing the country over \$55 billion/year. Globally 87% cities are in breach of WHO air pollution guidelines, meaning that billions world-wide are exposed to dirty air and toxic emissions due to burning of fossil fuels. By 2050, cumulative damages from climate change may reach \$8 trillion, impoverishing world gross domestic product by 3% with the poorest regions affected the most. To secure the economic welfare of the people in these times of global warming, we need to balance the costs of climate change mitigation and those of climate change damages. Current economic models like GDP which heavily focus on economic growth are incompatible with environmental sustainability. The rising economic costs of environmental damages reveal that economic systems driven by these models are not resilient enough, especially when climate change is adding fuel to the fire.

The road networks and infrastructure that we are creating are binding the future generation to unsustainable living. Great disparity exists in the world following the 'Champagne Glass Theory' which shows that most of the world's resources and wealth, up to 85% of it, is taken up by the top 15% of the population. The rest of the 15% is spread among the rest of the 85%. This is unequal

distribution of our resources. We are also using up the resources of 2 Indias every year. So, there is a big question: what kind of growth can we have with depleting resources. To continue on the path of sustainability, we should look at the emissions per capita or look at the material use per capita. We have to drastically improve our efficiency and move away from a champagne glass to a glass of water that allows for equal distribution of resources and wealth. We need to be at that point where we have low ecological footprint while having high HDI at the same time.

Bold and urgent actions are required to slow down the anthropogenic climate change and restore the environmental stability for human well-being. 35 Nations have already managed to grow their economies and reduce emissions by 2015. The UN estimates that bold climate action will trigger at least US\$26 trillion in global economic benefits by 2030. The political profile of green issues is higher than ever, and the costs of renewables are falling fast. Climate resilient development will be crucial to minimize risk and maximize opportunities. This requires decision makers to identify 'triple win' strategies that generate climate adaptation, mitigation and development benefits. Starting to plan climate resilience will help the community and businesses by reducing the cost to recover from the economic shocks, getting a jumpstart on pursuing new opportunities, investment and businesses.

Many times, environmental degradation is perceived as a population problem. It is not so, as the means to sustain the population within the bio-capacity exist. If we can't sustain livelihoods and lives, the population will decrease. We are at a cross-road where a decision is required now. In fact, we are in a phase where decisions should have been taken 10 years ago. But looking forward, we have only 10 years according to the world scientists' body – IPCC, to make things right. If we don't do this, the opportunity is lost. We need to adopt the Zero Eco-Imbalance policy approach. Change in the preference structure of society and redistribution of income and wealth is needed for the reduction in growth rate. Policy initiatives and actions need to be combined with an intellectual, emotional commitment to humanity along with genuine political will, so that there will be universal and equitable sharing of rights to global resources, which is required for the development of all.

1d. Synergizing environment and economy

The complex and interactive systems which shape our economy, ecology and society, make any sort of development challenging. But sustainable development can be accomplished by interactive, iterative and strategic shifts in planning and decision-making. Awareness about what is environmentally friendly and what is an environmental misdeed among all citizens is very important. Making environmentally prudent decisions is critical for our long-term well-being. We need to combine economic, environmental and social means to ensure a more stable and less damaged planet. The path to climate and environmental action is not through stopping economic



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growth, but through steering it towards environmental sustainability and simultaneously, far away from mindless environmental destruction.

Synergizing economic and environmental goals can help to shape and redesign our strategies towards a more sustainable future. For this, Green Economy can create a focus on investment, capital and infrastructure, employment and skills for positive social and environmental outcomes. It will influence and address many other factors like scarcity of resources, foreign competition, structural changes and technological changes for responsible economic growth. On the other hand, unsustainable consumption patterns can increase socio-economic and environmental costs and decrease productivity. Poor environmental quality negatively affects the economic growth and well-being by lowering the quality and quantity of natural resources. It is estimated that cities investing in going low on carbon (GHG) emissions may contribute to net present value of US\$16.6 trillion by 2050.

To achieve synergy, the alternative economy must look at nature as an operating system for life forms and an operating system for the economy rather than provider of inputs. It means nature is the provider for renewable and non-renewable energy which is the input for the economy. It is also an enabler of life-sustaining capacity and ecosystem services which are essential to the economy and most importantly, it provides security to all life forms. For ecosystem services, we should track bio-indicators, ecosystem productivity, soil health, pollution abatement etc. The UN SDGs too not only lay down Climate Action as an agenda in Goal No. 13 but almost all others directly or indirectly address the issue, like Goal 6 - clean water and sanitation, Goal 7 - affordable and clean energy, Goal 11 - sustainable cities and communities, Goal 12 - responsible consumption and production, Goal 14 - life below water and Goal 15 - life on land.

Relying on fossil fuel economy now will only create more losses and problems for the energy, environmental and economic sectors. A rapid shift to renewable energy (RE) will be economically highly beneficial. To focus on environmental stability and economic growth simultaneously, we also need to change economic indicators and models, so that we can do well without over-exploiting the earth's environment. We must rethink of planning, development and management to synergize economy and environment objectives. The triple challenge of energy, environment and economy must be given importance not only for our economic growth but also for the aspirations of our younger generation. We need to develop economic models that integrate environmental and economic policies while prioritizing human well-being.

The wealth of a country should be defined on not just produced and financial capital but also atural, social and human capital. Besides, the produced and financial capital too should focus on distributive efficiency and not just economic growth. Governments need to change policy priorities

to achieve synergy between environment and economics by focusing on factors like renewability, food and nutrition and ecosystem services with a focus on non-anthropocentric security for all life forms. These can be measured using proxy indicators or indices. Some enablers for reaching econoenviro synergy can be revamping agriculture and food sector, regional planning based on biogeography and agro-climate, decentralized democracy, activation of CRPs, restoration and conservation economy etc.

The idea often embedded in the mainstream economics that 'all growth is good' has led to unprecedented problems for the world. Rather than taking a simplistic pro or anti-growth view, finding the balance between the right mix of economic growth and environmental stability will be most crucial for determining the future of our civilization. Today, technology options for energy are available and are as competitive as fossil fuels in terms of power and cost. Solar, wind and waste to energy projects must be taken up by industries. The government too has ramped up its targets for solar. The responsibility to reduce carbon is equally shared by the government, industry and the civil society. Every citizen is a stakeholder and therefore awareness about climate change must be spread throughout the society and at every level. To summarize, economy and ecology are emerging to be two sides of the same coin and need to be addressed together.



Chapter 2

Green Development: A Low Carbon Pathway

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rom the start of the 21st century, India's annual average GDP grew at 6% to 7% and during 2014 to 2018, India was the world's fastest growing major economy. According to the Economic Survey 2019-20, India has set a target to become a 5 trillion USD economy by 2025. Today, we know that business services, manufacturing and agriculture sectors form the major backbone of the Indian economy with the service industry (IT and business outsourcing) contributing to more than half of India's economic growth.

However, according to the World Bank report, the annual cost of environmental degradation in India amounts to about Rs 3.75 trillion (\$80 billion), equivalent to 5.7% of GDP. Hence, the growth sectors mentioned above are highly vulnerable to climate-related economic downfall as highlighted very well by RBI and the World Bank estimates that targeted policy interventions can reduce environmental vulnerabilities in India at minimal cost to GDP. Hence, by not addressing environmental concerns, we are incurring huge cumulative environmental costs which can hinder or counter the gains we make in terms of economic growth.

Despite growing the economy at a rapid pace, we are witnessing a global climate challenge, toxic pollution levels in the air, soil and water bodies, which are essential to sustain a healthy and prosperous life. This century, we have challenges in India like rising population, alarming rate of construction and material extraction, rising GHG emissions, growing per capita consumption, poverty and hunger. We are facing major challenges in the economic, social and material facets and we are losing ground on each front including, losing topsoil, forests etc. that are intensified by the increasing climate crisis. To reiterate, the most famous development model that is used gives equal consensus to planet, people and profit in 3 intersecting circles, for which the current economic model uses GDP as a metric for economic growth that is based on monetary gains, assuming it will be used for the growth and development of the nation. But in reality, the planet precedes people who precede profits, as there are other important factors too. Once such a model is adopted, planning and policy can and will go low carbon and promote green development.



Figure 1: Shift in Decision-making

In the 19th century, companies were blatantly profit-driven and had no issues in exploiting people as well as the environment in order to make a profit. Looking at trends, businesses in the 19th century were operated in a conflict of environment vs. welfare vs. economy. In the 20th-century, businesses started to become people-friendly and the conflict of environment vs. economy was excluded wearing the welfare mask in the 20th-century. In the 21st century scenario we have now accepted that while making a profit, business activities should be people-friendly as well as planet-friendly.

2a. Green Development Models

Since most of our activities are economically driven, it is important to question what real impact does the GDP led economic growth entails on the development of a nation. The accepted definition of economic growth refers to an increase in real national income / national output and economic development refers to an improvement in the quality of life and living standards. It is expected that economic growth would enable more economic development. Although this link has worked in some nations, the link is not guaranteed. Even though countries are revered for the GDP rise, such an economic model is not necessarily able to factor in or capture the externalities, such as the impact of pollution on biodiversity and human health with its related economic consequences.

Hence, in order to sustain social and economic life on earth, it will become imperative for nations to take an alternative – 'Green Economic' approach, one that is socially, environmentally and economically inclusive. A Green Economic model is one that results in improved human wellbeing and social equality while significantly reducing environmental risks and ecological scarcity. It is an upgrade over the current GDP based economic model that entices growth within an economy but cannot account for human well-being or environmental risks.

Such an economic model is possible for India by using a suitable combination of Low Carbon Economy and Circular Economy. It has a huge potential to create jobs for the least educated people and it is capable of conserving traditional knowledge. These economic models have proved to be very valuable for countries that have adopted it. The European Commission recently estimated that green economic transitions can create 600 billion Euros annual economic gains for the EU manufacturing sector alone. Such studies need to be conducted in India too, as the growing manufacturing sector can benefit immensely from it if combined with our Atmanirbhar Bharat policy and aspects of Industry 4.0.

Circular Economy: In the linear economy, raw natural resources are taken, transformed into products and disposed of. On the other hand, a circular economy model aims to close the gap between the production and the natural ecosystems' cycles – on which humans ultimately depend upon.

By doing so, Circular Economy provides added value to a region giving jobs, improving efficiency, making investments and solving waste problems. Circular Economy is also about "managing materials more intelligently." It involves breaking away from the take-make-dispose model to using the principles of designing out waste, system thinking, use of RE, thinking in cascades (step-by-step way to improvise and adapt to CE). At national level, this type of an economic model is estimated to boost annual gains, for example 2.5 billion Euros for Finland's economy and may benefit 1000 billion US dollars to global economy annually.

Low Carbon Economy: A low-carbon economy (LCE) or decarbonised economy is an economy based on low-carbon power sources or technologies, which therefore has a minimal output of greenhouse gas (GHG) emissions into the atmosphere, specifically carbon dioxide. Urgently shifting to a low carbon pathway will have immense benefits for the future as today's development and investments lead to technology lock-ins for decades to even a century. The road networks infrastructure that we are currently creating is binding the future generations to unsustainable living.



In a Green Economy, we can also move tracks from globalization towards localization as it will help businesses to cater to local communities by using local material, energy and human resources. To localize energy use shift from fossil fuel to renewable and to make the shift effective, it is important to adopt high efficiency. The shifts in thinking will help the realization that while businesses are finding it hard to give up their prioritization of profit-making, the profit-making itself, will depend on the conservation of the environment and delivering social good.

2b. Incorporating Low Carbon Economy in all Decision-Making

According to the commonly acknowledged Kuznets Curve hypothesis, once the tipping point is breached, we see a downward trend in consumption of resources, but we are not seeing that. Resource use just keeps on growing! Hence, if we follow this model, we will be obliterating our planet's resources. Our natural resources like topsoil, ocean fish, water supply, phosphates and rare earth minerals are all under threat of depletion. Dr. Khosla from Developmental Alternatives shared some studies that show that we are using up the resources of 2 Indias every year. So, there is the big question of what kind of growth can we have with depleting resources. According to the Kuznets Curve, a poor country becomes rich and clean and then tries to clean up. But India cannot go on such a road. We must tunnel through the Kuznets Curve to avoid catastrophic resource degradation and environmental impacts.

RBI in its Annual Report 2019-2020 reported, "Given that the impact of climate change on India is expected to be one of the severest globally, the need for an appropriate framework to identify, assess and manage financial risks arising out of climate risk has become an imperative. Central banks and regulators need to provide leadership in the propagation of the ESG (environmental, social and governance) principles through the standardisation of the ESG investment terminology, design of a standard disclosure format for firms and by incorporating ESG principles in financial stability assessments."

The RBI has clearly highlighted the need for robust and innovative investment schemes that direct Green Development. Foreign companies and banks are now prioritizing green investments in developing nations and India must create the paradigm shift to attract these foreign green investments. We need to keep in mind that correct finance and policy priorities can play a big hand in making a smooth transition; hence we need to first analyse our growth targets, understand its costs and benefits, plan for a transition and synergize it with the economy.

It is argued that a Low Carbon Economy can be very appropriate for developing countries given that most of these countries have opportunities to build new infrastructure and industries and therefore, can move to a green economy faster than well-established developed economies. In FY 2019, subsidies for oil, gas and coal amounted to INR 83,134 crore (USD 12.4 billion), compared to INR 11,604 crore (USD 1.7 billion) for renewable energy and electric mobility. Concentrating on providing incentives such as subsidies to green products, start-ups, reusing or recycling of raw materials and product sales subsidy (as done for EVs), should be focused upon. Such policies can drive consumer demand for green products/services as well as help revive environment stability.

Businesses are slowly realizing that changing consumer behaviour and adapting to climate change policies are one of the greatest commercial opportunities of this century for economic growth. Keeping efficiency at the forefront of business and using renewable energy has proved to cut costs and boost profitability for a company. Most notable examples include sustainable technology company – Tesla Inc. that has already been named the world's most valuable car company valued at 208 billion USD with a portfolio ranging from electric vehicles to solar energy generation.

The companies that are turning the climate challenge into a market opportunity to drive a change within their business practices can be rewarded economically. In the process, they would also help to create thousands of green jobs. India's shift to a green economy could add 3 million jobs in the renewable energy sector alone by 2030. This sector created 47,000 new jobs in India in 2017, employing 432,000 people, as per a July 2018 India Spend report. About 24 million jobs could be created by transitioning to a green economy, which includes activities such as recycling, rent and refurbishing and ecosystem services such as air and water purification, soil renewal and fertilisation and energy sector, according to the International Labour Organization.

National Outlook:

So, one of the biggest questions that remain is, why push long term low carbon growth now, when India has other challenges in food, water, agriculture, poverty etc. The truth is, there is no other choice. So, why is low carbon the best choice for the Indian economy? The entire global economy is making a technological shift, as has happened many times in the past. Sustained push for green economic growth will come from political, social, innovations and all must to come together to accelerate this technological breakthrough. Integration of climate change policies into other policy areas is necessary for successful Climate Action and sustained economic progress.

Once low carbon transition happens, it will result in changes in farming, water use, energy management, transport use etc. once you transform into a new technology it takes time to adapt to it. But if going low carbon doesn't work for India, it will hit it worse! The sheer size of our economy also makes it vulnerable. The pandemic has played out most hard in USA and India. Imperatives set



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by global leaders in technology and the large area and population of India will also make changes that don't work very difficult to manage. Hence, India as a country is tied in much more to planetary boundaries compared to the rest of the countries. Yes, we didn't cause the problem, but our current ambition makes it imperative to find a solution!

2c. Energy and Material efficiency

India extracts 1,580 tonnes/acre of natural resources, which is more than three times the average global extraction rate of 450 tonnes/acre! This resource-intensive growth is associated with air pollution and is harmful to lives and livelihoods, especially of the low-income groups. GDP can grow, as long as it is compatible with social and planetary boundaries. When not, the processes should be changed or redesigned to ensure low carbon development. This can be pushed by putting a price on carbon through a carbon tax or a cap-and-trade scheme. If handled rightly, following policies for Green Low Carbon Economy can deliver huge socio-economic benefits from clean air to green jobs.

If a business engages in zero-discharge manufacturing, its investment in the process would automatically result in energy and material-savings and improved profitability over time. So, there is no longer a trade-off between going green and growing business. Sustainability is becoming a simple, viable and desirable strategy. In order to make this transition to a green economic growth, financial stimulus from the public and private sector is essential. This will also involve formalizing green funds, accessing international funds and supporting and monitoring green business practices with appropriate regulations. The transition may be capital intensive but it can reduce manufacturing costs, generate added value and create sustainable wealth and millions of green jobs through the growth in green markets.

Incorporating energy and material efficiency is one of the most important components of a Green Economy. India alone has tremendous potential to have the most efficiency driven development out of all the developing nations. Improving energy and material efficiency works best when thought from a community perspective, from industrial to public. In the last 100 years, use of construction materials have increased 34 times, biomass 4 times and minerals by 24 times since the last 100 years and GHG emissions have increased by a factor of 13.

A public community driven initiative from the Hunsruck County in Germany can show effective and innovative ways that can be used to grow economy without exploiting resources. It cost them 300 million Euros to power the area as they were using fossil fuel driven technologies. After using RE and integrated Circular Economy concepts, today they get 40 million Euros per year benefit from the new system in the form of added value. Like mentioned earlier, for this, localization is very important. Local money should stay in the local system and we need to invest to let the village economy grow. It can also be translated as money of the company for the company. Optimizing the Climate Economics Series: Paper 1 I Climate Economics and the Changing Dynamics

flow of money is also a big part of the Circular Economy and improving resource and energy efficiency is a massive component of this.

For an industrial community to manage their energy and resource efficiency, a step-by-step approach can be taken. From 100% status quo, they first reduce 15% emission reduction via behaviour change. By investing in low hanging fruits by optimizing energy use and adopting RE, significant progress can be made and with strategic managements of its assets – where payback is slightly longer, by asking for new financing tools, relocating certain production units, co-operating with neighbouring companies to maximize systemic efficiency. In different sections of a company, we can optimize and reduce its emissions and footprint – in IT section, we can optimize energy by 75%, lighting by 70%, heat by 30%, HVAC by 65%, pumps by 30%, building envelope by 80%, compressed air by 50%. This is standard knowledge and it goes for almost all companies in the world. I encourage a lot of my students to do this!

20% of our entire electricity demand comes from pumps! We should focus on better pumping, pumping the right materials, in the right way and combine it with RE. We can contribute a lot to carbon reduction this way. Examples include – analysis with savings of water and energy with a payback of 0.8 to 6 years depending on the project. The business behaviour of these companies must also change in prioritizing long-term growth and bigger payback. Banks must change and accept this too. Banks should prioritize CE or LCE projects for ensuring their success.

That's what it means to go from linear to a circular economy. From a waste society to a zero-waste society. The linear economy has lots of unused potential, poor material innovation, inefficient systems; it's not only having environmental impacts but also flushing down potential revenue streams. On the other hand, Circular Economy is an efficient system where consumers also become producers, promotes regional development and cross-sector coupling.

Investing in Circular Economy RE is giving added value to the society byavoiding carbon emissions and over-exploitation of resources. This is why the money thus earned is giving a lot more value as it's an investment! Fossil fuel is only costing us but destroying our environment. So, India needs to ask itself – what quality of money are we injecting into our economy?



2d. Imperative for a Green Low Carbon Future

According to Dr. Deepak Dasgupta from the World Bank, India is almost on track to reach its Paris Climate Targets. The issue, therefore, is what the challenges are beyond 2030 that link with the financial issues and where will we bring the investments from for the Green Economy transition. The individual ministries in India such as for Coal, Steel, Mining, Power, Finance, Commerce, Energy, Agriculture, Urban Development are still undecided or against it. It is not yet a uniform goal among them. Hence the initiative needs to come from the leadership to get all the important sectors to line up with the Green Economy targets.

The government as well as the private sector will play a crucial role in going low carbon. The main business sectors are still divided especially since COVID-19 and face large financial risks already due to it! According to estimates by Dr. Dasgupta, two-thirds of the finance world in India (not entire India but only the important part) still views shifting to long term growth as a threat to their assets and declining value in their current investments and also a threat to their incumbent business activities. These sectors include - cement, auto, power, steel, coal, gas, mining etc. So, it's a big challenge for them as these are large assets that will lose value. These are the financing risks that we must be able to tackle as major private/ public institutions have invested in them.

Going low carbon and adopting Circular Economic pathways will need local human resources and hence, more equitable wealth generation. This entails a massive campaign for climate literacy to achieve Climate Action. To initiate this, business flows must consider analysing carbon flow and not just cash flows for performance. Formalizing climate education and integrating it in syllabi also very important. The 4 urgent actions important for setting the pace for sustainability are – climate literacy, basic carbon accounting, climate education formalizing at university level and following these three, school students get a formal education on environmental issues.

The transition to a Green Economy may be capital intensive but it can reduce manufacturing costs, create sustainable wealth and millions of green jobs through the development in green markets. But can we measure green development or are our economic activities actually in tune with green strategies?

• The Sustainable Development Index (SDI) that measures the ecological efficiency of human development, recognizing that development must be achieved within planetary boundaries must be used as a growth matrix along with GDP. The Global Green Economy Index (GGEI) is one such index that uses quantitative and qualitative indicators to measure how well each country performs on four key dimensions: leadership and climate change, efficiency sectors, markets and investment and the environment. This can help to track the performance of a

country with respect to the green economy transition.

- Major business sectors in India can set goals for carbon neutrality. The WRI calls this an "ambition loop". For example, companies committing to ambitious carbon reduction targets and renewable energy purchasing can give governments the confidence they need to establish more ambitious NDCs and national policies to combat climate change.
- If the key sectors such as construction, agriculture and mobility take a circular economy path to development, it could bring India annual benefits of 40 lakh crore INR (US\$ 624 billion) in 2050 compared with the current development path – a benefit equivalent to 30% of India's current GDP.
- Industrial designs must be in line with circular economic models like adoption of Eco-Industrial Parks (EIP). EIPs ensure industrial sustainability in their design and operation as energy, raw material and by-products flow within an industrial cluster as and when required, for better efficiency. India's Special Economic Zones (SEZ) and State Industry Development Corridors should be incorporated with such EIPs that will provide not just administrative and financial advantage to industries but also ensure use of sustainable technologies for better production efficiency, cutting of GHG emissions and attracting green FDI from abroad.
- Tools such as Life Cycle Analysis will be crucial to move to a circular and low carbon economy. It will ensure that, the entire life cycle of a product or system is assessed during the decisionmaking process to ensure sustainable consumption and production, low carbon use and management of waste within the economy. Using the LCA methodology can have immense benefits to companies which gives them the ability assess the impact of their product or service at each stage of its life from cradle to grave or cradle to cradle. Today, more than 500 major companies pledge to go carbon neural including some of the Indian conglomerates.

Having said that, it is also important to acknowledge that public and private institutions will require capital investment for transitioning to such an economic model, which might not be feasible unless India is able to attract foreign green funds. However, a haphazard transition to a Green Economy could lead to some risks including it being defined or operated in a one-dimensional manner, as purely "environmental." The second risk is that of a "one size fits all" approach in which all countries are treated in the same manner.

India is one of the few nations that are most vulnerable to climate change but can benefit immensely from a green economy in developing the nation. For this transition to happen, capital investments need to be provided green financing, channelling the finances to these core sectors can truly spur India's economy. Hence a matrix or methodology to account for green practices and integration of green economy experts into decision making processes are extremely crucial for creating a robust structure for green economy transition. Green growth not only balances but builds on the synergies between economic growth, social inclusion and protection and preservation of the environment which is an imperative for economic and human well-being, for after all, there is no **PLANet B.**



Chapter 3

Building a Green Energy Future

Chapter 3. Building a Green Energy Future

Energy is the most important commodity in the world today for fueling economic growth. Energy has become a key ingredient in human development. Major global concerns such as food, water, health and waste come together because we need the energy to deal with each one of these things. Initially, humans relied on renewable energy like sun, wood, and waterflow to harness energy. Then with the advent of the industrial revolution, we shifted to fossil fuels. The sudden energy abundance along with human ingenuity brought-about unprecedented technological advances which increased wealth and vastly improved human lifestyle luxuries. Unfortunately, burning of fossil fuel also caused increasing accumulation of GHG that led to anthropogenic global warming. The sheer size of energy consumption today has imposed a negative externality on the environment, making it a central tenet to the energy dynamics for the future. It is clear that the time is ripe for the next evolution in energy dynamics to clean renewable energy (RE) that can support sustainable economic progress without any penalty on the environment.

The energy sector is the largest contributor to climate change. It accounts for nearly 70% of GHG emissions. We need to seriously 'decarbonize.' Decarbonization of our economic systems combined with decentralized and digitally-enabled electrification technologies can provide access to modern energy services for the billion people who currently lack it, strengthen energy security and reduce exposure to energy price volatility globally, build overall system resilience to increasing natural hazards (especially in vulnerable, small island states) and cut the costs of air pollution worldwide. The clean energy transition is well under way, driven by market forces and plummeting costs of renewable and storage technologies. There is a sense of urgency to transform the energy sector immediately in order to avoid a massive wartime type mobilization of this industry.

3a. Costs and Consequences of Business-as-usual

The cost of fossil fuel use is much more than the rising amounts of payments which we make at our petrol pumps or what are sanctioned in the trade deals. These amounts do not reflect the total costs such as the cost imposed due to GHG emissions. Every aspect of our life which needs energy also causes emissions. They can be categorized into three parts, embedded emissions (before the product reaches us), emissions during operation (when we use the products) and end-of-life emissions (to discard the product). The use of fossil fuels has many such hidden costs which must be accounted. Apart from financial cost incurred during the transaction, fossil fuels impose massive economic, political, health and environmental costs.



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Irresponsible energy consumption has a direct and tangible impact on the economy as social systems and technologies are created in accordance to the nations where the energy use is extremely high. The present economic model is a testimony to this fact. It has resulted in unequal distribution of economic benefits and caused global economic disparity. Today, we are yet to establish the minimum social foundations of all our citizens. With high energy demands by the affluent, the majority of people are deprived of energy access. This is due to the energy imbalance created by fossil fuel economy that created increasing wealth for the rich with little regard to the social or the environmental costs. Renewable Energy (RE) on the other hand, can be much more equitable as it is abundant and accessible almost everywhere on earth, if planned for resilience.

Exploitation of natural resources for generating energy is drilling a big hole into the world's and especially India's economy. The economic costs of just air pollution caused due to the burning of fossil fuels are estimated to be equivalent to 5.4% of our GDP, let alone the cost incurred due to the frequent environmental disasters. Fossil fuel pollution also has an impact on the economic productivity; it was responsible for 1.8 billion days of work absence.

Fossil fuels are ultimately finite resources and found only in specific nations. As FF reserves dwindle, they are likely to foster increasing political tensions. It is notable that, for many of the major conflicts of the late 20th and early 21st centuries (ex. Iran-Iraq war, both Gulf Wars), fossil fuel supply was a critical factor. Fossil fuel exporting countries have also had leverage on the importing nations; this has skewed the balance of the world and has given control to only a few nations. Staying dependent on fossil fuels would put us in a politically volatile position and we can also expect threats to our national security because of the centralized nature of thermal power stations, like the potential malware attack by China on our power sector.

But probably the biggest cost that we have to bear is the direct and indirect impact on health and well-being of our citizens. Globally, about 4.5 million people died in 2018 due to exposure to air pollution from fossil fuels. On an average, each death was associated with a loss of 19 years of life. Approximately 40,000 children died before their 5^{th} birthday because of exposure to PM2.5 pollution from fossil fuels. The total economic costs of other impacts such as disability from chronic disease, asthma, adult deaths, child deaths, pre term births and sick leave amounts to a staggering 2.9 trillion USD. i.e. 3.3% of global GDP in 2018 alone.

Thus, we must address the multiple tensions which are at play here, such as tragedy of the horizon, tragedy of the commons and flattening of values, due to which we are pitting our planet against profits. The four-fold costs which we have to bear in order to sustain the fossil fuel industry will have massive and long-lasting consequences in the future. Once we look at the larger picture, we understand that the world is incurring unjustifiable economic, social and political losses. A decisive

and rapid transition to RE can provide us clean, equitable and economically viable energy solutions. India's objective of 'Atma-Nirbharata' can be achieved as well as made sustainable by this transition.

Indian scenario:

India's energy sector is majorly fueled by thermal power plants which generate 62% of our energy, followed by RE presently at 24%, hydro 12.2% and nuclear 1.8%. India has been responsible for almost 10% of the increase in global energy demand since 2000. Projections show that India will become the highest emitter by 2050, if we follow the same path and on the other hand India is also the most vulnerable country to climate change among all the 1 trillion-dollar economies. This imposes a risk on economy, ecology and additionally, on our cities.

It is evident that India will have to overcome the Trilemma of energy access, energy sustainability and energy independence. Currently, India is on a sticky wicket due to the rising energy demand and a fossil fuel dominated energy sector. At the same time, India is yet to provide electricity to millions of people. So, transitioning to RE will meet the twin goals of energy access and sustainability. Achieving energy independence means being able to fulfill your energy demand through indigenous sources and not being dependent on imports.

Achieving energy independence will give India the autonomy to take decisions about pivotal factors such as budgeting, national security, resource allocation, etc. India needs to aim at achieving 'energy independence' by 2030. The tools to achieve energy independence would determine India's success in controlling Climate change. Therefore, energy independence must be achieved strictly by RE sources so as to reduce the climate vulnerability of India and become a resilient nation.

3b. RE Alternatives for Clean Technology

We lack the vision to create the same amount of liquid and gaseous fuels which we use today to drive our cars and power our systems and still control climate change. So, in order to continue the use of our modern systems, we must electrify vehicles, heating, cooling appliances, industrial equipment, etc. Electrification gives us the added advantage of energy efficiency. So, the most important foundation which must be laid for the green energy transition is 'electrification of all systems.'

Promising RE alternatives include solar, wind, biofuels, hydro-electric, Hydrogen, geo-thermal or wave energy. All these have huge untapped potential and combine very suitably to meet increasing demands of the future. Solar PV in particular is emerging to be most cost competitive with several operational advantages. Just the incident solar radiation available on earth surface is average 1361



watts/square meter with maximum nearer the equator, which is much more than what mankind may need for centuries.

A modern option which is emerging as a smart and cost-effective alternative for large scale grids is the 'smart microgrid network.' Smart microgrid is a small network of energy sources that connect to the bigger energy grid. The difference is that smart microgrids can detach from the larger grid and operate on their own. In instances of power outages or severe weather, the microgrid can continue to give electricity to the homes and buildings that connect to it. Smart microgrids run on renewable energy — most commonly solar. These grids are much more resilient, localized and efficient. This sustainable alternative will be great for rural areas as these grids can have different inputs according to their location. Such distributed generation can turn consumers into 'prosumers' as they too can become the producers. Smart microgrids are the future as distributed generation and distributed supply enables us to have 24x7 RE with minimal cost and minimal impact on nature too.

Technological innovations have also introduced us to a novel concept of 'Hydrogen energy.' It has overwhelming environmental and social benefits, as well as economic competitiveness. It can be converted into hydrogen fuel-cells and can be used in various sectors such as energy generation, heat and cooling for buildings and households, industries, transportation, etc. Hydrogen energy not only offers the potential for near limitless supplies as it can be derived from many locally-supplied sources including water, followed by clean conversion to electricity using fuel cells. These advantages continue to make Hydrogen energy a valuable investment opportunity in the energy policy of many countries around the world.

Development of storage technologies will be the most important step for the transition. Currently, 'lithium-ion batteries' and 'pumped hydro' are two most used types of storage. These technologies have material and geographical limitations and therefore newer innovations must be looked at closely. Flow batteries are coming out as promising technology as they have a lower footprint and work on a different chemical composition than lithium-ion batteries. Thermal energy is also being developed to be used on utility scale and has a better capacity than flow batteries. Various other innovations in mechanical, material as well as chemical energy are being developed. But we can look beyond batteries for storage. Existing sources of storage such as biogas, using biodiesel, gasifier + fuel cells model and solar + wind model can be combined with microgrids for cheap and clean storage.

Making an integrated Climate-Energy-Economic policy is the need of the hour and its implementation must start immediately if we wish to control climate change impacts by 2030. India must set a target to be self-reliant for all its energy needs by 2030 and RE remains the best means to achieve it. An integrated strategy for transitions in various sectors such as electricity generation, industry, housing infrastructure, transportation, etc. needs to be implemented for a sustainable future.

3c. Understanding the Economic aspects of RE Transition

Depleting reserves, increasing costs and the age-old inertia to stay longer with established infrastructure for fossil fuels are becoming limitations to economic growth, as our current energy sector is stuck in the loop of problems such as electricity pricing, electricity markets and debt ridden DISCOMs. On the other hand, reducing operational cost, resource abundance and pro-environment quality of renewable energy is making it the best choice for future economic growth. But walking away from long dependence on fossil-fuel industry and the massive infrastructures developed for its world-wide use will be a major challenge. A slow shift to RE has already begun, but the scale and the rate of the transformation required will need bold and pragmatic policy drivers like removing all the subsidies and cross-subsidies on fossil fuels immediately. Continuing with an uncertain, polluting and non-competitive energy policy would mean a bleak future for our next generations.

The levelized cost of electricity (LCOE) - from coal has reached Rs. 6 per unit and it will only go up; on the other hand, RE sources like solar and wind have a much lower LCOE of Rs. 3 and Rs. 3.5 respectively. Solar power with battery storage has also become cost competitive (Rs. 4.5) to coal and investments in R&D will lower the cost even more. Thus, it makes financial sense to phase out fossil fuels and bring in RE.

India has the potential to create 310,000 GREEN jobs in 2021 alone and add 3 million new jobs into the economy just by 2030 itself. These green jobs can be created on all levels of government and as a pre-requisite, India must establish skill training centers to produce skilled workers who can work in building green energy infrastructure as well as regulating it. Having such skilled workers in a booming industry will help attract investments from all around the world and RE technology, infrastructure and manufacturing process will take India to a new height in prosperity.

Most green funds come from the commercial banks, followed by public sector undertakings and then government budgets. Lack of dominance of the green bond market in India is a sign of worry, which must change. There should be green investment banks and existing banks should have the component of climate change in their investment portfolio. The government must create lucrative investment opportunities for the sector.

Research & development in RE innovation and technological exploration must be given priority in Indian knowledge institutes such as IIT's, energy engineering colleges, research institutes, innovation foundations, etc. Developing a supportive ecosystem for R&D in India would be crucial. In order to pioneer the 'green energy revolution,' this ecosystem will need to be backed by 'green financing/funding' through government institutions and private individuals. This must be viewed as an investment for achieving the large goal of 24/7 RE with storage capacity.

3d. Facilitating Rapid Transition to RE

India's transition is driven by two major initiatives; the first one is the transition to renewables and second is transforming the transportation sector. Transportation sector is another major contributor to the GHG emissions in urban areas and with the rising cost of fossil fuels, conventional vehicles are no longer practical options economically. The electric vehicle transition must be powered by renewable sources of energy; if EVs are powered by renewable energy there is the potential to get down to 'extremely low operational cost.' The prerequisite to this is that energy grids should be powered only by renewable sources as early as possible. A comprehensive plan for phasing out conventional vehicles must also be created.

Phasing out fossil fuels and transition to RE must go hand in hand. The government would have to develop effective incentive schemes with financial drivers such as zero energy bills, opportunity to sell energy back to the grid, investment tax credits, interest free-loans or establish a 'climate change levy' like the United Kingdom has. Dis-incentivizing the use of fossil fuels by increasing taxes and issuing stricter norms would have to be done simultaneously. India has a scattered problem; we will have to look at a far wider range of levers going forward. The following are the aims and actionable points which must be the basis of our new Climate-Energy-Economic policy. India must set a target to be self-reliant for all its energy needs by 2030! Some actionable important points and targets for this are:

1. Rapid RE Technology roll outs like solar, wind and Hydrogen and setting up smart microgrids in rural as well as urban communities with due financing and incentives.

2. The electricity generation sector must ramp up and achieve 24/7 RE generation capacity with storage technology by 2030 out of which 40% must come from decentralized solar roof-tops.

3. Empower and engage local governments for energy finance; responsibilities must be allotted in order to ensure decentralized development.

4. Create 3 million new jobs in the rejuvenated renewable energy sector (most of the jobs relevant to RE transition would be those of skilled technicians who do not necessarily need an engineering degree; skill training centres must be established for capacity building).

5. Invest in R&D to bring energy efficient appliances and green innovations into the market so that Indian citizens can become a part of the green energy transition.

6. Mandate the automobile sector to only manufacture electric vehicles by 2030. The public road transportation system must fully transition to EVs by 2025. Simultaneously, the process of phasing out or conversion of FF driven vehicles must be planned in order to manage waste.

7. Create a cross-sector framework for systematic decarbonisation of energy sector in industries, agriculture, building and infrastructure and transportation.

8. Standardize and mandate Carbon and energy budgets for companies and states.

India's young demography is perfect right now for energy transition as bulk of the population is young and progressive with no old-baggage of fossil fuel addiction. RE transition will start yielding results very soon and help the youth to progress fast. Another reason for rapid transition is that making a transition after an economic or a climate crisis will be very difficult. Making a plan for recovery through a crisis is difficult as no crisis is the same and you cannot create a manual for any crisis. Above all, a rapid RE transition must be done because it ensures 'equitable and clean' energy for 1.4 billion Indians. Today, we have time, we have the technology and we have a plan. Hence, it is only logical to start the transition immediately. Pushing for a rapid RE transition will be beneficial for political parties as many environment initiatives are taking shape around the world and as pressure groups garner more support, green votes will become precious.

The ideal future for the Indian energy sector will be one in which India is self-reliant for all kinds of energy. This will lay the foundation for a robust social structure, healthy economic growth and sustained human well-being. But for this to happen, the next 10 years will be decisive and our actions today will be defining the fate of the country for years to come. Decentralized-diversified-distributed energy will ensure equitable energy for all and reduce the burden on the government. RE transition alone won't be the solution. It has to be supported by industrial, social, agricultural and political reforms.



Chapter 4

Environmentally Responsible Development

Chapter 4. Environmentally Responsible Development

Global warming impact seen today is like the tip of an iceberg – a lot more is happening underneath the surface.

Projections show that India will become the highest emitter of GHG by 2050 if we follow the same path. India is also the most vulnerable country to climate change among all the 1 trillion-dollar economies. This imposes risk on economy, ecology and additionally, on Indian cities. There is gathering scientific evidence that the risks of unleashing irreversible changes have been underestimated. Leading scientists have warned that more than half of such climate tipping points are now 'active.' UN Secretary-General Antonio Guterres said, "Delayed climate action will cost us vastly more each year in terms of lost lives and livelihoods, crippled businesses and damaged economies...The highest cost is the cost of doing nothing." Climate change is now an economic, development and social concern and most of all, an existential concern for several people worldwide.

Human population increased two-folds in 60 years (1960-2020) and Global GDP increased 30 fold per capita. For India, it is 75 fold GDP growth in 2019, within the same time. But we are still facing problems of poverty, hunger, poor condition, growing waste, and environmental crisis. The most basic and pressing issues like hunger, shelter, health, unsustainability, environmental and climate crisis, etc. continue to prevail all over the world. These are also consequences of short-term planning and rewarding short term economic gains. We need to understand and explore — what is the economic activity per hectare that will be caring and respectful to the planet? We need to ensure ecological integrity and a habitable planet.

4a. The Environment-Energy-Economy Trilemma

Scientists warn that global warming beyond 1.5°C will lead to mass displacements, heat stress, food scarcity, water stress for hundreds of millions of people and also trigger species extinction.3 This in turn will affect sectors like agriculture, fisheries, human health and social security. Tropical countries like India will be more severely affected due to changes in sea level, water resources, weather patterns and degradation of ecosystems due to climate change. The economic impacts get exacerbated in developing countries due to lack of preparedness and finances.

Adopting an economic system that vastly reduces its impacts on the environment will help India grow in a better way and also raise the threshold at which climate impacts can become dangerous.



Tropical forests are the most cost-effective climate mitigation measures and can offset 1/5th global GHG emissions before 2030. Healthy ecosystems and ecosystem services are crucial for better resilience. India can thus both adapt and mitigate climate change by restoring and expanding natural ecosystems.

Nations are pushing forward political interventions like Green New Deal, USA and the European Climate Law, EU to increase climate ambitions. Yet, despite decarbonisation efforts guided by the UNFCCC and IPCC, since 1988, the world is not even remotely on track to addressing the climate emergency. The slow and steady unlocking during the Covid19 crisis is an unprecedented opportunity for a profound systemic shift to a more sustainable economy. We are at a cross-road where the profound decision-making is required now and right away. There are only 10 years according to the world scientists body(IPCC) to make things right.

4b. Environmentally Responsible Economy

Environmentalism is often associated with future-thinking but it actually includes many dimensions. Even pollution, perceived as a future threat, is a current problem. Pollution is already costing humans and ecosystems in terms of health, wealth and well-being. This also applies to historical responsibility, often neglected in international Climate Change discussions. Environmental justice is not just about how humans are responsible for protecting future generations or addressing perceived future problems, because these problems are harming our current health, quality of life and environment too.

India faces an immense challenge in addressing an ever-rising energy demand in this decade. Energy consumption is GHG emission plus air-pollution today due to the country's heavy dependence on fossil fuels. The current consumption patterns and energy sources contribute significantly to both climate change and air pollution. Globally, air pollution is the fourth highest cause of death and India faced 1.67 million deaths due to poor air quality just in 2019. In 2018, climate change caused more than 2,000 deaths — 0.16 per 100,000 inhabitants, losses of 37,807 million USD and a decrease in per capita GDP of 0.36%.

Overall, the air quality scenario indicates that the action plans in many cities in the state are not very effective in controlling air pollution and need reforms. Instead of tackling these problems separately, there are technological solutions that address both concerns at the same time. Rapid shift to RE and decentralization with RE will help reduce dependency on fossil fuel and hence, diminish air pollution too. Expansion of E-mobility and sustainable transportation systems like shifting to E-buses, car-pooling, cycling and walking will decrease the use of private vehicles and traffic problems. Building urban forests and green spaces, water bodies can significantly help in reducing air pollution impacts.

Economic impacts get exacerbated in developing countries due to lack of preparedness and finances. Tropical forests are the most cost-effective climate mitigation measures and can offset 1/5th global GHG emissions before 2030. India's forest area per unit of GDP dropped 7 fold from 3500 to just 500 sq m/US \$ from 1990-2016. This means we have 7-8 times lesser forest area to absorb the consequences of our economic activities in just 26 years! India also hosts 4 biodiversity hotspots – Eastern Himalayas, Indo-Burma, Western Ghats, and Andaman-Nicobar islands, which are critical for native biodiversity. Healthy ecosystems and their ecosystem services are crucial for better resilience too.

India can thus adapt and mitigate climate change by restoring and expanding natural ecosystems. Adopting an economic system that reduces its impacts on the environment will help India grow in a better way and also raise the threshold at which climate impacts can become dangerous.

With the current economic model, India wants to develop at all costs and grow fast, but if we want to go far in this climate-challenged world, we need to develop responsibly and take a step-by-step approach to make a swift, clean transition to a Green Economy. India is a growing economy that is yet to reach its full potential and needs to focus on key areas such as, sustainable transport, reen energy transition, Carbon sequestration and green building infrastructure and eco-industrial parks, all of which are pieces of the greater green economic puzzle that will help India reach its true economic potential.

Rethinking our capacities and roles as governments, organizations and households with a common purpose of Climate Action and Sustainability will address different aspects of other social issues like equity, inclusivity and resilience as well. Replacing current economic models like GDP may reduce economic growth in some fields but will create new opportunities and jobs in other fields which are more sustainable. With environmentally responsible design, management, technology and innovation; we can successfully achieve sustainable economic development.

These goals however, are hindered by heedless management, temptations for easy money and lack of vision to see beyond short-term profits, compounded by the ideological rigidity by some who believe that the environment must be sacrificed for economic growth. Instead of choosing or rejecting capitalism or economic growth outright, the real challenge is using all means to drastically reduce our footprint on the earth while realizing social ambitions.

Business models must reward good sustainable practices and punish the harm caused to the environment. Local empowerment should be focused upon. Our environment should be the mother of life, not the economy. The challenge is NOT of growing economy but about containing human greed and lust for power. We need to recognize that the real challenge is ensuring that the planet



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remains habitable and address pressing issues like equity, justice and end of hunger. We need to ensure ecological integrity.

4c. Financing Strategies for Green Development

Short-sighted policies for quick return on investment must now change to more prudent approaches for long-term sustainability in a changing earth-ecosystem that will get increasingly hostile. Innovative solutions must be found to create the motivational gradients for change and shift to long-term focus on sustainability rather than quick return on investment. Economic signals, such as a price on carbon, do not require governments to intervene in individual sectors, choose a particular technology or dictate consumer behaviour. Building confidence among industries and commercial ventures that implementing environmental protection measures also attracts investors is necessary.

Carbon accounting is an essential requirement for firms, particularly in the light of increasing awareness of risks associated with GHG emissions in a climate-challenged future and will likely become necessary due to government legislation. A company must look at its overall environmental responsibilities and accurately gauge and measure carbon production and emission caused by its very existence. Financial data must be directly linked through lifecycle assessments, enabling action to be taken to help reduce greenhouse gas emissions. A wide participation by firms in activities in the area of carbon accounting, emission reductions and reporting can send a strong signal that industry is proactively engaging in the climate change dialogue and response process. Such activities will contribute towards political process through analysis and reporting.

India ranked 5th in countries surveyed for corporate commitments to science-based targets (SBT) by Carbon Disclosure Project in 2019. However, the same report also states that by not measuring and reporting their forests-related risks and opportunities, Indian companies might be at a competitive disadvantage in the global market and will face adverse effects of deforestation and climate change on their supply chains. India's ~26 million micro, small and medium-sized enterprises are also especially vulnerable to climate change impacts.

India can facilitate a few 'immediate or no regret moves' like transition to large scale renewables, to other fuels like Hydrogen and driving industrial and energy efficiency. Renewable Energy will be the core of long-term energy transition of India. The investments needed for this are in the ballpark of 2.8 trillion USD and the faster we move the better. Due to the high population growth rate in India that is expected to add another 700 billion people by 2050 and taking into consideration the 5.5% average annual GDP growth rate, our energy use emissions will blow out over the 2030 to 2050 period at BAU. But it is possible to get the emission down. That is why we need to reset our priorities now and if we are able to do it, we can stabilize our GHG emissions. For example, making

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investments adopt low-carbon design in new infrastructure when it is designed rather than waiting to retrofit or replace it, makes more economic sense.

Along with decarbonisation, India needs to go from linear to circular economy; from a waste society to a zero-waste society. Linear economy has a lot of unused potential, poor material innovation, inefficient systems that not only has environmental impact but also flushes down potential revenue streams. On the other hand, circular economy is an efficient system where consumers also become producers. It promotes regional development and cross-sector coupling. The entire global economy is also making a technological shift to becoming low carbon, as has happened many times in the past. Sustained push for green economic growth will come from political, social and industry innovations. India will have to look at a far wider range of levers going forward as we need to decarbonise electricity, transportation, industry, agriculture and building sectors at the same time.

Currently, most of the green funds come from the commercial banks, followed by the public sector undertakings and then the government budgets. The lack of dominance of the green bond market in India is worrying and thus there should be green investment banks and existing banks should have the component of climate change in their investment portfolio. India has the potential to create 310,000 GREEN jobs in 2021 alone if it adopts the Green Energy route. This transition needs lifestyle changes by using energy-efficient appliances and innovation and participation of every citizen.

The private sector will also play a crucial role in going low carbon. Two-thirds of the finance world in India (not entire India but only the important part) still views shifting to long term growth a threat to its assets. These sectors include - cement, auto, power, steel, coal, gas, mining etc. So, it's a big challenge for them as these are large assets that will lose value! These are the financing risks India needs to tackle as major private / public institutions have invested in them.

A Blended Finance strategy needs to be adopted combining government and corporate funds for suitable financing for low carbon sustainable development. Global funds are shifting their focus from high-tech high investment infrastructure to more natural solutions for building infrastructure to adapt to climate change. As the global effort in providing financing to adapting to climate change has reached an all-time high, India should focus on green economy over conventional GDP biased model. By this, a more robust financial structure will be created where social and environmental well-being will also be given priority over purely economic gains.

4d. Drivers to achieve Green Development

We are facing a new paradigm where every environmental action taken and not taken today will have immediate as well as far-reaching consequences on our progress, health and safety. Thus, there is an imperative for making systemic changes so that environmental actions become wide-spread, profitable and acceptable. This requires some immediate or effective drivers to successfully realize human and environmental quality of life. We need to integrate material well-being, non-material quality of life, equity, justice, sustainability, resilience and democracy as the pillars in planning and development. A globally connected citizen should take ethical and moral responsibility for equality. People need to understand that the effect of any action is not limited to immediate or direct impacts but also indirect and future consequences.

In general, technology for addressing the climate crisis is available. But using the technologies may have constraints like appropriateness to address specific issues, maintenance and accessibility, skilled human resource, profitability for the user and balancing the economics which is subject to factors like technology adoption challenges and the increasing costs of the cash economy. However, other systemic changes like energy conservation, material and resource efficiency, circular economy, ecological restoration, etc. are equally important for economic and environmental stability.

The wide spectrum of desired actions in order to adopt and disseminate the appropriate low carbon technologies need — leadership with a vision, efficiency in overcoming policy and regulatory issues and obstacles, overcoming economic constraints like availability of green finance and tendency by leaders to plan for short-term profitability, better knowledge and understanding among citizens and finally, a collective will to change. This sort of resolution and planning is in a very bad state in our country right now and needs to improve greatly.

Centralized governance is environmentally and energy-wise expensive. India is a geographically and socially diverse country. Larger the system and more complex the network, larger is the energy required to maintain it and it also becomes less and less green. And according to laws of physics, more the energy use, more will be the entropy (simply put, randomness or uncertainties which can lead to varied mild to extreme outcomes). Thus, Green Economy cannot be realized with a centralized governance structure. We are living in a diverse community and everyone's opinions and views in achieving sustainability may differ. We need deep democracy to achieve it because neither centralized planning nor 'corrected market processes' are going to be enough. We need to integrate values along with profits and consider multiple externalities in decision-making.

Many times, integrating green measurements in GDP doesn't work because lower-income groups are impacted more by environmental degradation. They may represent the value of the environmental impacts as very low, even though it is very high for vulnerable populations. Equity cannot be left out in the energy, environment and economic growth discussion. We need to think differently, given the problem we are facing. Going beyond self, our daily moral and ethical decisions should be made by thinking about how they are affecting the rest of the world. Gandhian economy focuses on community building, social well-being and local empowerment with a view to satisfying human needs rather than the human greed. It should be approached as sustainable localised living rather than an economy.

The problem of population growth and its impact on the environment should not be addressed with control and coercion but by making the demographic transition with development strategies and women's empowerment. Some states in India, like Kerala and Tamil Nadu, are already on track to achieve it.

Focussing on environmental quality of life instead of just urban needs, must be reiterated into our development goals. Nature must become an integral part of our neighbourhoods and daily lives. We need to strengthen the Right to Information (RTI), Forest Rights Act, Environmental and Forest Clearance processes, etc. and especially strengthen and make Pollution Control Boards more accountable. We also need to initiate water rights process and distribution for all. We must have mechanisms to monitor and manage our direct and embedded footprints.

Misinformation about Green Economy among businesses and governments leads to wrong decisions. Environmental actions don't always reduce profits. We cannot discount sustainability while aiming for economic growth. We need to move away from the present costing system and ensure it will include all environmental costs. Governments need to push sustainability without fearing that the GDP would get affected and use economic indicators that consider both — planetary health and human development. We must create a common reform road map and vision to establish a cohesive monitoring mechanism between the ministries and the states to make efficient decisions in future.

Understanding problems requires a global perspective but solutions need to be more local. Hence, we need locally-rooted solutions based on globally relevant science. The green economy-related knowledge should be made available right from primary to higher education. This can be achieved by integrating research and local case studies in syllabi and empowering teachers to accomplish it. We also need to democratize knowledge through freely accessible digital resources, to help humanity to invest their talent, skills and ambition in achieving sustainability and Climate Action.

We need to promote a system that will promote the environment and at the same time encourage non-polluting technological interventions. Governments should subsidize green alternatives to speed up the process and make them more attractive. Economic models must reward sustainable practices and penalize any harm caused to the environment. Local empowerment needs to be focused upon to achieve sustainability. To sum up, our development models should be based on the maxim that our environment is the mother of life, not the economy.

Conclusion

he often embedded idea that 'all growth is good' has led to unprecedented problems for the world. Infinite growth cannot happen on a finite planet. Going beyond simplistic pro- or anti-growth views, we need to find the right balance between economic growth, inclusive development and environmental stability to sustain our well-being.

India is one of the few nations that are most vulnerable to Climate Change but can benefit immensely from a Green Economy as a developing the nation. The technology and innovation needed to achieve this exist. However, promoting and expanding them over existing barriers remains a challenge. Economy and ecology are emerging to be two sides of the same coin and need to be addressed together. The responsibility to mitigate GHG emissions is equally shared by the government, industry and the civil society. Every citizen is a stakeholder and therefore, awareness about climate change must be spread throughout the society at every level.

The energy sector is the largest contributor to climate change, it accounts for nearly 70% of GHG emissions. We need to decarbonise our economic systems, strengthen energy security and cut the costs of air pollution, worldwide. Clean RE options are available and are as competitive as fossil fuels in terms of power and cost. Solar, wind, hydrogen and waste to energy projects must be taken up by industries; the government also has ramped up its targets for solar. The clean energy transition is underway, driven by market forces and plummeting costs of renewable and storage technologies. Decentralized and diversified energy mix and distributed energy systems, will ensure equitable energy for all and reduce the burden on the government. The ideal future for Indian energy sector will be one in which India is self-reliant for all kinds of energy. This will lay the foundation for a robust social foundation too.

Public and private institutions will require capital investments for transitioning to green economy, which might not be feasible unless India attracts foreign green funds. Thus, Green Financing needs to be boosted. Creating a methodology to account for green practices and involvement of green economy experts in decision making processes is extremely crucial. Local circular economic material and cash flows need to be encouraged widely. India, as a growing economy that is yet to reach its full potential, needs to focus on RE, ecological restoration, sustainable transport, green building infrastructure and eco-industrial parks. All of these are pieces of the greater green economic puzzle that can help India reach its true economic potential.

Adopting an economic system that vastly reduces its impacts on the environment will help India grow in a better way and build resilience towards natural disasters and other climate impacts. India can also both adapt and mitigate climate change by restoring and expanding natural ecosystems. The next 10 years will be decisive and long-lasting. We are living in an age of consequences, where our actions today will be defining the fate of country and the world for years to come. We can foster human ambitions without jeopardizing environmental health and security if we make the right decisions within this decade. We need to ensure that India takes responsibility towards the future and makes low carbon sustainable progress now.

With the current economic model, India wants to develop at all costs and grow fast, but if we want to sustain in this 'Climate-Challenged World' we need to develop responsibly. We need to take a strategic approach to make a swift clean transition to Green Development. To transition to a better and reliable present and future, we need to opt for the following inclusive, sustainable and econo-environmental framework:

Foundations:

- Green Economic Development Redesigning priorities and processes for deep decarbonization, energy transition to RE, green industrial ecosystems and restoration of ecosystems
- Systemic Changes Focusing on resilience and national security in terms of energy, resources and land use and aim for achieving a frugal economy
- Integrated Policies Considering environmental responsibilities in all policy and finance decision-making, at all levels

Tools:

- Non-Fossil Fuel Economy Rapid transition to renewable energy, especially solar, wind and waste-to-energy processes and phasing out fossil fuels systematically with policy interventions
- Decreasing Demand –Reducing overall demand by changes in lifestyle and product life-cycle to reduce adverse effects of consumerism and simultaneously increasing efficiency of energy and natural/local resource use at individual, community as well as regional levels with due incentives and subsidies
- Ecological Prudence Ecological restoration, accounting for the cost of doing nothing when nature is being destroyed and considering long-term consequences and benefits of any development activity
- Accelerating Climate Action– Policy drivers, incentives, regulations and laws to encourage citizens and industry to shift to green practices and applying Climate Economy principles with carbon pricing



Metrics:

- Using green economic models and indicators The wealth of a country should be defined based • on produced, financial, natural, social and human capital together. The produced and financial capital gains should be calculated for distributive efficiency and not just economic growth.
- Assessing impacts of Action Focusing on factors like renewability, food and nutrition, • ecosystem services and security for all life forms. These should be measured using proxy indicators or indices with regular monitoring and mapping of success
- We need to use novel ways, explore technologies and change mindsets and societies for a truly • green transition. This paper provides a vision and means for human society to be more environmentally and economically responsible and thrive together with nature. And we need to realize them NOW.



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