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Working towards a Green Economy – Meaning, Measures, Policies & Implementation

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Abstract:
The transition towards a Green Economy is a critical human response to the imminent threat of climate change, driven primarily by anthropogenic global warming. This paper explores the multifaceted aspects of Green Economy, encompassing sustainable development and economic growth that mitigates environmental degradation. The concept is grounded in the UNEP definition of a Green Economy, emphasizing improved human well-being and social equity while reducing environmental risks. Key areas include renewable energy, sustainable transport, green building, water and waste management, and land management. Measurement of progress towards a Green Economy is examined through various indices like the Global Green Economy Index (GGEI) and methodologies proposed by OECD. The challenges faced by developing countries in monitoring and achieving Green Growth are discussed, highlighting the need for enhanced statistical capacities and integrated policy frameworks. Policies for transitioning to Green Economic Growth are analyzed, with a focus on developing countries and strategic sectors. The paper also delves into specific policy instruments such as environmental labeling, green subsidies, payments for ecosystem services, environmental taxes, and promotion of green energy investments. Additionally, it discusses strategic trade policies and innovation indicators, using China as a case study to illustrate the potential benefits and challenges. The conclusion underscores the necessity of harmonizing economic growth with sustainability, advocating for a model where Green Economic Growth serves as both a driver of economic development and a solution to environmental challenges. This holistic approach is essential to prevent economic regress and ensure a sustainable future for all.

Keywords: Green Economy, Global Green Economy Index (GGEI), Environmental Policy, Strategic Trade Policy.

1. Basic Ideas & Motivation for a Green Economy

The conception and realisation of the Green Economy and Growth is one of a broad range of human responses to the serious threat of impending climate change in the current epoch, which is occurring through anthropogenic global warming (UNEP,2011). Green Economy is understood as a system for economic operation and growth that strategizes for sustainable development, that is, economic development that does not degrade or impose irreparable costs on the natural environment in which it functions, and whose resources it consumes.

The standard and commonplace definition of Green Economy is by the UNEP:

"[A] green economy [is] one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP,2011)

Integral to a Green Economy is fairness in the distribution of ecological resources and of the burden of a Just Transition for workers affected by transition to a Green Economy (UNEP).

The ICC (International Chamber of Commerce) *Green Economy Roadmap* (ICC,2012) defines a Green Economy as *"..an economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion while supporting progress on social development..".*

Standard Economic theory views the Gross Domestic Product (GDP) as a fair approximation to many aspects of human well-being and seeks to increase the GDP to improve human well-being. Increasing GDP, however, is observed to impose costs on the environment such as air pollution and CO2 emissions. Green Economics, therefore, seeks to put a valuation on environmental costs, calculate environmental capital costs while estimating GDP growth, and so pursue GDP growth only by minimizing or reversing the incurring of environmental costs.

A school of thought (Bowen & Stern 2010, Barbier 2010) emphasizes the synergy between mainstream understanding of economic growth (GDP increase, creation of economic demand for goods and services, creation of jobs, Keynesian stimuli in case of economic recessions) and Green Growth.

Conceptually, a Green Economy is an economy seen as an integral part of the broader inclusive ecosystem (Margulis). Explicit costs are attributed/assigned to ecological resources the economy consumes, which were hitherto excluded from cost accounting. Hence, a full cost accounting for ecological resources is pursued (Runnals - wiki). Green economic functioning seeks various adjustments to reduce the explicitly valuated costs imposed on ecological resources and achieve greater ecological productivity and sustainability. Naturally, such a complex economic notion has a variety of varying and sometimes differing/opposing perspectives (UNEP,2011).

A Green Economy is defined to have a "hexagon" (UNEP,2011) of 6 primary sectors (Burkart, in Wikipedia) –

i. Renewable Energy,
ii. Green Building,
iii. Sustainable Transport,
iv. Water Management
v. Waste Management
vi. Land management,

and pursues sustainability in all of them and their mutual interaction.

Thus, for instance, a Green Economy using renewable energy and sustainable transport would reduce fossil fuel consumption and attempt to minimize incurred environmental costs of air pollution, mitigate CO2 and pollutant-induced global warming and preserve fossil fuel stocks. Waste management would mitigate environmental costs of waste-disposal, and water management would sustain global water resources. The six proposed primary sectors would operate in a symbiotic manner to preserve the Earth ecosystem's net environmental capital stock.

2. Measurements & Indicators of Progress towards Green Economic Growth

As Green Economic principles seek to transition towards a more sustainable economy, it is necessary to have an objective measure of the degree of progress towards, or distance from, a Green (or Greener) Economy. Green indices are numbers defined to encode such measures.

A number of Green indices have been proposed:

1. A Green Score City Index (2016 – 2022) measures anthropogenic impact on nature.
2. A prominent Global Green Economy Index (GGEI) (Dual Citizen LLC,2017), that's in its 6th edition by now. This has been calculated for 130 countries, from 18 indicators along 4 broad axes of Climate Change and Social Equity, Sector Decarbonization, Markets & ESG (Environmental, Social & Governance) Investment and Environmental Health. This measures green economic performance and perceptions of the same.
3. A city-centric Circle of Sustainability (2009-2013) score for 5 cities in 5 countries.
4. A Siemens-commissioned Green City Index (2009-2012).

The GGEI seems to be the most comprehensive and generalized of these Green Indices.

2.1 Methodologies & Issues in Measuring Green Growth for Developing Countries

The OECD has suggested (OECD, 2011b) monitoring of four aspects of Green Growth and their incorporation in the definition of measurement indicators:

i. resource and environmental productivity of the economy

ii. the natural asset base

iii. the environmental quality of life

iv. economic opportunities and policy responses that arise

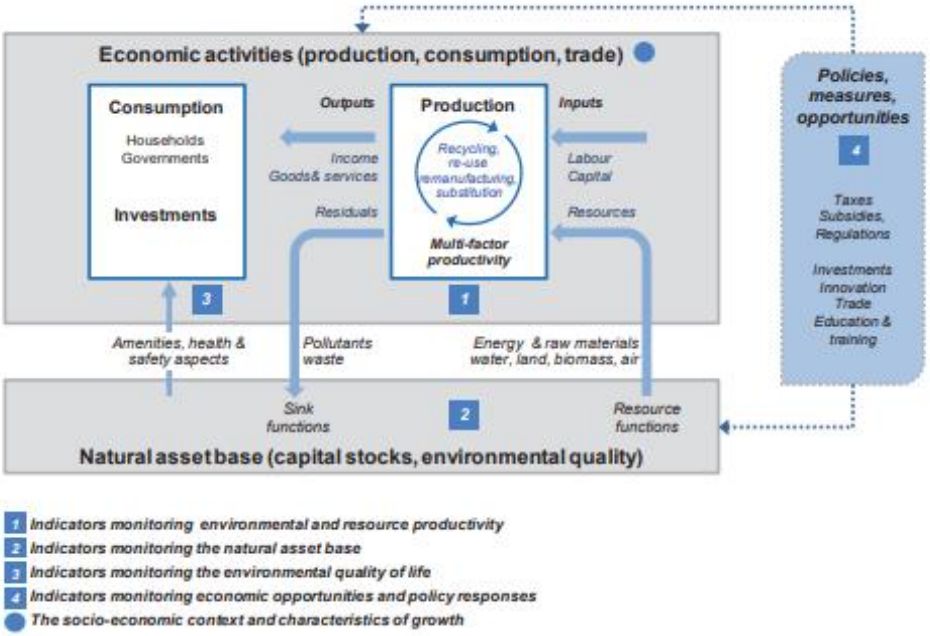


Figure 1: Measurement Framework for Green Growth (OECD, 2011b)

As can be seen from the figure, the suggested OECD 4-parameter framework seeks to quantify most relevant sub-systems in the entire Green Economic functioning system: 1. the economic productivity (where goods & services are actually produced), 2. the capital stock of natural environmental (which includes environmental quality), 3. the environmentally-influenced health and safety factors and 4. the actions taken by the country in question to sustain and enhance Green growth.

Developing countries face issues with their statistical capacities in realising a monitoring framework for Green growth, as harnessing relevant capacity and resource to produce, collect, analyse and propagate relevant information.

While monitoring Green growth is integral to achieving it, developing countries can use pre-existing statistical collection methods to measure Green growth indicators and need take on additional burdens. Initiatives exist to upgrade pre-existing national statistical systems, for example, MBSS (Modernisation of the Barbados Statistical Service Project), NSDS (National Strategy for the Development of Statistics), both under PARIS21 (Partnership in Statistics for Development in the 21st Century).

2.2 Standing of Countries on the GGEI Index

As it the GGEI Index is the most comprehensive available Green Index, we discuss how countries around the world fare on that index. The 18-indicator index measures the progress each country has made in 2005 – 2020, as also its distance from globally defined sustainability targeted. It's, therefore, a reasonably good proxy for countries' transition towards a Green Economy.

European countries are at the top of the index, including Germany and the UK, with Sweden as number 1. The largest GHG emitters fare rather poorly, the United States perhaps moderately well at 38th and Canada at 37th, and China, Japan, Brazil and Korea cluster together at 58th, 47th, 52nd and 59th respectively. Mexico is at

78th, and India and Indonesia rank lowly 144th and 154th respectively. But some otherwise poor performers have made good relative progress: Israel, Jordan, China, Solomon Islands and Uruguay are all in the top 10 of relative progress.

The average progress in 2005 – 2020 across countries in reducing GHG/GDP ratio is 42%, but except China and Indonesia, the world's top emitters are all below this rate of progress. Again, except Germany and the UK, the top emitters have performed poorly at Sector-wise Decarbonization (building, electricity & heat, manufacturing & construction et. al).

The GGEI incorporates social indicators on gender equality in workplace & governance and income inequality. Gender equality is seen to improve, but not income inequality, with 1/3rd of countries seeing rise in income inequality from 2005 to 2020.

The EU and China are score highly on Green Energy investment and Innovation, with the US only 25th on the Markets & ESG Dimension of the GGEI. Green momentum exists in countries that rank highly.

Most countries fail the WHO Air Quality standards, with only 5 countries pass. The average PM2.5 exposure of all 160 countries is more than 5 times the WHO guidelines, indicating huge potential for improvements.

Biodiversity and Ocean protection, involving protection of key marine & terrestrial biodiversity, see better progress, with more than half the countries achieving the target of remaining below 30% by 2030.

The conclusion from the examination of the GGEI index of 160 countries is that net zero targets and NDC emission reduction goals are very far from being achieved, indicating an urgent need for countries to spur appropriate efforts.

Green indices exist for the crucial primary component of the Green Economy (Burkart, 2012) given above.

3. Policies for Realising Green Economic Growth Transition

A plethora of policy proposals/initiatives, policy frameworks and strategies have been suggested for realising a transition of economic systems to those incrementally realising the principles of the Green Economy.

Voluntary Sustainability Standards (UNFSS) are intended to guide towards and inculcate of self-certification of ecologically sensitive products, as having a certain standard of compliance on sustainability factors like water-resource protection (UNFSS, webpage) green-house emissions, and worker's rights. Ecolabels and Green Stickers on products guaranteeing a standard of sustainability in stages of product life cycle allows industry-centred promotion of green practices and consumer-centred judicious choice of green products. Thus, starting as a voluntary labelling scheme, the Energy Star program of the US EPA specifies standards of energy-efficiency for 'Energy Star' certification of computer peripherals, computers, consumer electronics, buildings, industrial plants and others (Energy Star,2022), permitting consumer choice for Energy Star products.

The International Chamber of Commerce, the world's largest organization representing the interests of businesses (especially private enterprise), has a Green Economy Roadmap (2012) to guide businesses and policymakers towards a Green Economy. Ten interrelated conditions are suggested:

Economic Innovation

- Open & competitive markets
- Metrics, accounting & reporting
- Finance & investment
- Environmental Innovation
- Resource efficiency and decoupling
- Life cycle approach

Social Innovation

- Awareness
- Education & skills

- Employment

Mutually Reinforcing and Cross-cutting Elements

- Integrated environmental, social and economic policy and decision-making
- Governance & partnership

The key principle here is to harmonize and share innovations across sectors, which is critical due to mutual interdependences, to achieve the most effective Green outcomes. Synchronization and reconciliation of short-term and long-term action is another critical idea presented herein, as long-term results are the intended objective, yet the pathway towards them is constrained by short-term factors that have to be negotiated in a manner that enables long-term goals.

Thus far, we have discussed generic policy guidelines for transitioning to a Green Economy. We shall now examine more detailed policy recommendations for the important specific cases of Developing countries, broadly, and important Asian countries, in particular.

3.1 Policies for Green Economic Growth in Developing Countries

Developing countries comprise the bulk of the world population (6.69 billion, 85.33% of the total (worldmeter,2023). While they have lower per-capita level of GHG (greenhouse gas emissions) emissions than developed countries, with expected rapid economic growth and the added imperative of economic growth for increasing relatively lower standards of living for their populations, their large aggregate populations indicate a considerable potential future contribution to greenhouse emissions, and potential damage to their local and global environments. Green growth can ameliorate that, as well as contribute to economic growth (Bowen and Stern 2010; Barbier 2010). and increase in standards of living in its own right, and improve the local environment and health costs associated with environmental damage.

Developing countries are aware of the relevance of Green Economic Growth for their development, formulating, e.g. India's National Action Plan of Climate Change (NAPCC), Ethiopia's National Development Plan and Cambodia's Green Growth Roadmap.

Broadly speaking, developing countries can best pursue Green Economic Growth by first creating conditions enabling and conducive conditions for Green Growth, followed by incrementally converting Green Growth into a mainstream mode of economic activity and finally, by planning and implementing specific policy instruments like ecological certification and green energy. We discuss suggestions for each of these categories.

3.1.1 Creating Conducive, Enabling Conditions for Green Economic Activity

Possible enabling policies include less environmentally damaging and more 'Green-oriented' government expenditure, and more focussed enforcement of existing Green legislation. Legislative changes may be needed for helping transition for workers, institutions and employers. Mandating and funding greater green scientific research and skill-developing can be helpful. Using behavioural psychology by framing Green Growth as a social goal, and inclining the populace towards greater Green behaviour by presenting it as an explicitly rewarded choice can be helpful. These measures – especially effective enforcement, scientific research and skilling and use of behavioural psychology – can be applied to businesses for adoption of green best practices, green technologies and environmental accountability. Finally, government must take care to ensure traditional workers retain their traditional land and water access rights in face of powerful entrenched stakeholders.

3.1.2 Conversion of Mainstream of Economic Activity to Green Growth

To effectively realise the best Green growth, conducive policies have to supplement by concrete institutional design and action to maximise the "greening" of standard economic functioning.

A mechanism like PEER (Public Environmental Expenditure Review) (Worldbank) can review government expenditure across budget sectors and examine and return feedback on its effectiveness. Thus, it can enable for efficient environmental spending, and by raising public and official awareness, even increase Green budgets.

An integrated, analytical assessment of Green plans, policies and current programs can be made under an SEA (Strategic Environmental Assessment) (europa.eu), which can evaluate their ground impact on sustainability and economic effectiveness. Potential unintended consequences and trade-offs between varying socio-economic and green goals can also be examined under SEA. SEAs are increasingly prominent in Green policymaking.

CSD (Councils for Sustainable Development) are proposed (Brundtland Commission, 1987) 'ombudsman'-like structures consisting of Green Economy stakeholders, including representatives from government, business and civil society. They can play a critical role in reconciling differences of perspectives and interests of stakeholders to advance the overall goal of Green Economic Development. With multi-perspective, multi-stakeholder input, better harmonization of policy formulation, planning, implementation, oversight and evaluation can be facilitated by CSDs.

"Green Accounting" of GDP entails factoring into GDP calculations the costs imposed on environmental capital by GDP growth, and so better informing policymakers about the pathways for Greener growth, where GDP growth minimizes or even reverses net attrition of environmental capital. "Green Accounting" – and Alternative Development Measures – In a broader sense, purports to integrate environmental and social (e.g. equity-related) information into standard national GDP accounts, to portray and aim for a more just, Greener economic development. There are initiatives seeking mainstreaming of practical green accounting approaches (WAVES, World Bank).

3.1.3 Particular Policy Instruments to Promote Green Economic Growth

Several specific policy practices can constrain action of the population in favour of Green growth. We briefly describe them below.

a. Environmental Labelling or Certified Sustainable Practice

As for the Energy Star labelling mentioned earlier, distinguishing products created and distributed in compliance with certain environmentally friendly and sustainable "green" norms can enable consumer and market behaviour towards greater Green growth, as well as inducing a greater adoption of such practices by producers and distributors. This requires an agreement on the standards of green best practices, a fool-proof certification process and, naturally, appropriate labelling of the end-product. Issues facing small-scale and informal sector producers and difference in production and distribution circumstances have to be factored in when imposing the relevant "green" norms.

b. Green Subsidies

Strategic modification of existing subsidy practices can facilitate a Green Economic transition. Where subsidies are granted to "brown" economy, they can be shifted to the equivalent "green" economy, which will, in-turn, get incentivized. Reducing such "brown" subsidies can release funds for subsidizing people and workers adversely affected by Green Economic transitions, especially if environment factor costs or production costs increase due to reduction of "brown subsidies"

c. Payments for Ecosystem Services (PES) Schemes

PES Schemes (WAVES,2015) offer payments to ecosystem and land-using workers – like farmers – to manage land resources to conserve and potentially improve ecosystem services of the land. Ecosystem services simply refer to the provision of renewable environmental capital provided by nature, such as forestry, fisheries and groundwater retention. Thus, land-users are incentivized to implement sustainable practices. Successful PES schemes need to provide know-how on ecosystem management (e.g. forestry expansion and reduction of soil-erosion) and implement policies to ensure implementation of this know-how.

d. Environmental Tax Implementation

Economic activities – such as natural resource extraction (like forestry), water or air emissions pollution – that impose costs on the environment can be subject to an environment tax or user surcharge. This can improve efficiency of natural resource use and preserve and improve environmental capital, leading to a positive feedback loop of increased Green Economic activities. The revenues thus realised can be used for poverty alleviation, adjusting to the Green Economic transition or further environmental conservation. By-

products of such taxation, involving better monitoring and enforcement of restrictions on, say, water pollutant emissions, can actually be more efficacious than the charge itself (Blackman, 2006, about Colombia).

e. Green Energy Investment Promotion Frameworks

Promotion of Green and Renewable Energy is fundamental, as bulk of GHG emissions are from utilizing fossil fuel for energy (US EPA). A legislative and fiscal framework for pushing energy market reforms towards Renewable Energy production is required. Renewable Energy projects find bank financing hard (especially in light of the Basel III normed tightening) and require financial risk mitigation instruments to undertake projects. It is, therefore, especially necessary to promote ease of foreign investment in this sector, as also easy of entry, acquisitions and mergers, and joint ventures. Public-Private Partnerships and increase of public sector capacity can assist further investments and broaden & deepen markets for greater financial sustainability of Green Energy projects.

f.Green Innovation

Developing economies, by definition, are still building their economic infrastructure and systems of production and manufacture. It is, hence, critical to work towards Green methods of production from the outset. Low-cost, Green "process", or "making-do" innovation, adapted to local conditions of developing countries, can actually lead to greater productivity in a greener manner. This helps firm profits, and so, such innovation-based profit can push Green Economic Growth than more restricted notions of Corporate Social Responsibility (CSR). Policies for Green Innovation should indicate consistent and unwavering support for sustainable technologies to investors and innovators. Public R&D efforts can be directed towards Green Innovation for local needs water supply provisioning, topsoil erosion, forestry and water-body preservation – all critical for sustainability. Adoption of foreign technology for local conditions must be promoted, and local green product markets must be expanded, and their functioning made more efficient by better government procurement, and regulatory policies.

4. Strategic Policies for Green CCMT Innovation & Trade: Trade & Innovation Indicators for China

We discuss which policies can be pursued to achieve the maximum Green Economic Innovations and the gain the most strategic trade policy advantage. In particular, we will focus on how policies need to consider country-specific strategic factors and advantages, examining instances of certain Asian countries.

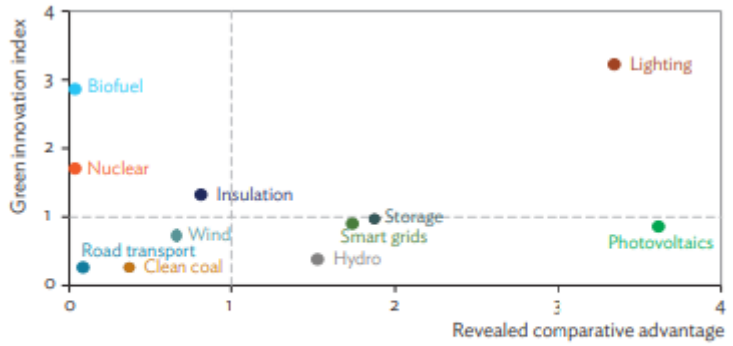
Countries need to identify technologies that can innovate in and strategically pursue for specialization in trade. Thereafter, it is necessary to identify methods to achieve specialized and greater production of CCMTs (Climate Change Mitigation Technologies).

Identification and selection of technologies for specialization can be governed by the following considerations:

a. Is there a technology in which the country presently has an innovation and export advantage?

b. Which technologies can have a multiplier, i.e., a spillover positive impact on the economy?

Evidently, countries should not seek primacy in every single possible technology but attempt to focus on the most promising alternatives. Point i. can be addressed by looking at the relevant country's graph of Green Innovation Index (GII) vs Revealed Comparative Advantage (RCA), available from UN Comtrade. Examine the graph for China below.



PV = photovoltaics.
Note: 2012 data for green innovation index and revealed comparative advantage.
Sources: International Energy Agency; United Nations Commodity Trade Statistics Database (UN Comtrade); European Patent Office; Vivid Economics.

Figure 2: The People's Republic of China's Strengths by Technology

The Green Innovation Index (GII) roughly measures the innovation advantage the country has in that sector, where a GII > 1 indicates the country has a special advantage in innovating in that sector and is well-positioned to capture value from that design, and a score of 1 indicate neutral condition, and <1 implies a disadvantage. The Revealed Comparative Advantage roughly estimates the comparative trade advantage of the country in the respective sector, where, as with the GII, RCA > 1 implies a specialization in exporting the technology, indicating better long-term likelihood of gaining value from trade and manufacturing, and capturing global market share from that technology. RCA of 1 indicates neutrality, and RCA < 1 indicates disadvantage.

In the 4 quadrants of the graph of "The PRC's Strengths by Technology":

i. Top-Right Quadrant indicates an innovation and export advantage, revealing greater Green growth prospects.

ii. Bottom Left Quadrant indicates absolute weakness, with no export or innovation advantage.

iii. Top Left Quadrant indicates innovation strength, but export weakness. This indicates a major opportunity, as the country can leverage its innovation to boost manufacturing and hence exports.

iv. The Bottom Right Quadrant indicates strong exports, but poor innovation in a sector. This is, comparatively, a threat, as innovations elsewhere or a change in technology can outdate the country's exports in the sector.

Per the above scheme, China (PRC) has a huge advantage in Lighting technology, which it should seek to sustain and expand. It has tremendous potential in Biofuels, with strong innovation and virtually no exports. It should seek to boost its Biofuels exports. Likewise, it has somewhat lesser, but still solid, innovation in Nuclear technology, but almost no exports. It should also expand its exports of crucial Nuclear technology substantially. Finally, it faces a certain threat in Photovoltaics, Storage Technology and Smart Grids. It needs to innovate in there to retain and potentially expand its world export market share. China has weaknesses in Wind, Road Transport and Clean Coal and would require radical policy efforts to innovate and competitively trade in these technologies.

We note, however, that any country can use the above graph as guidance to select even technologies in which it's relatively weak to move them up the Y-Axis, seeking innovation improvements, and move them down the X-Axis, seeking trade improvements.

For point ii., national governments need to examine inter-sectoral linkages in their economy. Whichever technologies have multiple and strong "backward" and "forward" linkages to multiple sectors, i.e., take inputs from many sectors and feed output to and stimulate multiple other sectors, should be preferred for promotion. For instance, supporting electric vehicles can boost multiple Green Transportation-related sectors, as electric engines can be use in other types of vehicles, the batteries used have broader applications and EV charging stations help create multiply usable transport infrastructure (Hidalgo et al., 2007).

Market-forces alone cannot be relied upon to deliver on desired CCMT-related outcomes. It is found that CCMT innovation was energy price-drive till the 1990s, but subsequently, its pace has acceleration due to environmental policies (Dechezleprêtre et al. 2011). Government, then, need non-market mechanisms to boost CCMT innovation and strategic exports in CCMT.

1. Price Mechanisms

The inaccurately factored in pricing of GHG (Greenhouse Gas) emission – the climate change externality – is the primary market failure inhibiting Green Technology growth. This can be tackled by levying a de-facto GHG price by modified subsidy schemes and taxation. Carbon taxation, amounting to a carbon price, can incentivize emission reduction with firms responding by clean technology innovation (Aghion et al., 2012). Continued subsidising of "dirty" energy from fossil fuels and ensuing under-pricing of energy (Coady et al., 2015) is a major policy distortion. Such subsidies should be removed, and governments should encourage, support and subsidize renewables and electric vehicles.

2. Non-Price, non-Market Methods

Accurate carbon-pricing is difficult, and suggests a need for additional supportive non-price, non-market measures. Such non-price measures fall in 3 broad classes:

i. Regulation

ii. Skills

iii. Financing

Regulation facilitatory for CCMT innovation involves strong IP regimes that permit technology transfer, which is crucial as every country cannot become a frontier innovator in CCMTs. Weak IP regimes inhibit trans-national diffusion of patented knowledge (Dechezleprêtre, Glachant, and Ménière 2011). IP holders should feel secure in transferring their technology to countries desirous of foreign technology.

Initial stages of green innovation for CCMTs might require government-supported R&D. Such green innovation, similar to IT (Information Technology) innovation, gives technical boosts across a range of sectors, mitigating costs of climate change and generating economic growth in its own right. Governments can also help in planning and building rules and codes, and imposing efficiency standards that boost Green innovation to adjust to the said regulations.

Governments can plug gaps in critical infrastructure, like transmission lines or supply chain design, where coordination failures reveal such gaps.

Countries need to provision adequate number of properly skilled personnel to conduct CCMT innovation and production. Existing skill-bases, like software professionals in India, can be used to advance India's comparative advantage in smart grid technology. Indonesia, lacking comparative advantage in existing CCMTs, can still choose to focus on a CCMT where it has a substantial physical capital, like Geo-Thermal energy, and train personnel in developing and expanding it.

Financial policies, too, as a must to enable adequate financing of Green innovation. Innovations funds, payment-by-results schemes and Green bonds are all means of funding Green innovation. Innovators competing for funds can drive R&D in early-stage technologies.

Green and CCMT innovation can, as mentioned earlier in this paper, lead to a Green economic transition that leave certain workers unemployed and underemployed, due to frictions and rigidities in the labour market (Bowen and Kuralbayeva 2015). Likewise, fallow carbon-intensive capital stocks can lead to financially unproductive capital on balance-sheets. A calculated, long-term investment strategy is needed to deal with this. There is also a documented resistance to accepting innovation (Aghion et al., 2014). It would, then, be necessary to lubricate the Green economic transition by phased and structured approaches, enabling labour elasticity and creating major industry leaders, having large scales.

5. Conclusions

In this review of Green Economic Growth, we started with a discussion of the meaning and relevance, establishing Green growth as growth inclusive of costs to the natural environment and conceiving a Green Growth Transition and associated issues. We examined a few ways of measuring this transition by numerical

indicators, finding a comprehensive Green Economy indicator, the GGEI, which ranks 160 countries. On the whole, GGEI indicated a mixed picture of Green Economic transition, with only UK & Germany doing well amongst the top GHG emitters, though a few favourable outcomes existed. Next, multiple aspects of policies for promoting Green Economic Transition and Growth were examined. It was seen that multi-incentivizing approaches, with co-operative and collaborative stakeholders, using Green Innovative approaches, coupled with institutional mechanisms and political will, seem to be most effective. Policies for CCMT/Green manufacturing and strategic trade advantage could be motivated by countries' standing on Export Advantage (RCA indicator) vs Innovative Advantage (GGI indicator) graph. Specific cases of countries' adjustment and issues involving Green Economic Transition to their specific circumstances were considered then. Significant GHG contributors China and India were viewed from the point of view of their manufacturing and trade circumstances, as well as from India's resource-endowment (solar surplus, dirty coal disadvantage) and cultural tradition of improvisatory, frugal innovation.

Finally, global warming, and ensuing anthropogenic climate change is an impending danger that threatens all humanity and its future generations. Widespread economic growth has lifted millions around the globe out of extreme poverty into a higher standard of living and has raised aspirations of millions more. However, rapid economic growth, by imposing unregulated costs on the very natural environment and natural resource-base on which it relies and on which the beneficiary humans rely and subsist on, threatens to undermine itself and lead to economic regress for many and leaving future generations of humanity with a depleted natural environment and damaged ecosystem, causing poverty and untold suffering. It is hence crucial to reconcile economic growth with minimal damage or even amelioration of the natural environment and natural resource base, leading us to the notion of a Sustainable, Green Economy.

The choice, then, is not between economic growth and sustainability. It is to attain economic growth through sustainable, green means; indeed, it is using Green Economic growth as a source and driver of economic development (jobs, more goods and services per capita) and economic stimulus (in face of recessionary pressures) in its own right.

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Authors Profile

Chetan Tippa has a strong background in architecture and data science, with experience in technical skills such as Python, SQL, Power BI, and data visualization. Chetan's education includes a master's in data science from Liverpool John Moores University & Upgrad, an Executive PG Program in Data Science from IIIT B & Upgrad, and an M. Arch in Environmental Design from the University of Nottingham and KLE Technological University. Chetan has professional experience as an assistant professor at BGS School of Architecture & Planning, senior architect at Srikar & Associates Pvt Ltd, team lead and sustainability engineer at McDBERL, and junior architect at Srikar & Associates Pvt Ltd.

Notable achievements include leading a team to the Solar Decathlon India finals, enhancing student performance and engagement through workshops and events, directing multidisciplinary projects, achieving significant waste and energy reductions, and presenting at 'Design Uru' on the impact of engineering on architecture.

Chetan has been awarded a prestigious Developing Solutions scholarship for his studies at the University of Nottingham, as well as the Rushcliffe Solar Prize during his Masters. Certifications include Registered Professional Architect (CoA, India), IGBC Accredited Professional, and EDGE Accredited Auditor & Expert.

Kshitij Amodekar received his M.Sc. degree in Environmental Design and Engineering from University College London in 2007, and his Bachelor of Architecture degree from the University of Pune, India, in 2005. He is currently pursuing an MBA at the Telfer School of Management, University of Ottawa, with an expected graduation in August 2024. During his career, Kshitij has held prominent roles in various organizations, including Associate Director of Design and Sustainability at Krea University, Head of Sustainability and Climate Change at SEED Engineering Consultants Pvt Ltd, and Director at Arca Verde Pvt Ltd. His work has focused on integrating sustainability strategies into campus infrastructures, pioneering carbon-positive movements, and large-scale renewable energy projects.

Kshitij is also a LEED Accredited Professional (BD+C), WELL Accredited Professional, and EDGE Accredited Auditor & Expert. He is passionate about fostering transitions towards low-carbon operations and balancing technical innovation with the goals of equity and sustainability.