UN GLOBAL COMPACT
Network India

ENERGY & CLIMATE CHANGE
WORKSTREAM WHITE PAPER

Some policy recommendations through a systemic perspective to strengthen India's Net-Zero transitions

Dedicated to the Pioneer of this Workstream

Late Shabnam Siddiqui
Former Executive Director,
United Nations Global Compact Network India

Shabnam was a great believer and practitioner of Collective Action, and believed that the private sector plays a critical role in the attainment of Sustainable Development Goals. She had made significant contributions in creating an active community of changemakers committed to accelerating positive change and innovation to achieve SDGs. She was one among such stalwarts who are remembered for their deeds for generations.

UN GCNI first Energy & Climate Change Workstream White Paper was initially started by her meticulous efforts. The work on the said workstream has been deeply inspired under her initial guidance. She had a calm, composite demeanor but at the same time her energy and dynamism in the affairs of social, scientific & sustainability programmes were unmatched. The workstream draws sincere motivation from the teachings of Shabnam Siddiqui and she shall always be alive in our work activities. She was an advocate of comprehensive welfare and a sustainability warrior.

UN GCNI lost a visionary, a scholar, an orator, a writer, an educationist, a reformer and an activist who spent her life serving the causes of Environment, Biodiversity and Society. Shabnam created institutions and encouraged young, energetic and talented people to tackle new heights. UN GCNI Sustainability initiatives today especially the ones on Climate change & Biodiversity get inspired by the way of life and work culture using which Shabnam Siddiqui served the society.

There are people who leave behind an indelible mark and an unforgettable legacy before their departure to the ultimate and permanent abode and Shabnam Siddiqui was surely one amongst those.

We hope to be steadfast on the noble path of the deceased so that we continue with her sublime mission.

Foreword

India's achievements in the energy sector in recent years have been outstanding. The Government of India is implementing reforms towards a secure, affordable, and sustainable energy system to power a robust economic growth. India has mobilized global level consensus through the solar energy alliance and has consistently through the knowledge capital assisted IPCC assessments too. The efforts through the Perform, Achieve and Trade framework are quite remarkable; notwithstanding the continually emerging technology and price challenges connected with such transitions.

Energy & Climate related challenges can no longer be thought of as short-term domestic issue. They have overarching impacts across geographies, especially with rapidly changing geopolitics and the climate change imperative. While scientific evidences establish the cause – effect relationships of climate change, the consequences of emissions from using fossil fuels are increasingly clear. Preventive management is the call of the hour. A growing groundswell is evident through the race to tackle impacts of climate change. Dozens of the world's biggest economies have adopted targets for net-zero emissions by 2050; cutting fossil fuels and boosting clean energies. Big investment trends appear to enable technologies for alternatives – based transitions. Meanwhile, carbon prices are soaring, and energy companies are recalibrating their strategies and business models for a net-zero world with a new sense of urgency. COP26 of the UNFCCC saw Honourable Prime Minister of India Shri. Narendra Modi has committed to Net-Zero emissions by 2070. India's commitments create and strengthen the foundation for global pathways to achieve ambitious 1.5˚C global warming target.

India is also introducing important energy pricing reforms in coal, oil, gas, and electricity sectors; essential to enhance the robustness of open energy markets and their financial health. Indian is taking significant steps to enhance energy security through domestic production and building dedicated oil emergency stocks as a strategic petroleum reserve. These are truly large achievements from a public policy perspective.

The present white paper takes stock of developments in the stated and related areas. It relates to four pillars of holistic growth, namely; environment, energy reliability, affordable energy for the poorest and competitive markets for

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our businesses, industries, and households. This white paper examines the landscape of strategies over long term, to give industry the confidence to invest to help us deliver our goals - a truly sustainable energy policy.

I thank the NTPC School of Business, notably Dr. R. Gopichandran and his team including Professor Brijesh Bhatt, Gireesh Chandra Tripathi & Ambika Prasad Dash for the excellent collaboration as the research partner this workstream. Their most important guiding principle for the uniqueness of this publication was not to repeat well known and often overemphasized facts available in the public domain about policy recommendations. They have on the other hand highlighted the fact that significant impetus is evident through initiatives by firms that came together for this knowledge consolidation. This aspect of industry partnership has been crucial for this energy workstream, thereby I express my thanks and gratitude to all the partners viz; Avaada Energy Private Limited, Indian Oil Corporation of Limited, Renew Power Private Limited and SAP India Private Limited. They inspire thoughts and the much needed confidence to help India co–evolve her ambitious energy transitions. These will reinforce India's commitments to net-zero, through outlooks that seamlessly serve the triple bottom line of economic, environmental and social gains. Industry initiatives are at the centre of such a co–evolution.

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The three main objectives of the white paper are to:

1. Substantiate challenges India faces in translating the net – zero intent into a reality;
2. Indicate policy measures that can resolve the stated challenges &
3. Present insights from Industry partners of this Workstream that indicates implications across the value chain.

These objectives are set in response to a felt need for such sector – specific insights as stated by the IEA [1] and inferred from some India – specific [2-9] and other country contexts and the post – CoP 26 imperatives.

India's commitments are quite credible; what with the recent doubling of budget allocations for the Ministry of New and Renewable Energy (MNRE). These are meant to enable viable ecosystems in addition to infrastructure with the momentum from production-linked incentive (PLI) scheme. India's resource efficiency policy takes note of the country's almost total import dependency for metals crucial for alternative energy production systems. These cannot however be viewed in isolation. Transportation links other sectors, with enormous carbon footprints; with implications for distances served through batteries, swapping standards and related services. This sets the context for circular economy in several sectors; twinning the entrepreneurial and carbon – efficiency agendas. Such market and institutional mechanisms as sovereign bonds for green infrastructure and environmental clearances are important augments (optimization, transition and deep de-carbonization).

https://economictimes.indiatimes.com/industry/renewables/budget-takes-a-green-turn-towards-net-zero-target/articleshow/89358012.cms?from=mdr

This could help India strengthen and reorient her investment strategies that acknowledge business opportunities in climate-resilient infrastructure.

(https://www.cigionline.org/static/documents/documents/PB%20no.106web.pdf

&

https://www.cdp.net/en/research/global-reports/global-climate-change-report-2018/climate-report-risks-and-opportunities)

Some important policy leads emerged out a recent meeting of top business leaders through the World Economic Forum

(https://www.weforum.org/agenda/2022/01/surprising-net-zero-transition-approaches-innovations-davos-agenda/).

They asked for enhanced support clean hydrogen as a means of industry – wide de-carbonization and standardize protocols to compare product carbon footprints. These are in addition to deep engagement with such initiatives as the Global Commons Alliance (GCA), the Marrakesh Partnership and the Science Based Targets for Nature

(https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf).

The Race to Zero involves businesses and investors in addition to other stakeholders, within the Climate Ambition Alliance

(https://unfccc.int/climate-action/race-to-zero-campaign).

The Net-Zero Asset Owner Alliance launched its second edition

(https://www.unepfi.org/wordpress/wp-content/uploads/2022/01/NZAOA-Target-Setting-Protocol-Second-Edition.pdf) aligned with the **(https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf** & **https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/)** latest IPCC pathways.

Sharma & Jaspal 2021 (Mihir S Sharma and Mannat Jaspal, Eds., Shaping Our Green Future: Pathways and Policies for a Net-Zero Transformation, 116p, November 2021, Observer Research Foundation, **https://www.orfonline.org/wp-content/uploads/2021/11/ORF_Monograph_ShapingOurGreenFuture_9Nov.pdf** & The Geoeconomics of Climate Finance 2021 Akshay Mathur and Mannat Jaspal 16p **https://www.orfonline.org/wp-content/uploads/2021/11/ORF_IssueBrief_508_Geoeconomic-Climate-Finance.pdf** present an excellent analysis of the transitions India is faced with. They highlight the need for massive investments in green technologies and equipment and mutually reinforcing low carbon and net zero pathways and clear sectoral targets. Empirical evidences are needed about the limits and limitations of systems in vogue with special reference to the economy – wide impacts of such pathways. They refer to the energy-systems and input-output macroeconomic models of the World Resources Institute, the Climate Policy Lab, Tufts University, and Cambridge Econometrics, Cambridge and of the International Financial Reporting Standards (IFRS) as useful leads to address these correlates. Post - Glasgow scores of firms that account for trillions of dollars in assets came together as part of the net-zero emissions agenda. The new Glasgow Financial Alliance for Net Zero (GFANZ **https://assets.bbhub.io/company/sites/63/2021/11/GFANZ-Progress-Report.pdf**) brings several net-zero initiatives from across the financial system to consolidate and further inspire transitions. They emphasize science-aligned interim and long-term goals alongside the above referred UN Race to Zero campaign. These include the Net Zero Asset Managers Initiative and the Net Zero Asset Owner Alliance that strengthen the United Nations Environment Programme Finance Initiative **(https://www.un.org/en/climatechange/biggest-financial-players-back-net-zero).**

Two important guiding principles establish the uniqueness of this paper. The paper does not repeat or overemphasize the need for the net – zero strategy. This aspect has been stated several times over by leading energy related platforms at the national, regional and global levels. References cited in this document substantiate this observation. The present paper accordingly only indicates important determinants of strategies for transitions as the context for the policy recommendations presented. This is through an overarching framework and industry - specific insights; aligned with the stated objectives and framework. These insights are presented as standalone elements / chapters, in the following.

CONTENTS

Executive Summary

The present white paper is in response to a felt need to consolidate insights held by industry about India's preparedness to pole-vault into net – zero regimes. Such important industry leaders as IOCL, ReNewPower, Awaada and SAP contributed to the document. A detailed interpretation of the power sector was also carried out. Several policy leads are presented to strengthen the development and implementation of mutually reinforcing plans, programmes and projects. They address issues of scale, infrastructure, finances, incentives and end – use engagement in addition to issues pertaining to production, consumption and governance. The paper highlights the need to align policies to five facets of inclusive development. They are:

1. Accelerate deployment of cleaner and energy - efficient energy technologies;

2. Infuse mandates and standards to drive consumer spending and industry investment on climate efficient technologies and foster best practices that deliver economy – wide integrated mitigation and adaptation gains;

3. Define targets and related institutional mechanisms for larger scale integration of energy from renewable sources including wind and solar for electricity sector transition aligned with fossil fuel subsidy phase-outs, carbon pricing and other market reforms for appropriate price signals;

4. Enable commensurate infrastructure investment, including smart transmission and distribution grids and related end user needs &

5. Foster innovations to expedite sustainable transitions through advanced batteries, hydrogen electrolysers, clean cooking solutions, direct air capture and storage and other system – specific interventions. Regulations and market mechanisms too should co – evolve and therefore the scope for flexibility should be built into the design of such interventions.

Several policy leads are presented to strengthen the development and implementation of mutually reinforcing plans, programmes and projects. They address issues of scale, infrastructure, finances, incentives and end – use engagement in addition to issues pertaining to production, consumption and governance.

1 Introduction: The temporal setting for Net-zero goals and a logical framework for directions

The present paper is temporally relevant because of deliberations at the CoP 26. India announced a net zero goal for 2070; committed to her NDCs. This calls for a significant reduction in carbon output by 2030, along with increase in energy from renewable sources. India's efforts are also aligned with comparable initiatives at the global scale and through bilateral partnerships. For instance, methane emissions and de-forestation are targeted through US and EU initiatives in particular on priority to enhance mitigation outcomes. This covers oil and gas production. The Global Methane Pledge involves many nations and the Climate and Clean Energy Agenda and the Trade Policy Forum involving India and the USA are positives. The India UK initiative on disaster resilient infrastructure and the proposed Green Grid Initiative raise hopes. However commercial dissemination of mitigation and adaptation products and technologies continues to be a challenge. The ethanol opportunity, carbon border adjustments and incentives for innovations too dominate the transitions landscape. Opinions of citizens are important drivers too[16]. The premise is to balance ambitions, risks and returns. The role and impacts of climate – technologies in enabling such transitions and investments appears to be determined by such aspects as capex gains or tax efficiencies[17] regulations, abatement feasibility, scale, product/ service growth and brand optimization.

India can derive useful lessons from the EU and other countries about the congruence of policies and plans of action to sustain transitions. The premise from the latter is that as countries stimulate economies and build back after the Covid-19 pandemic, they have historic opportunity to stay on target about net zero emissions. A 10 – year time horizon is considered for a wide variety of low-carbon technologies and the means of steady integration. IEA's Clean Energy Transitions Programme supports governments especially assess and tackle technical and economic transition risks for an inclusive energy system. Based on the above, it is essential to adopt an integrated framework of analysis of policy options and related thrust areas to define achievements this far and the way ahead.

The case of solar mainstreaming in the USA has been presented by The Solar Futures Study18]. This is especially to de-carbonize grid and related energy system. Several important correlates determine the spread and depth of gains in this context. They include the time to double and quadruple solar deployment, concurrently co – accelerate other renewable energy sources and diurnal energy storage. They reportedly are influenced by cost-reduction, configurations for use in multiple sectors and access to materials to sustain production. These in turn influence demand flexibility, grid resilience, transmission, load automation systems, operations and

maintenance assets with implications for energy justice. Policy makers from around the world deliberated at the Glasgow Conference of Parties about the forms and functions of pledge on mitigation and adaptation action. This is against the backdrop that we have only 29 years more at hand to become climate resilient according to the 2050 target.

Two important questions are therefore central to the insights presented in the following.

1. What are some of policies that should be addressed on priority to enhance synergies across regulations, market instruments and institutional mechanisms? &
2. What are the unique and cross – cutting sectoral perspectives addressed by this work stream? An integrated framework of analysis of policy options is also presented as the basis for policy guidelines; especially for the power generation sector.

Production, transmission and distribution efficiencies including energy sources are critical for the energy sector per se. They cover conventional and alternative energy sources as a function of availability, access, storage and efficient extraction and use. End – use efficiencies in transport, buildings, domestic and industrial operations and are equally important in all sectors; influenced also by behavioral dynamics of all stakeholders. Such mitigation and adaptation strategies as energy efficiency enhancement and emissions reduction, capture and value added uses are central to comprehensive gains.

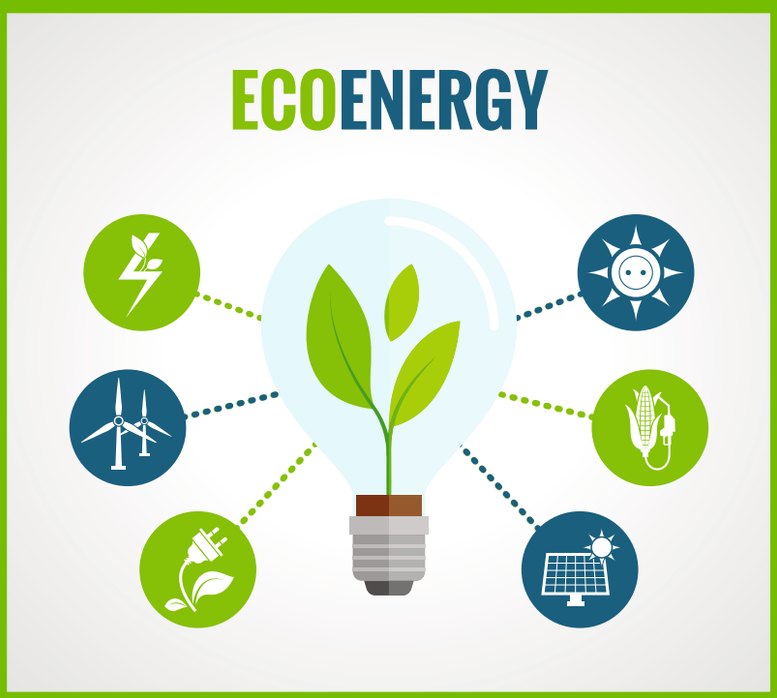
1. Adopt most technically feasible, cost-effective & socially acceptable measures.
2. Ensure rapid deployment of alternatives,
3. Enhance technical preparedness to use alternatives and clean energy jobs &
4. Secure energy supplies; and relate to peaking periods & related impacts / safeguards with respect to: average per capita income, economic growth rate, pace of transition as a function of peaking and net-zero periods / circumstances,
5. Tackle stranded assets, economic trade-offs & related carbon – leakages also due to trade exposure and international policies &
6. Assess cost effectiveness of mitigation and improved air quality through sustainable structural change as co-benefits; distributional and competitive impacts and the scale and distribution of new growth opportunities and challenges

Table 1: Six important cross cutting policy prescriptions influence outcomes of strategies.

These imperatives have to viewed with respect to the likely installed capacity by the end of 2029-30.

Fuel Type	Capacity (MW) in 2029-30	Percentage Mix (%)
Hydro*	60,977	7.46%
Pumped Storage (PSP)	10,151	1.24%
Small hydro	5,000	0.61%
Coal + Lignite	2,66,941	32.66%
Gas	25,080	3.07%
Nuclear	18,980	2.32%
Solar	2,80,155	34.28%
Wind	1,40,000	17.13%
Biomass	10,000	1.22%
Total	**8,17,254**	
Battery energy storage#	**27,000MW/108,000MWh**	

*including hydro imports of 5856 MW # Active battery storage, Source: CEA 2020: 16



2 India in the context of net – zero commitments

India's latest biennial submission to the UNFCCC indicates that she is poised to fulfill her commitments. She has taken note of the need to significantly upscale preventive and integrated mitigation and adaptation strategies as part of the way ahead. It is however essential to strengthen the forms of functions of policy measures that will translate intents to reality through a deep congruence with all related stand – alone and cross cutting plans, programmes and projects. India's efforts are laudable because they have emerged despite several ambiguities and related challenges faced by countries with comparable circumstances. These include time frames for net-zero target and intermediate milestones aligned with seven important considerations.

1. A growth-friendly strategy[5]-[8], [18]-[25] should have a green investment plan supported by carbon pricing mechanisms. We also recognize that it is not easy to de-carbonize such sectors as transportation, agriculture, and land use. Such interventions should inspire green investment that can be fostered by credible reporting, and verification that help reduce related externalities and market failures;

2. Greater clarity is however needed about the aggregation of GHGs to determine net-zero outcomes, relative gains from abatement and direct carbon removals, and offsets, additionality, committed funding and technical assistance programmes. Leakages across countries, sectors, and value – chain initiatives have to be addressed on priority to rationalize gains.

3. The groundswell for management of social and environmental risks based on principles of equity and justice is palpable. It is therefore important to interpret gains holistically; centered on India – aligned fair and just transition.

4. This calls for low-carbon policy packages for all sectors through a systems approach. This includes mutually reinforcing regulations to phase out high-carbon technologies and behaviours and balanced carbon pricing that favours low-carbon options.

5. Institutional mechanisms that help citizens exert their rights to quality of life are equally important. It is equally important to showcase locally evolved technology and management solutions to create the much-needed impetus for seamless transitions.

6. A recent observation by CEEW indicated that India should increase her solar power capacity to 5630 GW[26] to become a net-zero emissions nation by 2070. India presently has 100 GW of installed renewable energy capacity, of which solar comprises 40 GW. This aligns with the possibility that coal could peak by 2040 and drop by 99 per cent between 2040 and 2060.

7. The above stated are topically relevant because the present period in time is important for global climate debate as indicated above[27]-[35]. It is also well known that climate pledges by governments to date are not adequate to meet the net – zero target56.

2.1 Five major important elements of governance accordingly call for urgent attention to create the much needed over – arching and robust policy milieu. These over – arching five elements relate to 17 others that follow as a comprehensive basket of 24 policy thrusts we propose.

They are:

1. Establish the
   i. Veracity of emission offsets, despite significant progress world over and the emerging greenhouse gas removal markets / negative emissions framework,
   ii. Coherence of interim and suitably aligned long – term targets, and infrastructure support including storage and grid integration
   iii. Policy stability with respect to fiscal and non – fiscal instruments and centre – state dynamics
2. Strengthen
   i. preventive management including cleaner production strategies to reduce emissions and other wastes at source &
   ii. waste stream characterization for targeted material recovery, value addition and reuse,
3. Re-define frameworks of storage and permanence of captured gases based on rigorous life cycle assessments
4. Call for a deeper understanding of environmental fate of chemicals / pollutants across all media with implications for efficient CCUS &
5. Enhance access to empirical evidences about reductions including successes and adequate spread and depth of robust data to ensure consistency across all policy frameworks.

2.2 Oil and gas majors around the world have developed uniquely adapted net – zero strategies[36]-[43]. Some interesting overarching policy leads create the opportunity to:

- infuse the enterprise risk framework to assess interactions between operational, market, financial and reputational risks[39]
- acknowledge and support transitions through operational efficiency, low – carbon power / fuels, enriched CCS and other natural sinks and behavioral incentives for green consumerism and business[37]. This is against the perpetual dilemma that people say they want sustainable products, but they don't tend to readily buy them (https://hbr.org/2019/07/the-elusive-green-consumer)
- interpret sustainability of oil & gas businesses that will be influenced by climate policy with respect to stranded volume of fossil fuel reserves left unexploited, stranded capital investment in fossil fuel infrastructure not recovered over the operating lifetime due to fall in demand or reduced prices & stranded value as a reduction in the future revenue generated by an asset or asset owner assessed at a

given point in time due to reduced demand or reduced prices[40];

- strategize low carbon business models that help firms sustain profits
- present such strategies to markets and other stakeholders
- develop ESG metrics that are transparent, objective, and accessible to investors
- invest in the promising concepts of net zero emissions and circular economy &
- encourage growth of international carbon markets and expand possibilities for joint cross-border projects for emissions reduction.

A snapshot of 2050 - commitments by leading oil and gas companies[44]. The Net Zero Standard for Oil and Gas published recently developed by the Institutional Investors Group on Climate Change (IIGCC), the Transition Pathway Initiative (TPI) and Climate Action 100+ (CA100+). This covers such important elements as ambitions, targets, decarbonization strategies, capital allocation, climate policy alignment, governance, just – transitions and TCFD disclosure[45].

2.3 Energy critical elements too attract policy support[46]-[53] . They are central to the energy sustainability of transitions on account of the:

- Dynamics of scarcity wherein production is determined by geographical concentration of more than 60 metallic elements involved in energy pathways; economies of scale and high-volume demand of base metals, industrial minerals, and rare-earth elements to be met from mining or recycling and provision
- Types of substitution, namely: Substance for Substance; Service for Product; Process for Process & New technology for Substance Substitution;
- Service materials provide:
  - Gallium, germanium, and indium in thin film photovoltaics with high absorption coefficient.
  - Rare-earth elements corrosion – resistant - neodymium and rhenium used in permanent magnets due to high curie temperature and therefore do not lose magnet properties.
  - Neodymium, lithium, and cobalt to produce RE systems & wind turbines, photovoltaic cells, and batteries with respect to battery, photovoltaics, wind or motor-related and vehicle-related applications.
- Interdependencies, future development integrating LCA basis of RE systems, technology paths, Material criticality, efficiency, potential for replacement / recycling; Responsible mining and consumption with resource and reserve parameters of critical and conflict materials, Price volatility & Investment strategies;
- Need for standards, and certificates of sustainability of practices in mining and the supply chains of metals / metalloids / alloying elements &
- A much-needed framework for a system analysis of energy-critical metals with respect to production /

refining / recovery & reuse of "energy-critical elements" for example as:

- gallium, germanium, indium, selenium, silver, and tellurium in advanced photovoltaic solar cells
- dysprosium, neodymium, praseodymium, samarium and cobalt in wind turbines and hybrid automobiles
- lithium and lanthanum in high-performance batteries
- helium in cryogenics
- cerium, platinum, palladium, and other platinum group elements (PGEs) in fuel cells as catalysts
- Rhenium in high-performance alloys for advanced turbines &
- Fluid Cracking Catalysts in Oil Refining.

Clean energy demand, basic availability and supply risk, substitutability, competing technology, political, regulatory and social acceptance and codependence on other markets and producer Diversity are equally important determinants.

2.4 On the renewable energy front[6], [54]-[59]:

- Policies to stimulate RE uptake in buildings are scarce, despite options to improve efficiency in new and existing buildings. Heating and cooling operations have been especially targeted. This is true also of RE uptake in industry. There are some signals about hydrogen strategies for industrial decarbonisation. They are however not competitive enough.
- The transport sector has not been amenable to RE integration. Greater impetus is needed for systems integration of renewables and enabling technologies, such as energy storage, power system flexibility and control.
- India should resolve challenges [6], [57]-[59] relating to:
  - Expanding affordable RE access and use in the context of financial stability for the DISCOMs and integration of increasing secure and reliable shares of RE;
  - Leveraging potential sources of power system flexibility to optimize solar and wind inputs;
  - Better monitoring and management of roof top systems
  - New regulatory and policy frameworks for greater flexibility from storage
  - Changes to wholesale markets and power purchase agreements to harmonize interstate trade
  - Flexibility to reduce curtailment, system operating costs and lower CO_2 emissions &
  - Regulatory and remuneration framework for optimal battery / energy storage/ pumped-storage; (hydro) with respect to size, technical capabilities; energy arbitrage opportunities and contribute to ancillary services for managing system ramps.

3 Insights and suggestions for policy from the industry stakeholders of the present energy work stream.

3.1 The oil and gas sector narrative is based on the niche the value chain it influences.

The stakeholders recognize that energy transitions with lesser emissions are critical and should be twinned with energy security. Importantly, electricity cannot be the only vector for the energy sector's transformation. A commitment by oil and gas companies to provide clean fuels to the world's consumers is critical to the prospects for reducing emissions. Ten important challenges dominate this landscape when the value chain elements are considered.

1. **Uncertainty and price volatility:** Rising crude oil prices (currently trading at near three year high), geopolitical tensions and instability especially in Middle East region, weakening of Indian Rupee against the US Dollar and the Covid-19 impact of consumption and infrastructure expansion exert a drag on maintaining profitability within the Indian energy sector. Increasingly stringent environmental and product quality regulations could further increase production costs and lower productivity. Changes in government policies like monetization of IOCL assets, shift to gas, and privatization of OMCs could impact IOCL business further.

2. **Need for affordable, reliable, and scalable source of energy:** India despite being 4th largest global energy consumer has abysmally low Per capita Primary energy consumption compared with the global average. Issues of scalability, reliability and affordability prevail especially considering the low per capita GDP of $8,085 ($2019, PPP) against a global average of $18,500. These are true of green hydrogen, carbon capture and utilization in particular with special reference to RE related storage and transmission, distribution infrastructures.

3. **Dependence on import:** While coal is available locally, oil and gas are largely imported. India's net dependence on oil imports of around 75%, while natural gas import dependency has increased from 20% in 2010 to almost 50% in 2019. Growing energy demand of the country is expected to further increase this dependence.

4. **Need for new Infrastructure and required finances:** New sustainable technologies need appropriate infrastructures and heavy investment. Under the SDS of IEA, India needs about USD 239 billion investment in 2030 up from USD 84 billion in 2019. We need to access low-cost funds for this purpose.

5. **Stranding of existing assets:** An abrupt shift to RE could render established infrastructure redundant or under-utilized. This will reduce financial viability of existing projects and limit

investments into new fossil fuel-based projects. Efforts to reduce refinery carbon footprint will in turn increase production costs and reduce refinery margins.

6. **Energy Storage and e – mobility through batteries has to address challenges** peculiar to the wide variety of climate conditions across India's latitudes. Lead Acid Battery option is an organized sector but best suited for stationary applications, and e-mobility in the e-rickshaw segment. Low energy density and limited Cycle life are other challenges. Li-Ion Battery, though promising and established technology, suffers from limitations on raw materials; as Co, Li are not available in India. This is true also of Al – Air battery. Lack of manufacturing facilities, inadequate charging infrastructure, limited driving range, higher charging time, high cost and fire - safety are other challenges.

7. **Solar PV** too faces such challenges as variability & uncertainty over a year basis in addition to high capital cost, import content, panel breakage, and electrical grid integration. Solar CSP can solve issues of energy on demand; yet is not cost competitive with the present efficiency levels. Manufacturing facilities for critical concentrated solar power components in the country are not adequate.

8. **Re-skilling of manpower** is an imperative that should be addressed on priority.

9. **Green Hydrogen:** The cost of green power at source is expected to be Rs 2/kWh. However, energy storage, conversion, transmission and re-conversion to DC will raise costs to about Rs 5/unit. Electrolyser Technology's costs vary from $1800/kW to $700/kW depending upon the core elements, capacity and place of production. While the Chinese suppliers are able to sell electrolysers at a low cost, the European counterparts are offering durable technology at much higher costs. With the intermittent RE generation, the capital investment in the electrolysers cannot be utilized 100%. Energy storage and complex operations add costs. Electrolysers and fuel cells depend on precious metals for chemical reactions. Hydrogen transportation and storage are yet to be addressed adequately.

10. **With respect to the Green Energy Business models and diversification strategies it is important to ensure:**

- Organizational restructuring, enhanced R & D investments, robust business models and acquisition of new skill sets to deal with CGD, EV, fuel cell, battery technologies, bio – fuels, Hydrogen etc, e – mobility value chain; midstream and downstream gas market. The 20% share of electricity in global final consumption is growing, but electricity cannot carry energy transitions on its own against a backdrop of rising demand for energy services. Hence aggressive investments not only in Giga-factory for Solar Cells but also in Fuel Cell and Electrolsyers, Carbon Fibres, Green Chemicals and Green Fertilizers, e-Fuel, EV would be required.

3.2 The renewable energy perspective:

1. **Promote investment in clean energy:** Move towards market-based pricing for energy commodities including electricity, coal, gas, petrol, diesel etc; Levying of appropriate taxes on energy commodities to promote clean energy and Stable regulatory regime and equitable rules for all players in the market

2. **Prioritize energy security through cooperative federalism:** Establish a collaborative framework between Centre and state(s) to expedite energy policies / rules / regulations and integrate variable renewables to boost flexibility of the grid

3. **Foster energy technology and innovation** through integrated R&D strategies across ministries

4. **Focus on electricity sector specific aspects through enhanced:**
   - **a. Sanctity of contracts and bidding process:** Adherence of contractual obligations by state utilities without any window of renegotiation of tariff and other terms of contract; discovered tariff, Letter of awards by bidding agencies &
   - **b. Policy and regulatory certainty** for at least 05 years without any retrospective changes.
   - **c. Sustainable distribution sector:** Adopt direct benefits transfer (direct subsidy to eligible consumers) for electricity sector; Tariff and administrative reforms necessary to have a financially viable distribution sector; Smart grid specific interventions for clean energy and user friendliness aspects & Enhanced public private partnership models.
   - **d. Promotion of Open Access:** through Uniform Open Access policies and regulations across various states & a single window clearance for Open Access approvals in a timely manner
   - **e. Transmission planning and Green Energy Corridors** through State / national level integrated resource planning and commissioning to enhance transmission evacuation infrastructure; wherein a Central agency is responsible to coordinate development.
   - **f. Renewable Sector Specific: Renewable Power Purchase (RPO) Obligation:**
     - Stringent measures to implement National Trajectory for RPO obligation for all consumers including discoms, with strict penalties for non-adherence.
     - Ensure timely payments for all projects, including vintage RE projects to high tariffs
   - **g. Large Scale RE Integration** through improved RE forecasting and scheduling mechanism and allowing balancing of deviation through procurement of power from open market & Revamp of F&S mechanism to make it standard across state geographies; Regional grid operators to be given more responsibility and authority – to be able to control operations of even state grid connected large assets (anything above 50MW generation capacity) & Large scale deployment of storage facilities as a part of ancillary services by system operator as an independent grid participant.

Storage to be at the disposal of grid operator, and to be deployed for short to medium term – say 5 to 15 years.

h. **Energy Storage:** Provide level playing field for faster adoption of storage technologies -
   - Encourage energy storage to mitigate the intermittency of RE sources and to strengthen the national grid.
   - Promote multiple Battery Energy Storage Systems (BESS) and reduce related tax burden; with a level playing field in terms of regulatory dispensation. Currently hydro storage has an edge over battery storage in regulatory dispensation by virtue of Hydro Purchase Obligation.

i. **Green Hydrogen** integration needs Fast track regulatory approval; Single window clearance/approvals with fiscal incentives; Suitable PLI scheme for manufacturing of electrolysers & Suitable banking facilities for green hydrogen manufacturing projects.

These dovetail with an additional thrust on five broad areas on priority. They are:

1. Scaling EV charging roll out
2. Trust based trading
3. Efficient recycling of renewable materials to support clean energy
4. Distributed Energy Resources (DER) penetration impacting Balancing /Deviation Settlement Costs &
5. Energy Efficiency.

Thrust areas	Some rationale	Technology use
Scaling EV Charging Rollout	Many countries established EV charging networks and consumer-friendly processes. India could leverage related expertise/models to fast-track guidelines / strategy to synergize Utilities / Oil & Gas companies' efforts especially for EV charging at gas stations.	Multiple touch points for technology include E-Mobility Platform for Charge Point Operators, DISCOMs, EV OEMs to manage E2E operations for EV charging including consumer authentication, charge transaction detail exchange, billing & payment disbursal etc.
Trust Based Trading	Draft policies for Block chain-based Trading Certificates for RE Power Generation and Trading. Energy Saving Certificate (ESCert) trading market could incentivize energy savings and investments, critical for decarbonization.	Use block chain-based platform to generate Digital Certificates / Token for E2E auditability; from generation source to end consumer stages.

Thrust areas	Some rationale	Technology use
Efficient Recycling of Renewable Materials to support Clean Energy due to life-span of panels.	Initiate R&D on recycling technologies/enterprises for equipment (Solar Panels, Wind turbines etc.) Support with policy framework for safe recycling of materials as a key requirement for Operators/OEMs. This could include disassembling and routing to respective recycling supply chain enterprises; with guidelines for the re-cycling network.	Renewable Asset Maintenance & Recycling Platform auto - identify active life span of assets. Intelligent Strategies are needed to dismantle assets and recycle individual parts in the most cost effective and environment-friendly manner.
Distributed Energy Resources (DER) penetration impacting Balancing /Deviation Settlement Costs	Due to the increase in DER contribution to the Energy mix, volatility and variability are a major challenge for Utilities and the Load Dispatch Centers (LDCs). Therefore ■ Introduce regulations (such as DER central master data storage, Demand Side Management for Residential Consumers leveraging Smart Meters rollout). ■ Increase renewables penetration (especially behind-the-meter generation sources which have no visibility at LDC/utility level) and inherent volatility is a huge risk for grid stability.	Digital Platform to centrally maintain DER asset register and accessible to all concerned parties. Additionally, leveraging this DER Information, the DISCOMs/ SLDC, NLDC can generate Accenture Demand Forecasting based on Artificial Intelligence /Machine Learning and reduce settlement costs.

Thrust areas	Some rationale	Technology use
Energy Efficiency Example: Swiss Railways	To promote renewables penetration, end consumers need to be incentivized to change their consumption pattern from peak to off-peak hours. Energy Management Solutions should be deployed to optimally leverage On-Premises Renewable Generation (solutions such Solar Panels, Battery Storage etc.)	Digital technologies that predict energy demand accurately and provide real time actionable insights for the customers to shave off Peak Energy curves by optimally deploying On-Premises Renewable sources should be mainstreamed.

Yet another renewable – energy perspective takes note of the fact of abundant sunshine across most of the states in the country. This advantage can be optimized through:

1. Centralized Generation Vs Distributed Generation for Solar PV with respect to economies of scale and related ease of planning, execution and operations;
2. Sustainability and predictive algorithm that precisely measure trade-off between LCPV and DGPV for renewable sector.

LCPV is a legacy approach and was suitable for thermal power projects which had PLFs (plant load factors) varying from 60% to 90%. Solar PV plants are much smaller in design and size. Solar PV plants are primarily designed with generation load factors of 17 to 20% of installed PV capacity. The only gain is in administrative cost which is less than 1% of operating cost. DGPV is not a new approach of system planning in India and growth in the solar sector since 2010 has been driven by this philosophy. It is presently at par with conventional sources of power; with infrastructure contiguous with the consumers. A properly planned and operated DGPV can offer consumers and society significant economic savings and improved environmental performance; reduced demand for traditional utility ancillary services. They do not involve extra electrical elements to manage electrical grids. A typical infrastructure mandatory for DGPV is transmission line over 05-20 kms at Sub-Transmission voltage level. With better planning between developers and state regulatory authorities can optimize on this aspect. LCPV plants are being developed at Badhla in Rajasthan and Pavagada in Karnataka. The CAPEX incurred for the evacuation infrastructure for 4000 MW Solar capacity in Bhadla is approximately Rs. 2000 Cr cumulatively for PGCIL, STU & Solar Park Development Agency on Transmission infrastructure. The DGPV approach curtails losses and cost of transmission and distribution largely because of radial distribution schemes. Hybrid schemes with storage technology can create small islands of mini and micro grids thus increasing the availability of power systems.

The typical utilization of any solar PV is 20-22%. If this is hybridized with wind turbines the utilization factor may increase to 35% to its best. The utilization of Transmission infrastructure in conventional energy sources ranges from 60-90%. Thus, the same transmission network may be employed for transmission of non-intermittent renewables in DGPV scheme. System management and maintenance too are simple and redundancy of (n-1) is also not required. Networks can be automatically reconfigured, reduce down-time through better systems security and relates to emerging arbitrage, peak support, peak shaving etc.

LCPV system does not facilitate any support to local voltage control and security system, entailing separate electrical elements for these functions which incur an additional budget for sub-transmission and transmission system. DGPV can help drive growth and job creation, better than the LCPV. The Government is actively promoting policies for construction of multi-GW solar parks and all forthcoming tenders are reflective of the same. We believe that this approach is not appropriate and needs to be reexamined. Developing small-mid size capacity plants across the country is healthier for equitable development, along with creation of better employment.

LCPVs are prone to project delays due to challenges like land acquisition for projects, RoWs for transmission infrastructure etc. Construction of solar parks requires massive land. (1 GW solar park will need 5,000 acres of land). The acquisition of such large land at a single location is not easy and invariably ends up in disputes with farmers who lose their livelihood. The risk of project delay due to land can be significant. Quantum of land required for 100-250 MW projects is relatively less – thus limiting challenges for land acquisition, and impediments in execution. Transmission charges and losses are higher for LCPV plants The lower capacity utilization factor for solar plants, ranging from 20-22% results in inefficient and prodigal building of transmission lines, which would have been avoided by using existing networks.

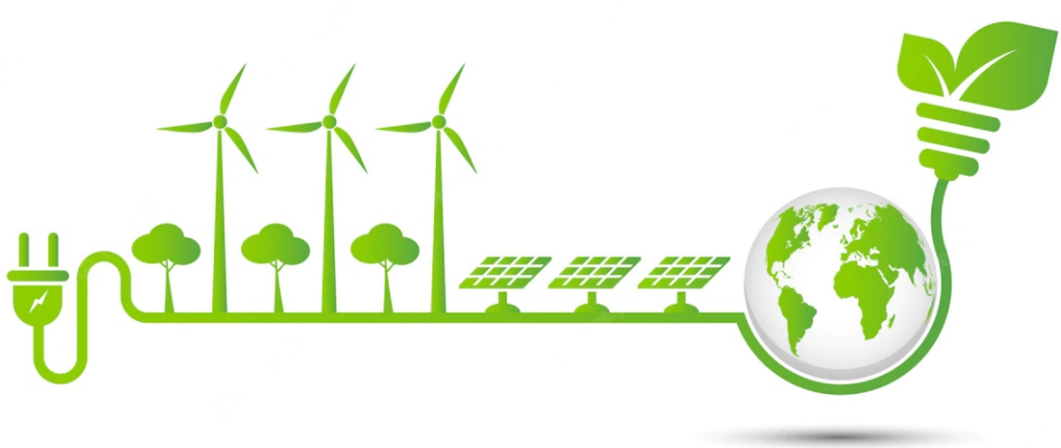
The LCPV approach promotes plants located away from the load center which leads to construction of a dedicated transmission network resulting in sub-optimal utilization of resources and time. The low utilization will ultimately translate to end users paying 4-5 times the charges for transmission infrastructure as compared to thermal power plants or if the plant was located near a load center. Evacuation of power over long distances leads to higher electrical losses of 3- 5%, ultimately borne by end consumers. In contrast, if generation capacity is restricted to 100-250 MW and is installed near the load center, losses reduce substantially.

Case example 1

1000 MW Centralized generation Vs 1000 MW Distributed generation: The Western Region

This involved 1000 MW Capacity solar projects evenly distributed in State of Gujarat, Haryana, Madhya Pradesh, Maharashtra and Uttar Pradesh with approximate project size of 60-70 MW capacity.

- For decentralized systems, average CUF of 18.05% which if translated in terms of Energy (kWh) is equivalent to 1582 MUs. This energy when delivered at STUs at 132 KV Level considering 15 KMs of transmission line will result in total losses of 0.538% which is 9.207 MUs. Considering average Tariff of Rs 2.9 per kWh the total transmission losses will be Rs 2.47 Cr.
- In comparison to above, if a similar plant of 1000 MW at single location (LCPV) with extremely good radiation zone say in Bhadla, Rajasthan will result in better energy yield of 19.3% CUF which if translated in terms of Energy (kWh) is equivalent to 1690 MUs yearly. This energy will be collected at medium voltage (33kV, 66 kV) and stepped up to 400 kV at Site by CTU substation and transmitted to load centers located in Gujarat, Haryana, Madhya Pradesh, Maharashtra & Uttar Pradesh and considering same to be delivered at 132 kV STU bus will have cumulative transmission losses of 130 MUs. Considering average Tariff of Rs 2.62 per kWh the total transmission losses will be Rs 34.1 Cr.
- The incremental Transmission Losses because of location with better irradiance will be equivalent to Rs. 31.6 Cr. In per unit terms, in Bhadla (LCPV system) transmission charges are Rs. 1.31/kWh as compared to only Rs 0.19 paisa/kWh in case of a decentralized system. The benefit of higher CUF gets negated completely because of transmission charges and losses.



Case example 2

Southern Region

Southern Region: involved 1000 MW solar projects, evenly distributed in Southern States of TN, AP, TS & Karnataka with approximate project size of 60-70 MW capacity.

This could result in an average CUF of 18.12% which if translated in terms of Energy (kWh) is equivalent to 1587 MUs. This Energy when delivered at STUs at 110 KV Level considering 15 KMs of transmission line will result in total losses of 0.694% which is 11.01 MUs. Considering average Tariff of Rs 2.70 per kWh the total transmission losses will be Rs 2.97 Cr. If bulk generation of 1000 MW at single location (LCPV) of good radiation like Pavagada, in Karnataka is considered it will result in better energy yield of 18.38% CUF which if translated in terms of Energy (kWh) is equivalent to 1610 MUs yearly. Considering average Tariff of Rs 2.70 per kWh the total transmission losses and PoC charges will be approximately Rs. 1.40 per kWh as compared to only Rs. 0.20 /kWh for decentralized STU connected plants. The cost of power at Sub Transmission level is significantly higher than the same power when delivered at sub-transmission level by DGPV. Further, the EHV Transmission system and voltage management requires complex switching systems and intricate grid operation for grid operators. **Policy makers accordingly note that the future of grids is mini & micro grids with storage and islanding operations and should move in that direction.**

3.3 The Power Sector narrative:

The International Energy Agency (IEA) indicated in its India Energy Outlook 2021 that she must consider the mid-2060s as the time frame for net – zero emissions. This is based on the possibility that a global – level target could be 2070 for complete transformation([4]; IEA's Net Zero by 2050 A Roadmap for the Global Energy Sector[1]). Several countries have announced their net – zero commitments. While this includes G20 members, most of them are yet evolving supportive policies or law[20]. India's energy strategy is driven by three considerations. They are energy efficiency, electrification and a switch to decarbonised fuels. India also could appropriately adopt renewable electricity, and hydrogen and bio-energy as key fuels[18], [19], [21], [25], [27]–[30]. The IEA recently observed that the next ten years are crucial to ensure net-zero targets and therefore invites countries with comparable growth circumstances to re-define their energy extraction and use plans. This is also related to the quantum and functional integrity of sinks to capture emissions[60], [61].

The policy prescription for the electricity sector is to:

1. Improve prospects to integrate Variable Renewable Energy (VRE) into the electricity grid, with gradual enhancements over the next two decades.
2. Address “intermittency” through flexible conventional power

generation using hydropower and gas in particular to complement the intermittent supply of wind and solar electricity generation
3. Expand transmission grids to pool different renewable energy sources,
4. Expand storage capacity;
5. Adopt sector – coupling excess electricity from RE will produce zero-carbon hydrogen fuel &
6. establish significant carbon removal projects.

The electricity sector interfaces with several other sectors. Think tanks around the world and in India highlight pros and cons of alternative development trajectories and safeguards needed to meet commitments. This is also related to India's efforts to serve the developmental aspirations of her citizens through seamless economic growth and secured energy supplies. India also deliberates on the types of clean energy infrastructure, likely to be built across the immediate, medium and long term horizons; the extent to which they are likely to differ from the present, the plan for deployment and challenges in rapid deployment on a large scale if any.

The transportation sector could benefit from “feebates” as in France, the Netherlands, and Norway; wherein tax collected for highly emitting vehicles subsidizes low-emission vehicles and ban vehicles with internal combustion engines (ICE) as preannounced by seven G20 countries.

Industrial de-carbonization could increasingly consider capital funding and incentives, and energy and resource efficiency policies. Her recent RE – CIRCLE, resource efficiency and circular economy outlook calls for concerted mitigation and eco – industrial development[62]. This addresses the manufacturing and consumption tracks including a cradle – to – cradle approach; aligned with SDG 12 and seven other cross – cutting SDGs as India's priority. The logical framework for the RE – CIRCLE framework is guided by insights about six mutually reinforcing correlates. What will be the implications of Post – Covid rebound on emissions as a function of increased industrial activity? They are about the economic importance of materials used in different sectors, environmental externalities in extraction, production and use, embodied energy, availability, access and related supply risks and import dependency. It also highlights benefits due to energy efficiency enhancement and conservation across sectors. Small and medium enterprises are significant guzzlers of energy through their unit processes and operations. Studies on opportunities to enhance energy efficiency and materials conversion are few and far between.

Removals are also seen as negative emissions, anthropogenic removals include biological sinks through reforestation, and chemical engineering. This includes bioenergy with carbon dioxide capture and storage (BECCS) and direct air carbon capture and storage (DACCS). It may therefore be useful to adapt the framework proposed by:

- Climate Action Tracker[22] that assesses target's scope, architecture, and transparency considering the scope, target architecture and transparency with clarity on the fairness of target &
- Robins et al[23] about the coordination functions of financial institutions using seven elements of financing for policy p action coherence. These relate to core mandates for price and financial stability that support economic policies. These are followed by banks in the EU to fast-track climate action.
- IIGCC et al[24] about Paris Aligned Investment Initiative to undertake climate financial risk assessment as defined by the TCFD, disclose information on governance and metrics to achieve stated targets and proactively involve such market actors as credit rating agencies, auditors and stock exchanges.
- Committee on Climate Change[25] about principles for targeted financing
- Deloitte (2020) deliberated on the impetus to change caused by financial institutions and technology and operational costs[63]. This also calls for adopting the framework of the Task Force on Climate-Related Financial Disclosures and the Sustainability Accounting Standards Board and ESG criteria in investment strategies. Is it therefore possible to strengthen abatement approaches with suitably strengthened offsets, bridge fuels if possible in transitioning away from coal, fiscal and non – fiscal measures to moderate price of technology & commitments from large entities to meet their energy needs from renewable sources.
- Black et al (2021) [64] and Hastings & Smith[65] reviewed policy – centered challenges in translating the intent of net – zero to a reality. This is especially true of the role of oil and gas producers to redefine output targets aligned with CCS strategies[9], [66].

Nine important elements of governance determine the forms and functions of outcomes of her initiatives. India already targets 33-35% reduction in emissions intensity by 2030. This does however not entail a reduction in overall emissions. Some estimate investments of over US$200bn covering various aspects of energy transitions. It is quite inevitable that clean energy transitions using low emission alternatives should be at the center of strategies. The call is for strategically important milestones for the electricity, industry and transport sectors in particular determined by technical feasibility and cost-effectiveness. According to the Third Biennial Report submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in February 2021, India's emission intensity of gross domestic product (GDP) has reduced by 24% between 2005 and 2016[3]. Some of the best-known examples include the development of the Union Territory of Ladakh as a carbon neutral region that will explore the geothermal energy option[67]–[69]. She has also evolved energy – mix policy alongside her commitments to install 450 GW of renewable capacity by 2030. India's commitments are rightly driven

by domestic concerns of job creation, providing enough electricity, lighting-up homes etc. It is equally important for her to address such challenges as access to reliable electricity supply for many, continued dependence on firewood, poor local air quality and related externalities. SDGs are twinned with quality of life especially for the economically and geographically marginalized. Is it therefore possible to decouple economic growth from greenhouse gas emissions? The Union Budget for 2021-22 addressed important elements of India's energy transitions. This includes renewable, mission - hydrogen and even smart metering. This was alongside support for such traditional areas of the energy sector as discom revival and tackling stressed assets. This is also true of energy access through blue flame coverage for clean cooking fuel[70].

The 2015 draft of the National Renewable Energy Act captures these and related elements; and the scope to re-evaluate the Ultra Mega Power Project (UMPP) plan; reduce India's reliance on imported thermal coal. These pertain to the scope for short – term plans that feed into each other, duly recognizing peak and ebb periods of energy demand, the price that has to be borne by the consumers and the political economy of trade offs. In the case of renewables, the challenges of providing round – the – clock access prevail. On the other hand is India matured enough to let markets determine the source of power, especially if all subsidies are removed? Steps to achieve net zero targets should be based on adequacy and fairness especially of liabilities. Citizen - action as part of social acceptance should complement the market and regulations groundswell[71]–[73]. India aims for energy security through optimal energy diversification to reduce dependence on coal imports. India should accordingly address social and economic impacts of transitions integrating climate, environment and other qualitative considerations that reduce energy – policy related risks in the long term to: accelerate use of distributed energy micro-grids; reduce aggregate technical, net operating and commercial loss to secure additional savings and enhance efficiency of coal production including washing of coal and grid / energy efficiency. Net electricity savings to reduce demand for electricity generation and access to capital & financial-market efficiency to reduce cost of capital are equally important. Capacity and efficiency of the electricity transmission and distribution grid, with smart metering n electricity grid's 23-25% transmission and distribution (T&D) loss rate and to drive a 6% energy efficiency saving for 2015 alone and coal-fired power plant thermal efficiency also draw attention in this context.

4 India can pick useful leads from other countries about environmentally sound production and consumption.

Some such approaches include the Mission Possible Partnership stated by the World Economic Forum, UN's Business Ambition for 1.5, Race to Zero and UN race to Resilience that addresses questions about technologies available at scale and cost necessary to enable the net-zero industry transition[74], financing and infrastructure investments, green technology advancements, picking the right carbon offsets and parallel progress across sectors[75]. There is an equally interesting argument that the present pandemic has avoided emissions world over. India's emissions too fell by 06 – 10% over 2020 and therefore India can take on a few more commitments to derive the best out of such an inadvertent abatement. Equally important is the vulnerability India's ecosystems face on account of climate change and therefore the need for preventive management[76], [77].

5 Some valuable lessons in internalizing externalities dealing with global commons; from India's leadership within the Montreal Protocol.

The present nexus between climate performance and technical/market preparedness to deal with climate change related challenges lend itself to such prescriptions. For instance, India is well known for her compliance with the Montreal Protocol and sustained efforts to fulfill commitments. India safeguarded her position by adopting three guiding principles as part of her response to the call for collective action; right from the beginning. She committed herself to preventive and remedial action by emphasizing that the use of alternatives should be only with minimal economic dislocation and minimal obsolescence costs to her production systems.

Equally important was her take that she will maximize indigenous production of alternatives so that her dependence on other countries would be minimal. She fostered technical excellence on the assessments of alternatives and therefore contributed to global efforts that rationalize their use. This logic can be extended to the development and implementation of integrated mitigation and adaptation strategies to tackle impacts posed by climate change. This extends into vulnerability reduction through an ecosystem based approach. This is also true of a large number of grass root - community led natural resources conservation initiatives that have to be interpreted for climate resilience and suitably up-scaled to sustain impacts[78]. India's robust natural sinks have to be assessed for the quantum and quality of ecosystem services they already provide, to rationalize conservation and augmentation programmes. The cited Congressional Research Service publication presents an integrated framework that India too can adapt while she considers the possibility of strengthening her net – zero strategy. This includes such elements as the basket of gases targeted and their corresponding removal/offset strategies across various time frames, forms and functions of regulations, market and institutional mechanisms that enable reductions, technical preparedness and social and environmental risks to be addressed on priority to prevent backsliding. That leaders in the Indian energy – industry landscape have been quite pro - active on all the stated fronts, is evident in recent reports (79 – 81) This creates significant hope that economic and environmental considerations will be seamlessly addressed to the best of its abilities.

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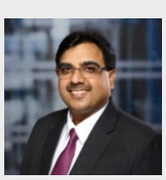

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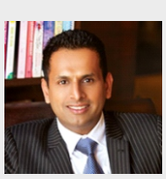

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About United Nations Global Compact Network India

United Nations Global Compact Network India (UN GCNI), formed in November 2000, was registered in 2003 as a non-profit society to function as the Indian Local Network of the Global Compact, New York. It is the first Local Network in the world to be established with full legal recognition. It, also as a country level platform for businesses, civil organisations, public and private sector, aids in aligning stakeholders' responsible practices towards the Ten Universally Accepted Principles of UNGC in the areas of Human Rights, Labour, Environment and Anti - corruption, broad goals including Sustainable Development Goals and other key sister initiatives of the United Nations and its systems.

It has also emerged as the largest corporate sustainability initiative in India and globally with a pan India membership of over 500 leading business and non-business participants, strengthening their commitment to the Global Compact Principles by becoming proud members of the Local Network in India. For more details, please visit www.globalcompact.in.

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