Lost in Transition! An Analysis of Justice Implications for Energy Transition in India

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I acknowledge the traditional custodians of the Gadigal lands of the Eora Nation on which stand the University of Sydney and many of its facilities I was privileged to use during my PhD - 2019-2023. These lands for thousands of generations have borne testimony to creation and exchange of knowledge for humanity were never ceded and have continued to be cared and nurtured by custodians past, present and emerging.

Declaration

Statement of Originality

This is to certify that to the best of my knowledge; the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Ram Niwas Arya

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Abbreviations

ABC	Australian Broadcasting Corporation
ASPCL	Andhra Pradesh Solar Power Corporation
ASPI	Australian Strategic Policy Institute
BBC	British Broadcasting Corporation
BC3	Basque Center
BHRRC	Business and Human Rights Resource Center
BMW	Bayerische Motoren Werke AG
CBDR	Common But Differentiated Responsibilities
CBP	Customs and Border Protection
CCP	Chinese Communist Party
CEEW	The Council on Energy, Environment and Water
CEO	Chief Executive Officer
CESC	Calcutta Electric Supply Corporation
COP	Conference of the Parties
CRE	Community Renewable Energy
DC	District Commissioner
DFID	Department for International Development
DISCOM	Distribution Company
DPR	Detailed Project Report
ECOSOC	United Nations Economic and Social Council
EIA	Environmental Impact Assessment
EIA	Energy Information Administration
EPA	Environment Protection Act
ESG	Environment Social and Governance
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIM	Green India Mission
GPS	Global Positioning System
GW	Giga Watt
HRW	Human Rights Watch
HSN	Harmonised System of Nomenclature
IEA	International Energy Agency
ILO	International Labour Organisation
INR	Indian Rupee
IPP	Independent Power Producers
IPS	Industrial Policy Statement
IREC	Installed Renewable Energy Capacity
IRENA	International Renewable Energy Agency
IRPGC	Installed Renewable Power Generation Capacity
JET	Just Energy Transition

KLPD	Kilolitres per day
LARR Act	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013
MLP	Multi-Level Perspective
MNES	Ministry of Non-Conventional Energy Sources
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MOSPI	Ministry of Statistics and Programme Implementation
MW	Mega Watt
NAPCC	National Action Plan on Climate Change
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organisation
NITI	National Institution for Transforming India
NOC	No Objection Certificate
NTPC	National Thermal Power Corporation
PLI	Production Linked Incentive
PMCCC	Prime Minister's Council on Climate Change
PPA	Power Purchasing Agreement
PRC	People's Republic of China
PSA	Power Supply Agreement
PTI	Press Trust of India
PV	Photovoltaic
PWC	Price Water Cooper
RET	Renewable Energy Technologies
RFR Act 2006	Scheduled Tribes and Other Traditional Forest Dwellers Recognition of Forest Rights Act 2006
RPOs	Renewable Purchase Obligations
RSP	Regulatory State Paradigm
RTS	Renewable Technology Systems
SB	Soft Bank
SDG	Sustainable Development Goals
SEB	State Electricity Boards
SECI	Solar Energy Corporation of India
SEIA	Solar Energy Industries Association
S-ESD	Social Energy Systems Design
SHU	Sheffield Hallam University
SIAs	Social Impact Assessments
SPVs	Special Purpose Vehicles
STS	Science and Technology Studies
TBEA	Tebian Electric Apparatus
TERI	The Energy and Resources Institute
TIS	Technological Innovation Systems
UFPLA	Uyghur Forced Labour Prevention Act

UK	United Kingdom
UMPP	Ultra-Mega Power Projects
UN	United Nations
UNDP	Unite Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNSDG	Sustainable Development Goals
UN-UDHR	United Nations Universal Declaration of Human Rights
USA	United States of America
USD	United States Dollar
WRO	Withhold Release Orders
XUAR	Xinjiang Uygur Autonomous Region

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Abstract

This thesis examines the implementation of India's energy transition in the domain of solar energy. The investigation focuses on issues of social justice along integrated supply chain through which energy transition is being realised. The analysis highlights the importance of distributive political and economic concerns, suggesting that the existing scholarship on energy transition in India does not account sufficiently for how the costs of renewable energy infrastructure development are distributed amongst the wider community and what are its social implications. It appears that dominant accounts neglect the concerns of society at large, consumer citizen, farmers, and pastoralists, who typically are the most vulnerable to the pernicious consequences of this transition.

This research examines energy transition to advance a new understanding of injustices involved in energy systems during and post-transition phases. The thesis posits energy as a socially and environmentally integrated justice issue and advances our current understanding of the links between energy and vulnerability, particularly along the solar energy value spectrum. In essence, it enlarges the ethical evaluations of energy technology development and the surrounding policy during energy transition. In this context, there is a dark side to India's seemingly bright energy transition, which has not been recognised let alone addressed. Land is one such important subject that has not been an issue of serious concern as a practical constraint for the government's ongoing renewable energy installations or as a subject of academic enquiry. This calls for much-needed adjustment to prioritise land in India's energy transition. India, unfortunately, does not have enough available land for the renewable energy infrastructure projects.

Another dark side of India's energy transition, that this thesis has brought to light, is the locating and integrating human rights violations in the supply chain of renewable energy systems. Energy justice presented in this thesis is a radical departure from the traditional understanding of energy as merely a collection of technological components, ignoring human activities, such as the use of forced labour in

the production of solar cells and modules in China's Xinjiang province that may have grave implications on justice outcomes of solar energy system in India. In-depth investigation is warranted since India is a significant importer of solar panels from Xinjiang and it is regrettable that the country has remained silent on the issue. Justice in the renewable energy studies has always remained confined to the geographical boundaries of a country and there is a visible absence of extending the concept of justice across whole of the supply chain as a source-to-sink concept. This thesis provides the academic basis and justification for a timely examination of the neglected subject of negative externalities of centrally located large renewable energy projects and its implications for justice.

My research project is an endeavour to better understand the potential for realising a decentralised low-carbon future for India's energy transition and expanding the boundaries of the concept of energy justice beyond the 'triumvirate of tenets' encapsulating distributive, recognition, and procedural justice. It provides a distinctive analysis by critically examining the transformative potential of renewable energy infrastructure for delivering justice. This is so true of India. The energy transitions are not only the outcome of technology and big corporate investments, but also of the people's participation in the decision-making processes across the energy transition trajectory. Contemporary transitions are affected by governments, policy makers and big businesses with hardly any room for public involvement at any stage of the project development process. How should a transition affect the justice goals of India, if any? Not applying human rights to the whole energy production process raises issues. Ultra mega utility-scale energy systems that make hundreds of megawatts of power and deliver hundreds of kilometres are the norm in today's national energy networks. Large-scale centralised energy systems are less desirable than decentralised ones since the former are more in touch with local preferences, decrease transmission losses, and rescue farmers and pastoralists from land disputes and loss of livelihoods.

Although it has been stated that large-scale centralized energy systems may offer benefits such as being more in touch with local preferences, decreasing transmission losses, and potentially rescuing farmers and pastoralists from land disputes and loss of livelihoods, an opposing perspective argues that decentralised energy systems may be a more desirable option. Decentralised energy systems have the potential to alleviate structural issues in India's energy infrastructure, increase access to affordable and reliable energy for marginalised communities, reduce carbon emissions, and improve social and economic welfare. Thus, it is crucial to examine the larger social and economic implications of the current energy transition within the country, with a focus on social justice, economic equality, and political considerations.

This thesis contributes to the expansion of the concept of energy justice to include the geographies and spaces of large-scale transboundary human rights violations that have emerged since the year 2017 within the supply chain of the Indian renewable energy system, particularly the solar installations. A critical examination of the ways in which principles of justice, equity, and fairness may be embedded all along the energy supply chain, including instances of violation of justice at the site of extraction of natural resources used in renewable energy systems, is required given the presence of social and economic relations in today's energy systems.

In conclusion this research presents a thorough examination of India's energy transition and the significance of incorporating social justice concerns throughout the process. By underscoring distributive political and economic considerations, the study highlights the social ramifications of renewable energy infrastructure development and positions the concept of energy justice within geographies and spaces of transboundary human rights violations that result from renewable energy systems, particularly solar installations in India. The study also underscores the importance of procedural justice in energy transitions; that incorporates impartial decision-making processes featuring stakeholder participation, influence, and information. As such, the study analyses the challenges and opportunities associated with India's energy transition and puts forth a more inclusive

policy-making that incorporates stakeholder participation as a key recommendation. Furthermore, the study identifies the issue of forced labor in the solar industry, especially in China's Xinjiang region, and highlights the need for global governance and transparency protocols to prevent the disbursement of goods made using state-sponsored forced labor in foreign markets. Overall, this research advocates prioritising social justice considerations in energy transitions and calls for a more equitable and sustainable energy system.

In conclusion, the study recommends a bottom-up approach that incorporates local interests and stakeholders in decision-making processes across the lifecycle, from extraction to production, supply to consumption, and waste management, to address social justice challenges arising from India’s energy transformation. These results may pave the way for a new line of inquiry that extends the idea of justice in the renewable energy industry throughout the full value chain. The concept of justice cannot be suffocated by the constraints of national borders.

1. Introduction

This chapter provides an overview of energy justice and the locations of injustices across the energy spectrum in India's energy transition, in particular solar energy, as an introduction to the study. It examines how justice, equality, and fairness might be entrenched across the energy supply chain, including forced labour in the extraction of solar modules, a major component of solar energy infrastructure. Justice has generally been limited to the geographical confines of a country in renewable energy research, and there is a noticeable absence of extending it across the whole supply chain as a source-to-sink concept.

The chapter introduces the discussion on transition with an assertion that it is possible to realise a decentralized, low-carbon future for India and that the notion of energy justice may be expanded beyond the 'triumvirate of tenets', i.e., distributive, recognition, and procedural justice. In addition, it's a timely study of negative externalities connected with big centrally located renewable energy projects and their justice implications. It provides a distinctive analysis by critically examining the transformative potential of renewable energy infrastructure for delivering justice. Energy policy discussions are broadly the subject matter of disciplines such as engineering and economics, meaning policymakers and analysts typically frame energy and climate risks in sanitised technical terms, largely devoid of broader social justice concerns. The fossil fuel-based energy systems are technology-centric systems whose continuity is a disaster for the environment and for the entire life system. Energy scholarship in the social sciences today, however, has recognised this neglect and the need to investigate energy development that places people at the centre, i.e., human-centric energy studies founded on values like equity, ethics, human rights, and justice rather than techno-economic ones. In recent years, interest in energy justice has escalated and academic and non-profit efforts are underway to identify, develop and address issues of inequity and injustice within energy production and supply

systems (Heffron, McCauley and Sovacool, 2015; Veelen, 2015; Jenkins *et al.*, 2016; Sovacool *et al.*, 2016). There is an in-principle agreement on the promotion of core values of energy justice, i.e., access to safe, affordable, reliable, and sustainable practices as long as renewable energy projects don't provoke controversy that may intrude on other societal justice concerns, for example, policies to promote renewable energy projects, which may have negative health, environmental or social impacts (Breukers and Wolsink, 2007). How communities in India see justice in renewable energy projects have been the subject of study for some time, but there is a much felt need for investigation into how people working in the renewable industry are affected by forced labour and how their rights are articulated and by whom.

In contrast to what is often believed, energy systems are not national but rather global in nature and are made up of a complex network of 'source-to-sink' actors and activities that cut beyond political borders and geographical locations. However, the national focus of energy programmes sometimes blinds them to problems like the use of forced labour in certain parts of India's solar energy system. This has led to the obliteration of our care for the pain and suffering of humans along the value chain of our energy system. Due to this, the field of energy policy primarily continues to be impersonal, uninterested in, and biased towards the more significant moral and legal concerns in the field of renewable energy. What follows from this is the need to move away from conceptualisation to operationalisation and instead, integrate the human dimensions of ethics and justice in the complex and geographically expansive solar value chain of the new energy system in India. A critical examination of the ways in which principles of justice, equity, and fairness may be embedded all along the energy supply chain, including in instances of violation of justice at the site of extraction of natural resources used in renewable energy systems, is required given the presence of social and economic relations in today's energy systems. Despite popular belief, renewable energy systems are equally as guilty of violating basic notions of fairness and justice as those based on burning fossil fuels. The

‘distribution of advantages and costs’ of energy is a crucial indicator of these principles for a society whose primary goal is to strive toward justice (Sovacool, 2014).

How the costs and benefits of energy production and use should be allocated and what should define the realm of energy justice in the light of existing inequities throughout the renewable energy spectrum remains an unexplored question. However, the concept of justice in energy systems has been around since at least the 1970s, when (Illich, 1974), used the concept of ‘powered mobility’ to recognise the gap between economic development, social justice, and individual freedom that results from unequal access to energy, its expansion to include philosophical approaches to the urgent needs of climate change is quite recent (Sovacool and Dworkin, 2014). Energy justice has emerged as a prominent subject in justice studies in a new interdisciplinary social science space that incorporates a wide range of topics, including the political economy of energy, energy security, energy justice, and advocacy, from its humble beginnings in the last decade.

As the energy transition debate weighs the social, economic, and environmental benefits of centralisation vs. decentralisation, it stands at a crossroads. When the world of energy transition is covered in ambiguous facts, contested values, and the urgency to avert a global catastrophe, this becomes much more challenging for decision-makers. Emphasising on the importance of values (Allen et al., 2022), it can be argued that non-domination, political equality, egalitarian pluralism, community, and sustainability are some core values that must find expression in a revived “political economy”. In the same vein, Benkler attempts at reviving the political economy discourse is to establish a triangulation of linkages between production, productivity and they link up to power (Benkler, 2022) in market societies. His political economy framework integrates institutions, ideology, and technology representing power, social and the material contexts, into the centrality of social relations of production. To what extent a society’s production takes place in a market sphere, how much takes place in nonmarket relations, and how deeply embedded those aspects that do take place in markets

are in social relations of mutual obligation and solidaristic exchange, is a contentious issue that organisations and individuals, both alone and in networks, fight over.

1.1. Project background, rationale, and delineation of theme: an overview of India's energy transition and the implications for justice

This research examines energy transition to advance a new understanding of injustices involved in energy systems during and post-transition phases in India. The thesis posits energy as a socially and environmentally integrated justice issue and advances our current understanding of the links between energy and vulnerability along the energy continuum. In essence, it enlarges the ethical evaluations of energy technology development and the surrounding policy during energy transition. It is situated within a body of literature seeking to interrogate the connections between the questions of supply chain (in)justices and renewable energy infrastructure development. In so doing, it brings questions of justice to the fore, because it is a matter of paramount importance throughout the supply chain. The notion of energy justice in its re-envisioned avatar presents an opportunity for locating injustices across the supply chain and creating new procedures for avoiding recurrence of injustices irrespective of geographic spaces (Bhukarin, 2022).

Energy justice presents a radical departure from the traditional understanding of energy as merely a collection of technological components, ignoring the human activities, such as the use of forced labour in the production of solar cells and modules in China's Xinjiang province - that may have grave implications on human rights (List Solar, 2021; Murphy and Elimä, 2021). This "source-to-sink" methodology for managing energy transition takes into consideration every step of the process, from production to energy installation to consumption to waste management and ensures that any inequities are identified and remedied.

This research investigates how justice, equality, and fairness may be ingrained across the whole energy supply chain in Indian solar energy systems, including wide-ranging forced labour in the extraction of solar modules, a key component of solar energy infrastructure. The concept of justice in renewable energy studies has always remained confined to the geographical boundaries of a country and there is

a visible absence of extending the concept of justice across whole of the supply chain as a source-to-sink notion. This chapter considers limitations of extant scholarship on the political economy of energy transitions. The findings suggest one major research gap could be addressed through an examination of the neglected subject of negative externalities of big centrally located renewable energy projects and its implications for justice.

Why energy transition? One, the conventional energy system of provision is no longer tenable, if ever it was, insofar as sustainability is concerned. Therefore, the current system needs to be replaced with a renewable energy system of provision that is renewable. In addition, the conventional energy systems are capital intensive technoeconomic systems whose development, governance, and regulatory dynamics, align with centralised forms of government control while concurrently making them ineffectual for the decentralised, local, and community-scale governance and application of energy (Eames and Hunt, 2013).

The deep flaws embedded in the conventional energy system are the major motivation for achieving a transition to low-carbon and renewable energy systems (Verbong and Loorbach, 2013; Kern and Markard, 2016). The only way to undo these flaws is by transitioning to the renewables built on a firm foundation and a vision (Ruotsalainen et al., 2017) which may serve to usher in the next great experiment of the new era of a new industrial civilisation (Sabonnadière, 2015).

This thesis explores the potential for realising a decentralised low-carbon future for India's energy transition and expanding the boundaries of the concept of energy justice beyond the 'triumvirate of tenets' encapsulating distributive, recognition, and procedural justice. It provides a distinctive analysis by critically examining the transformative potential of renewable energy infrastructure for delivering justice, moving beyond the disciplinary limitations of political science, international relations, and economics through an interdisciplinary framework of political economy, political ecological and geographical political economy analysis. This study draws on critical collective traditions of all these frameworks.

Energy the world over is in the process of transition, a transition that will see a check on the devastating unfolding of climate change. These transitions are the technical baseline on which contemporary renewable transitions are taking shape the world over and placed on a pedestal outside the realm of people and communities. This holds true for India too. This is so true of India. The energy transitions are not only the outcome of technology and big corporate investments, but also of the people's participation in the decision-making processes across the energy transition trajectory. The contemporary transitions are affected by governments, policy makers and big businesses with hardly any room for public involvement at any stage of the project development process.

T India's pursuit of an ambitious energy transition, aimed at reducing emissions and replacing fossil fuels with renewable sources of energy, is intrinsically linked to a complex array of factors, including technology, economics, pricing, and profitability estimates. To achieve these objectives under the Paris Agreement (2015), India has committed itself to a challenging energy policy dichotomy where policymakers must strike a balance between sustainable development and energy access for marginalized communities while rapidly transitioning away from a strong industrialization-driven model of economic development. This complex interplay of multiple factors and objectives presents a daunting challenge for policymakers to navigate and requires careful consideration and strategy to achieve the intended outcomes (Bombaerts et al., 2019).

The key challenge, however, India has not addressed in its transition is the challenge regarding the processes, intentions and implications that govern the actions of various stakeholders involved in the transformative change of energy transition and whether there has occurred any violation of justice in renewable energy deployment. The community, a major stakeholder who should be more intimately involved in decision-making processes and project impact assessment, is excluded from these procedures. Targets fulfilled, emissions lowered, and jobs created or not created alone cannot fully describe how this transformation impacts the lives of the people on the ground. This raises crucial

concerns, such as what results were anticipated from this change, whether they were realised, and who benefited from them.

Decentralised renewable energy causes social justice implications along the energy transition landscape. How these implications are taking shape in India are the concerns of this thesis. This relates to the development of a critical understanding of how socio-economic justice dimensions of energy transition can be negotiated through community renewable energy (CRE) infrastructure development projects. Furthermore, it investigates whether community-owned renewable energy systems are preferable to large-scale centralised energy projects in terms of equality and social justice results.

This research strives to establish a critical understanding of the concept of justice as it is incorporated in distributed renewable energy projects and the accompanying material and non-material benefits for people. The revolutionary potential of renewables in altering the future of local communities by delivering the local notion of justice is at the core of it. This research is an attempt at establishing a mutually reinforcing relationship between renewable energy systems and beneficiaries on the presumption that renewable energy has that transformative potential. Despite the development of the transition concept, it is widely accepted that social elements are often absent in the transition discourse, including a failure to recognise the social justice and equitable imperatives that are ideally integrated in energy transition.

The contribution to knowledge of this study of 'energy justice,' although situated in and built on the three tenets of justice proposed by Sovacool and Dworkin (Sovacool and Dworkin, 2014), expands to include displacement of peasants forming a class of landless labourers and conversion of many formerly common property resources into capitalist logic of accumulation (Harvey, 2003) as well as the geographies and spaces of large-scale transboundary human rights violations that have emerged since 2017 within the supply chain of the Indian renewable energy system, particularly solar installations.

The current energy justice paradigm is predicated on three pillars of justice: distributive justice, procedural justice and recognitional justice. When considered as a means of implementing justice, the term "energetic justice" not only brings together individuals with varying ideas about what it means to treat others fairly but also a shared commitment to bettering the lives of all people. Environmental justice, which considers environmental, racial, socioeconomic, and gender inequalities, laid the groundwork for energy justice, which was subsequently bolstered by a rising interest in climate justice, which aimed to connect climate change and human rights (Schlosberg and Collins, 2014).

1.2. Research problem: locating the nature and extent of loss of justice across the renewable energy spectrum

Before understanding injustices in energy systems, it is important to know what energy justice or a just energy system is. A just energy system must account for undue burdens and inequalities associated with production, consumption, distribution, and regulation (Hernandez, 2015). In other words, an all-inclusive view of energy justice must consider the complete spectrum of issues from production to distribution to ethical consumption to government regulation. While this idea of energy justice encapsulates all major points of human-energy convergence, it fails to account for human rights violation associated with manufacturing of equipment using forced labour on the supply side of the energy spectrum. An extension of this notion of justice can be further explicated through the application of the principle-based conceptualization of energy justice, which incorporates four fundamental assumptions that revolve around energy's role in facilitating fruitful and productive lives while ensuring respect for human rights, dignities, and capabilities (Jones and Sidortsov, 2014). The energy systems ought to represent allegiance to a set of values around which these systems in existence, transition or in the future determine how and for whom the energy systems exist. Since these energy systems affect or benefit various stakeholders differently across the energy spectrum, i.e., from resource extraction to production to consumption to waste and reuse, social resistance is but natural. This inbuilt disparity strengthens the need for a clearer understanding and the centrality of justice to

prevent recurrence and reinforcement of social vulnerabilities (Hernandez, 2015) along the energy spectrum.

How should a transition affect justice's goals? Is it only about safety, security, and cost-effective energy, or is there more to it? Not applying human rights to the whole energy production process raises issues. Ultramega utility-scale energy systems that make hundreds of megawatts of power and deliver it hundreds of kilometres away are the norm in national energy networks in India today. A small-scale, decentralised, locally based energy system produces electricity near the point of use. There is a clear preference for decentralised energy systems over the large-scale centralized ones, primarily because the latter are less attuned to local preferences, as well as their tendency to result in heightened transmission losses. Furthermore, failure to adopt decentralised energy systems may contribute to the occurrence of land disputes and the loss of livelihoods which further highlights the appeal of said alternative systems.

Energy is essential to human life and crucial to advancing society's goals. Developing countries like India, which are at the forefront of the renewable energy infrastructure rollout, provide a promising example for other nations to follow. The grave concerns of climate change need immediate action, and India's energy transition from fossil fuels to renewable energy is crucial in doing so without jeopardising economic growth or the energy demands of a vast population. However, little consideration has been given to the justice aspect of India's ambitious plans to increase its use of renewable energy. There is no denying that renewable energy is preferable to fossil fuel-based electricity, yet the impact of large-scale renewable energy projects remain understudied. This thesis aims to address that gap by investigating the effects of the shift on the individuals who are the project's primary stakeholders. What shape the Indian transition takes will determine its effects on the country's culture, economics, and environment.

Most nations have focused on renewable energy's technological improvements while ignoring the sector's broader social and economic implications. Then what, precisely, does an energy transition

entail? Long-term shifts in the energy system entail profound alterations to many facets of human life as well as natural and manmade environments. What most nations' transitions lack, however, is an understanding that a focus on technological improvements alone will not have a lasting effect unless social and institutional reforms are also prioritised. The idea that the energy sector's ongoing transition from conventional to renewable sources must deliver equitable results is a shared aim gathering support from across disciplines (Heffron, 2021).

The current mainstream approach to transition is characterised by centralised top-down mechanisms in perfect alignment with a neoliberal economic development agenda. However, there is an alternative approach evolving that attempts to mainstream the international struggle of working people, and low-income, energy-poor communities which want to take control of energy resources from the profitseeking, centralised energy establishment and use those resources for economic and political empowerment. The endeavour to wrest control and ownership of energy resources from private entities and vest them in the public domain stands as a cornerstone of energy justice. Such a pursuit runs counter to the government’s market -oriented agenda of privatisation, trade liberalisation, and economic disengagement, which ultimately engenders power balances in favour of private actors (Kumi, Arhin and Yeboah, 2014).

A modern ideal of energy, championed by the energy regime and capitalist political economy that purports to meet all material and non-material needs is premised on the belief that society limits its demands to the regime’s capability and willingness in a ‘democratic-authoritarian manner’ (Mumford, 1971). However, given the prominent place that the energy sector occupies in the power structures of the world today, a proper analysis of social justice must consider how energy enables concentration of wealth and power as well as associated social costs and benefits associated with energy (re)distributive patterns (Jones and Sidortsov, 2014).

1.3. Research aims, objectives and questions

The aims of this research: This thesis aims to investigate the implications of energy transition on justice in India's renewable energy sector. Considering the inequitable benefit distribution, the concept of "energy justice" has recently gained popularity in the discourse around India's energy transition. There is resistance to renewable energy systems because of unfair implementation methods, the centralised structure of large-scale projects, and the exclusion of socially and culturally disadvantaged individuals in the decision-making process. Additionally, the Indian transition is a purely capitalist top-down structure, the success of which has been questioned. To identify alternatives, such as bottom-up, participatory, inclusive, and implementation processes that are justice-oriented, requires extensive research and analysis.

The objectives of this research:

I. Observe and determine the negative impacts of India's energy transition on land use and livelihoods.

II. Discover the social, economic, and environmental aspects of renewable energy infrastructure development in India.

III. Investigate violations of human rights committed against transboundary workers involved in India's solar supply chain.

IV. Examine the socio-environmental impacts the ultramega solar parks have on the distributional and procedural aspects of infrastructure resulting from such projects.

The question of this research:

The question this research asks is 'what are the justice implications for energy transition in India'?

1.4. Scope: justice loss across the renewable energy spectrum

Energy has come to acquire a place of prominence and a new cross-cutting social science research agenda for scholars, who seek to apply justice or more specifically social justice principles (Jenkins et al., 2016) to the social order, including distribution of energy benefits and burdens in society. Energy

justice in the context of this research evaluates the locations where injustices emerge for whom, who the winners and losers of energy transition are, and are there institutional remedies for such injustices? The question then arises what constitutes energy justice?

The concept of energy justice has its roots in environmental and climate justice (McCauley, 2018) which later branched out into a more sophisticated and elaborate space of academic enquiry. Although energy justice built on pre-existing environmental and climate justice agenda (Walker and Bulkeley, 2006; Barrett, 2013), is a dynamic and innovative concept that needs to include poverty and vulnerability as significant social justice issue afflicting millions and of households and individuals (Ochoa, Rigoberto García Graizbord Ed, 2015). However, it does not sufficiently encapsulate emerging questions around equity, fairness, and human rights across the supply chain.

An energy justice that's outward-looking can help in developing a deeper understanding of decisions and their implications along the energy spectrum across multiple energy systems (Walker, Simcock and Day, 2016; McCauley *et al.*, 2019). In the Indian context, the energy spectrum from "source-to-sink" needs to be explored because there are serious issues of justice violation of labour engaged in solar cell/panel production in China. More than 85%-90% of India's solar panels come from China. Therefore, it is important that the operational field of justice is extended to capture the potential spaces of violation of justice. In other words, energy justice engages explicitly with energy systems from the beginning to the end of supply chain and explores the full range of injustices.

The extension of scope of justice to include all components and stakeholders of an energy system is an additional component that makes energy justice a wholesome framework that leaves out no stakeholder or is misrecognised in the new evolving world powered by renewable energy. The inclusion of affected communities in decision-making in major infrastructural projects ensures communities' broader capabilities within the context of an increasingly decentralised unconventional energy system. However, the absence of such an inclusion undermines not only the capabilities of concerned communities, but their human rights as well.

The worldwide shift to renewable energy sources is fast. Yet it is in the early stages of a protracted transition away from fossil fuels towards a renewable energy system, which might lead to disparities and loss of justice. Most people's first thought when they hear the term "energy justice" is either the lack of access to power in underdeveloped countries or the violation of justice within the conventional and fossil fuel energy business. Energy (in)justice issues during the shift to renewables like wind and solar centres on the possibility that existing injustices would deepen or perhaps expand in the wake of this paradigm shift toward sustainable energy (Baker, 2016; Forman, 2017).

Installation of clean energy is vital to global mitigation efforts, but there are rising concerns that the violation of human rights is rampant and has not been addressed by policymakers, governments and businesses involved in energy transition. Business and Human Rights Resource Centre, an organisation that works to advance human rights in business and eradicate abuse the world over, has collated allegations of 209 human rights violations only linked to renewable energy projects since 2010, 44% of these associated with wind or solar power (Business & Human Rights Resource Centre, 2020). An additional area of concern that may be raised is whether renewable energy can best achieve the aims of the public in terms of economic development; however, this question is outside the scope of this research. Focusing on several key indicators, such as who finances the transition, who benefits from the post-transition energy economy, including green jobs, who participates in decisions that determine how the new, clean energy economy will be materialised, and where the new clean energy infrastructure will be located, is necessary to ensure that the clean energy transition does not widen wealth and power disparities. These variables, however, won't serve as the main deciding factors for this study.

1.5. Research significance, justification, and contribution: framing a clean energy justice agenda

This study investigates the existing literature, ideas, and theories in crucial areas such as energy justice, utility size renewable energy projects, and energy transitions. The approach taken in this study lays the groundwork for seeing renewable energy as a viable solution to justice-related concerns throughout

the energy system, including injustices at the extreme end of the supply chain. It provides a new avenue for energy and energy justice researchers to critically engage with how decentralised renewables could impact social justice across the entire supply chain of the renewable energy system, particularly in solar energy systems.

This thesis demonstrates how convergence of political authority, corporate riches, and market rivalry are all shown to be relegating problems that are not central to their agendas to the back burner. My primary study objective is to extend the discussion of the energy transition landscape in India, where citizens are calling for a voice in policymaking. This research aims to convey the efforts and alternative vision of a decentralised, democratised energy system that gives people a voice in energy governance at all levels. It is a common but false belief that moving away from fossil fuels towards clean energy is moving away from injustices integral to fossil-fuel based energy as well. Moving away from fossil fuels reduces the injustices associated with climate change. This, however, does not mean there are no injustices to renewable energy. Had this been the case, the justice implications of a clean energy transition may seem superfluous, unnecessary, or at least secondary (Welton and Eisen, 2019). Fossil fuels have local effects that are distinct from those of renewables. For instance, health effects for mining communities, people living near thermal generators and those who rely on coal combustion, as well as perpetual open-cut destruction.

The injustices associated with renewable energy are distinct from those associated with fossil fuels, even though they are related (e.g., altered land use, mineral extraction, etc.). However, it is important that the Indian transition questions this belief because a clean energy transition may further concentrate wealth and power in certain groups and divert the burdens of the post-transition industrial infrastructure towards already disadvantaged communities, and poorer sections of the population. It is also important to make sure that transition dynamics remain sufficiently attentive to how the costs of infrastructure change are distributed amongst the wider community and which of its groups are most vulnerable to the negative externalities of this transition.

Framing a clean energy justice agenda is a challenging landscape that needs critical engagement with the issues of justice or lack of it in the energy value chain, i.e., from production to distribution to eventual consumption. The need for framing and mapping out a clean energy justice agenda becomes more important given the technocratic nature of energy, fossil-based or clean, and the unique challenges it presents to the procedural justice concerns manifesting in the form of lack of stakeholder participation in the energy value chain (Rowe and Frewer, 2004). Effective participation in energy justice literature relates generally to a space where all genuine viewpoints are treated in terms of their relevance to some combination of merits and the diversity of understandings by different groups affected by siting decisions (Armeni, 2016; Bailey and Darkal, 2018). The stakeholder participation is important, particularly in the context of safeguarding against cultural control and undue manipulation that might undermine or unduly subvert the rights of individuals and groups to participate in consultations (Schlosberg, 2007a; Heffron, McCauley and Sovacool, 2015). The need to incorporate distributive and procedural fairness principles into renewable energy decision-making may be addressed by framing a justice-based agenda for renewable energy, which acknowledges the need of placing people at the centre of the energy transition.

As the global economy is all set to transit to a fossil-free economy, it offers the potential for more equally distributing the gains and harms of this burgeoning sector (Cole, 1992). Traditionally, such a framing highlights the importance of approaching issues of clean energy and equity from an environmental justice perspective (Bailey and Darkal, 2018). This approach is useful as it combines both the procedural and distributive justice concerns into a united agenda. It is a common experience of renewable energy invoking impassioned debates often on climate change, energy security, and sustainable development. However, debates on the energy, environment, and social justice nexus of siting renewable energy justice projects remain a far-fetched dream in most instances, particularly where government priorities and planning processes limit opportunities for a free, fair, and all-inclusive public debate for or against renewable energy deployment. A real community perspective on

how energy, environment and social justice are framed, perceived, and articulated by groups directly affected by geographical proximity of renewable projects, and how conflicts emerging from such projects are resolved necessitates extensive and thorough public deliberations during the planning stage when the impacts of the proposed projects become apparent to the pertinent groups (Bailey and Darkal, 2018). For such projects the public may show support at an abstract level compared with actual deployments (Breukers and Wolsink, 2007; Bidwell, 2013).

1.6. Study limitations

During the course of this research, a number of potential shortcomings came to light. While most of what the study had initially set out to achieve has been accomplished, some were not. For example, the study's original plan called for extensive interviews with key stakeholders, including central and state government officials, employees of the private and public companies involved in energy installations and individuals who stand to be most directly affected by the development and implementation of renewable energy projects. This study would have benefited greatly by having access to the individuals, organisations, and the legality of the documentation maintained by the authorities in charge of implementing current energy projects. This first-hand engagement with the principal stakeholders would have improved the authenticity of the experience.

1.6.1. Future research

No direct links have been made between renewable energy projects and the land. Such research could illuminate potential barriers and opportunities that exist on the ground. As renewable energy enters the mainstream, more research needs to be undertaken to determine the effects on land resources. To this day, there have been very few studies conducted on India's energy transition that take a comprehensive look at the interlinkages between renewable energy resources, natural resource constraints (such as a lack of land and water), land use disputes, and the justice implications of human rights violations across the value chain. Of those that have been done, almost none have identified land scarcity and land-related disputes as major hurdles or obstacles to the development of renewable energy on farmlands

and on lands used by local communities as a common property resource, nor have they identified appropriate pathways for addressing these issues.

1.6.2. Thesis structure

Chapter 1. Introduction: This chapter serves as an introduction to this research by providing a brief overview of the topic of energy justice and the locations of injustices along the energy spectrum. It investigates how justice, equality, and fairness may be embedded across the whole energy supply chain, including extensive forced labour in the extraction of solar modules, a critical component of solar energy infrastructure. Justice has traditionally been restricted to the geographical limits of a nation in renewable energy research, and there is a clear lack of extending the notion of justice throughout the whole supply chain as a source-to-sink concept. It offers the theoretical foundation and reason for a timely analysis of the neglected issue of negative externalities associated with large, centrally situated, renewable energy projects, as well as its implications for justice. Overall, it's a detailed account of the aims and objectives of the study as well as research questions.

Chapter 2. Literature Review: This chapter provides an extensive literature review covering major developments in the fields of renewable energy, energy justice and how the two-impact people and natural resources. It examines a wide variety of studies looking at how switching from a carbon-intensive to a low-carbon energy system might prevent a climate disaster without endangering the economic growth and ambitions of people all over the globe, especially in India. The literature review discusses this thesis' significant contribution, which is to expand the definition of justice to include transnational violations of human rights for those working in the manufacturing of solar industry components.

Chapter 3. An Interdisciplinary Framework and Research Methodology: This chapter introduces the theoretical framework underpinning this study making connections between various key arguments of my research and arguing that the questions of energy justice and distribution are predominantly important to effect positive change in the marginalised sections of society. This framework serves to

link energy, justice, human welfare, and the capability to fully consider when designing and planning energy transformation within the realm of energy and justice as a social objective to be achieved.

Chapter 4. Anatomy of India's Energy: This chapter is a detailed historical account of India's electricity dating back to the pre-independence (1947) era. It covers the history of India's electricity and electricity policies and how electricity came to be conceived as the sole means of nation building and development in India's development discourse amongst the policy pundits and the government, and how power generation became a major development plank for the government under the combined responsibility of both the state and central government agencies. This chapter takes the reader through historical transformation embodied in electricity from being a symbol of the benefits of an independent nation to electricity invoking grand narratives of promoting economic growth, securing energy supply, and more recently, transitioning to more environmentally sustainable energy systems in which the fate of the nation is closely tied to infrastructural development.

Chapter 5. Indian Energy in Transition: Current Status - the very Soul on the Periphery: India is at the cusp of becoming a global economic powerhouse, and for this to come to fruition the government has realised that energy will lie at the heart of this transformation. This chapter delves into the ways in which the Indian energy sector, besieged by challenges such as significant dependence on fossil fuels, limited access, and rapidly surging demands for energy, is undergoing a metamorphosis towards a more sustainable and diversified energy system. The chapter aims to paint a comprehensive picture of the strategies, policies, and measures being adopted to overcome the significant challenges faced by the sector. Specifically, it examines the more sustainable alternatives to fossil fuels that are being explored, as well as the initiatives aimed at increasing energy access and availability to a larger segment of the Indian population. This chapter is particularly relevant to policymakers and stakeholders in the field of energy and sustainability, as well as to scholars and practitioners interested in studying the Indian energy landscape in depth. Does India have enough land and other natural resources to execute these renewable projects? For India, renewable energy is the answer to this

conundrum and its already in a fast-forward mode to implement this. However, what has been lost in this transition is the justice dimension of large-scale renewable energy projects. In essence, what has been lost in India's transition is the decentralised character, the very soul of renewable energy.

Chapter 6. Justice Lost - I: India, the Mute Spectator of Forced Labour in its Solar Supply Chain Linked to Xinjiang in China: This chapter analyses the links between the production of solar-grade polysilicon, the main component of solar cells and modules and an area of forced labour in the Xinjiang Uyghur Region of China, as well as the moral and ethical implications to India's solar systems. The chapter reveals, while the forced labour, camouflaged as a poverty eradication programme of the Communist Party of China, in the Uyghur Region has pervaded an entire supply chain and reaches deep into international markets, India being a major importer of these modules has maintained absolute silence. This is because, in India there is no specific legal framework for recognising justice issues in the energy supply chain.

This chapter, in contrast to the common perception, highlights that energy systems are international in nature and composition. They are characterised by a complex network of "source-to-sink" actors and activities that traverse political and geographical boundaries. However, energy policies in general are rooted within national contexts and ill-equipped to address transboundary issues, and in most cases oblivious to issues such as the use of coerced labour in the production of solar energy system components. This has resulted in the obliteration of our concern for the plight and suffering of people across the solar energy value chain. It has been the endeavour of this chapter to bring to light the plight of workers engaged in solar cell production in China. The energy policy field stays mostly detached, indifferent, and biased towards larger issues of ethics and justice. A direct implication of this is that there is a strong need to move away from conceptualisation to operationalisation phase and integrate human dimensions of ethics and justice across the entire expanse of solar value chain. The use of forced labour to make solar cells and modules, as well as many other products in the global value chain

that are worth billions and are traded every day between countries, has become a serious concern for businesses, governments, and international watchdogs like the United Nations.

Chapter 7. Justice Lost – II: Land and Livelihoods at Stake in India's Misplaced Priorities for Ultramega Solar Parks: This chapter explores the dark side of the so-called bright story of solar energy. This topic that has been generally avoided in discussions about solar energy growth is the land. Land is not seen as a constraint on India's ability to benefit from the many blessings that the sun provides. Large areas of land would be needed, which India lacks, to convert significant portion of our electrical supply to solar power. The amount of land needed for solar systems is unclear, and there is a lack of openness in the government's official data reporting. The shift to renewable energy will be significantly hampered by the enormous demand for land and probable environmental side effects such as the conversion of arable land and the disintegration of ecosystems. Rural locations, where large tracts of sparsely populated land are available at lower prices, are where a considerable amount of renewable energy production is currently taking place. As a result, it would put great strain on rural areas and residents, especially in countries like India, and compete with and possibly displace many current or alternative land uses, primarily food production. As a result, any transition to these new geographies of energy production will unavoidably result in significant new claims on, disputes over, and substantial new deployments of capital and labour in rural regions. There will be continuing and prospective injustices, worker exposure to hazardous substances, land eviction, on-going energy poverty, and habitat destruction throughout the lifetime of renewable energy.

Chapter 8. Conclusion and Recommendations: This chapter revisits the research questions and will conclude the thesis. The chapter will go on to summarise the outcome of this thesis by highlighting what it set out to achieve at the beginning and establish that the energy systems are not national, but rather global in nature and are made up of a complex network of "source-to-sink" actors and activities that cut beyond political borders and geographical locations. However, the national focus of energy programmes sometimes blinds them to problems like the use of forced labour in the production of parts

for India's solar energy system. Along the value chain of our energy systems, this has led to the eradication of our care for the pain and suffering of humans. Due to this, the field of energy policy primarily continues to be impersonal, uninterested in, and biased toward the more significant moral and legal concerns in the field of renewable energy.

In conclusion, this chapter has introduced key themes informing this study by providing a brief overview of the topic of energy justice and the locations of injustices along the energy system of provision. It investigates how justice, equality, and fairness may be embedded across the whole energy supply chain, including extensive forced labour in the extraction of solar modules, a critical component of solar energy infrastructure.

2. Literature Review

Introduction

This chapter provides an extensive literature review covering major developments in the fields of renewable energy, energy justice and how they impact people and natural resources. It expands the standard notion of energy justice which is based on the 'triumvirate of tenets'. It establishes the importance of investigating and locating the spaces of violation of justice of labour working in the renewable energy sector. It examines a wide variety of studies looking at how switching from a carbon-intensive to a low-carbon energy system might prevent climate disaster without endangering the economic growth and ambitions of people all over the globe, especially in India.

The literature review discusses this thesis' significant contribution, which is to expand the definition of justice to include transnational violations of human rights for those working in the manufacturing of solar industry components. In addition, the chapter aims to analyse and comprehend the increasing literature on energy justice as a key instrument for negotiating justice throughout energy transitions. It will investigate what is meant by energy justice, the aspects of justice, and who benefits from it. Why energy justice? While this research enriches the agenda for future research on sustainable energy transitions, it proceeds to demonstrate that this exploration is timely, useful, and effective as it will contribute to broadening the field of transition studies and help it remain reflective and critical of the existing reality of current energy transitions in India.

The benefits of energy justice are so unevenly distributed that the concept of 'energy justice' has gained prominence in the domain of energy landscape discourse in the social sciences (Sovacool and Dworkin, 2015). The current energy transition in India is a mirror image of the large scale centralised conventional fossil fuel energy systems. And they defeat the concept of decentralised energy serving the complementarities between energy transition and energy justice.

The concept of energy justice, therefore, involves a two-pronged critical analysis of occurrence of injustices or how they might be achieved within energy systems when low-carbon transitions are underway (Sovacool and Florini, 2012). The current energy system, faced with serious challenges, including depletion of natural resources, climate change, and energy poverty to name a few, demonstrates a widespread demand for re-working the established patterns of energy supply, distribution, and consumption (Bridge et al., 2013). These challenges acknowledge that there are strong links between energy and social justice and the need for a new concept of energy justice (Bickerstaff, Bulkeley and Painter, 2009). Energy despite being an embodiment of human and social justice dimensions is often treated as a system entirely consisting of technical problems with technical solutions.

The energy system relies exclusively on scientists, engineers, and economics to provide answers to the climate issue and energy transition. Since there are winners and losers throughout transition, it is critical to identify where in the energy system inequalities exist and who is accountable for these injustices by their actions or lack thereof. Energy justice broadens our understanding of how we plan, build, and regulate the transition from a carbon-intensive to a low-carbon energy system, interrogating our relationship with future energy that is fair and sustainable, safe and affordable, for current and future generations as well as the natural world. Justice concerns must be entrenched throughout the supply chain to provide a sustainable, secure, and equitable energy system.

2.1. Energy: both a boon and a bane!

The current energy landscape is aggressively pursuing systemic energy transitions to address issues of energy access, climate change, and economic development while relying on market-driven policies such as auctions, risk-mitigation mechanisms that ensure harmonised market conditions, and privatisation of the sector. While market-based processes led by the private sector play an important role in lowering energy costs and creating the correct investment environment for renewable energy

infrastructure, the transition process must not disregard democratic engagement, accessibility, and ownership.

These conflicting factors may seem to be at odds with one another, but when combined, they solve the challenges that define the "energy trilemma" (Heffron and Talus, 2016a). Energy infrastructure development is important not just for economic growth, but also for tackling climate change and energy security. This is possible if energy law and policy are placed in the centre of the 'energy trilemma,' whose three corners reflect economic (finance), political (energy security), and environmental (climate change mitigation) issues, as seen in the image. These three concerns are continually striving to gain control by influencing energy legislation and policy. However, to achieve the greatest progressive result for society, energy law must balance these aims, each of which is carving its own path (Heffron, 2015).

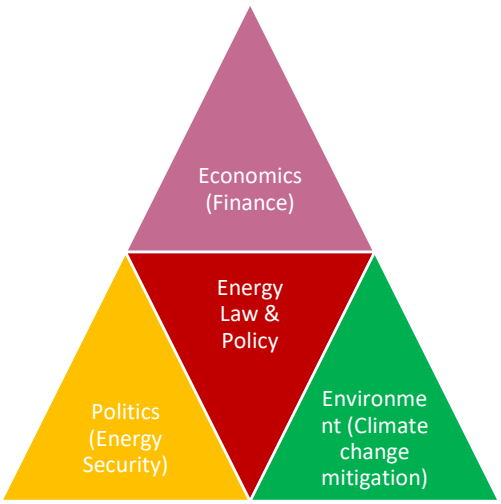

Figure (2a): the energy law and policy triangle—the ‘energy trilemma’ remove capital letters.
Source: Energy Law: An Introduction (Heffron, 2015).

Explanation: Energy law and policy is in the centre at equidistant from the three major issues residing in the three corners of the triangle, viz., economics (finance), politics (energy security) and environment (climate change mitigation). These three issues are each trying to pull, influence and control energy law and policy in their direction to their advantage. A good progressive energy law and policy negotiates the aims and objectives of each in a fair and just manner to deliver the best outcome to society. However, often it is just one of these issues that dominates the energy agenda.

Energy is both a benefit and a curse because of the critical role it plays in human and economic progress, as well as a major obstacle in humanity's most strenuous struggle against climate change and its disastrous consequences. The dual imperatives of transitioning to low-carbon energy systems while also ensuring affordability and equity need a deep knowledge of social justice issues (Jenkins, Sovacool and McCauley, 2018; McCauley and Heffron, 2018).

It is generally known that in the past, large-scale energy project execution has been riddled with conflict, opposition, and sustainability problems throughout the energy life cycle pertaining to energy for whom, for what, and at what cost (Goldemberg and Lucon, 2010). The subject of energy justice and its numerous aspects, as well as how justice might be included into the future energy transition, is the next logical concern. While the need for a low-carbon, equitable energy system is clear, charting a policy route critical of the old inequities of a fossil-fuel-driven economy remains out of sight in most cases.

Slow to adapt to renewable energy, the old outdated large-scale infrastructures recalibrate and rebalance some of the old inequities by inventing new 'logics of inequality' for their survival. While still in its early stages of development, the energy justice framework offers a conceptual lens for normative and empirical analyses in both old and new contexts (Sovacool and Dworkin, 2015).

There has been a surge of interest in 'energy justice' within transition studies during the past decade, particularly around 2010. Since its inaugural introduction by Naomi Klein, the phrase "energy justice" has stayed in activist literature, although in a restricted form, before becoming a mainstream cross-disciplinary issue of academic inquiry (Guruswamy, 2010). Although the notion of energy justice is new, it requires a moral examination of how humanity collectively navigates its way through the new emergent energy system and the effects it will have on all living form having one common objective, survival itself.

Scholars have claimed that the history of energy is a narrative of tremendous injustices at every stage of the energy life cycle, from production to transportation to transmission to consumption to ultimate

waste disposal. Decision-makers, regulators, policymakers, energy producing firms, and individual consumers all have a role to play in achieving energy justice, which means ensuring that the energy trilemma is balanced in a way that prioritises justice and equity over economic efficiency and profit (Heffron, McCauley and Sovacool, 2015; Heffron and Talus, 2016b).

If justice is included into energy policies, our view of energy systems would shift from one primarily concerned with maximisation of profit to one concerned with fairness and distribution of wealth (Sovacool et al., 2017). Energy justice, in this sense, is a grassroots movement that sprang from and continues to support struggles for environmental, social, and economic justice. With unprecedented concern for the environment, climate change, geopolitics, and the localising socio-spatial development of communities, the 21st century has seen the return of energy to the forefront (Huber, 2015). An energy change is being propelled by renewable sources, one that will affect not only our energy infrastructure but our whole civilisation in ways we have never seen before. Due to this, nations, regions, and communities all around the worldnow have the chance to build brand-new forms of social and economic infrastructure. Modern energy infrastructure is a centrally structured, techno-capital intensive system during a transition away from fossil fuels and toward decentralised, sustainable, renewable, low-carbon energy sources.

Global energy systems that are currently in place and those that are ‘in transition’ are shaped by political economy considerations of the dominant elite and significant players, which are frequently at odds with the energy requirements and environmental vulnerabilities of the world's poorest people (Newell and Mulvaney, 2013a). It suggests a need for a more equitable approach that prioritises the needs of marginalised communities and ensures democratic participation. On the other hand, better energy consumption patterns, improved justice outcomes, and resolution of fuel poverty can be achieved through energy transition with community involvement as a change agent. (Herington et al., 2017; Martiskainen, Heiskanen and Speciale, 2018). An important question that has arisen from this transition is the socio-economic implications of this transition for citizens, communities, and countries.

An unequal distribution of costs and benefits associated with fossil fuel-based energy systems have been sought to be altered in favour of a system that aligns with the principles of justice, equity, and fairness (Bridge et al., 2013) as a way of avoiding reproduction of the past malaises.

The drive for renewable energy has taken off in a big way the world over. However, social justice in most cases, especially in the developing world may be overlooked. In the case of India, large scale deployment of renewables has been planned through installations in areas like waste lands considered invulnerable to environmental and social risks. For this reason, these projects have been kept outside the purview of environmental and social impact assessment in India. Apprehensions regarding neglect of social justice issues surrounding the mega solar plants needs to be looked at with great concern for the loss of livelihoods of a lot of people. These social justice issues, however, have cropped up in connection with land acquisitions for large development projects in India in the past. Drawing on past experiences of land dispossession for industrial development, the current developments are reflective of state-developmentalism and neoliberalism in India (Nilsen, 2010; Levien, 2013).

2.1.1. State, citizen, and the social contract

A low-carbon transition is highly interventionist and places considerable dependence on the role of the state (Kirby and O'mahony, 2018), referred to by Duit, Feindt and Meadowcroft (2016) as 'environmental state' which consists of environmental ministries and specialised agencies, environmental assessment and advisory bodies providing a body of ideas and specialised knowledge with the goal of promoting greener values and attitudes, as well as special facilities and protection for the environment (Duit, Feindt and Meadowcroft, 2016).

In the context of environmental conflict and negotiations, this provides a legitimate basis for governmental action, authoritative decision-making, lobbying, consultation, and negotiation (Duit, Feindt and Meadowcroft, 2016). The environmental state is centred on a strong and transformative state. However, the task of balancing two apparently conflicting principles falls under the purview of the state, namely, usurping the role of an active state or empowering itself to actively determine

priorities, which in recent decades has been ceded to private market actors, while at the same time providing opportunities for citizens to partake in constructive participation in decision-making processes by endowing them with more active roles in politics (Duit, Feindt and Meadowcroft, 2016). They further emphasise that if the state fulfills the obligation of providing citizens opportunities to participate in the decision-making processes it can lead to 'ecological citizenship' paving the way to a 'Green social contract'. This is a new dynamic social contract between the 'environmental state' and the 'ecological citizen' which makes explicit the environmental rights and obligations for both the state and its citizens.

2.1.2. Challenges of low-carbon transition

Energy transition requires society to address a multi-dimensional challenge of simultaneous consideration of economic, technical, political, environmental, and moral questions. The transition to a low-carbon energy system is a significant issue, but it is far from the only one.

Securing the energy transitions requires substantial government involvement, since it is the primary influencer of political decisions and is the criteria used to build and construct energy infrastructure. To ensure that the low-carbon energy policy making process is fair and that no one is left out of its advantages or forced to shoulder a disproportionate amount of its liabilities, the government must assume the lead role in navigating the transition (McHarg, 2016).

Unfairness and injustice do not disappear and often gets worse in a post-transition energy system, just as they did in the pre-transition one (Eisenberg, 2019). However, the biggest challenge is ensuring that risks and costs to society are kept at a minimum while benefits are maximised and distributed according to 'fair' standards. For a holistic and complete approach, it is necessary to use both the "sociotechnical" and "justice" frameworks, which are related but not identical to one another in the growing transition research. Socially embedded technological and innovative features are at the framework's heart. Energy justice, on the other hand, is concerned with the distribution of costs, deprivation, and benefits throughout the energy value chain.

The fact that energy systems are authoritarian presents a significant challenge that is often ignored. They are intended to benefit the general welfare and are predicted. Since they are heavily centralised, integrated, capital-intensive, and focused on cutting-edge technology that demands specialised knowledge, energy systems have a basic tendency to produce a model of technocratic dictatorship. Due to this, energy justice issues are more closely related to the energy systems. The long-standing justification for the intense coordination that energy systems require across the commercial, administrative, financial, and political spheres of the public and private sectors has contributed to maintaining the status quo in favour of authority structures at all levels of government involved in decision-making, typically a forte of the professionals in charge, with little democratic input (Jones and Sidortsov, 2014).

Technology historian (Nye, 2014) highlights how large-scale energy systems, like the electric grid, may demonstrate some flexibility during the initial phases of development, but as ownership, control, and technical specifications are established, they become more rigid and less responsive to social pressures. Contrary to widely accepted opinion, the energy system is neither economically nor technologically indispensable. In fact, the reverse is true. This is primarily because the current energy system configuration is partially the result of "path dependence" on earlier technology and because finance and government have an interest-based alliance and actively oppose and suppress innovations that could upset the centralised power paradigm and endanger established financial interests (Sen, 2014).

The fact that all three goals - sustainability, dependability, and affordability - converge in the realm of energy exemplifies how intertwined the stakes are and explains why Goal 7 of the United Nations' Sustainable Development Goals is specifically focused on energy. Thus, for the sake of a comprehensive treatment of sustainability and social benefit sharing of a low-carbon transition, it is crucial for the emerging scholarship to consider sociotechnical and justice dimensions of transition as something intrinsically linked involving a process that sustains, complements, and reinforces each

other. Together, we must act to ensure an equitable and sustainable energy transition that addresses both the technological and social components of the problem.

2.1.3. Transitions as socio-technical issue neglects social justice

Numerous frameworks, including the well-known Multi Level Perspective (MLP) and Technological Innovation Systems (TIS) frameworks, have been used to examine energy transitions. The fundamental role that energy and technologies play in structuring or "creatively destroying" the socio-economic and socio-technological relations in the field of energy systems transition is not addressed by either the MLP or TIS frameworks.

In this perspective, energy may be seen as a sphere of influence and a crucial area for social, economic, and environmental justice. Therefore, a breach of justice or an act of injustice must demonstrate inequity and unjust treatment across the whole energy spectrum. A claim for or against justice is a highly debated and profoundly political idea. It then becomes logical to argue that the questions of energy justice and distribution of the risks and benefits associated with different energy technological systems are a function of the way dominant groups may use their power and influence to exclude or marginalise particular section(s) of society and its rights (Eames and Hunt, 2013).

It is these dominant groups who determine who will control access to affordable, reliable, sustainable energy supplies. They will also determine the beneficiaries and the losers whose lives and livelihoods will be put at risk in the new energy system. While several analytical frameworks have been employed to study energy transition within the broad discipline of sustainability transitions research, among them Multi Level Perspective, Technological Innovation Systems, and one of the key policy-oriented tools Transitions Management are prominent ones.

However, these frameworks provide a comprehensive understandings of transition processes, providing the ‘deep structure’ that accounts for the stability of an existing socio-technical system (Geels, 2004) and have mostly failed to address justice issues of energy transition. Generally, the phrase ‘energy transitions’ is referred to as shifts in the fuel source for energy production and the

technologies used to exploit that fuel (Laird, 2013). When used in this sense, it downplays the profound social and political disruptions such energy changes are capable of.

Within the energy transition research 'justice' has not been one of its core concepts nor has it been a significant element of exploration until 2013 (Heffron, 2021). However, it can be assumed that transitions can produce a creative wave of destructions in the 'Schumpeterian' sense by sweeping away old industries and paving the way for the advanced new ones; there is no proven reason to conclude a priori that a post-transition low-carbon economy will necessarily be any more equitable or just (Eames and Hunt, 2013).

A new energy system can propel or inhibit radical social changes with substantial justice implications for society. The renewable energy proponents believe that modern society had to be built on large bureaucratic institutions whose material foundation was on fossil fuels. A natural outcome of this transformation is the emergence of a decentralised renewable energy system and the creation of a democratic, egalitarian society (Laird, 2013). This, however, is not at all the case since each of the stakeholders wants to steer this transformation in the path that is most conducive to serving their own interests.

Large-scale installations, which have the benefit of economies of scale and the ability to be integrated into electrical grids more easily, offer a clear advantage over decentralised energy systems in this context (Miller, Iles and Jones, 2013). However, from the point of interest of consumers, it is the small scale, distributed installations that are best suited to deliver energy cheaper compared to the centralised installations. The study of sociotechnical transitions has its roots in the scientific community, with researchers focusing on how new technologies developed in labs relate to established social regimes and the niches within them in the field of science and technology studies (STS). It's important to note, however, that these inventions don't always gain traction only because of their inherent qualities or because they would seem enticing enough to the masses. Obviously, that is not the case. It's always

because of the mediation and agency of social practises, organisations, systems, and structures, bolstered by certain pre-existing tendencies of socioeconomic nature.

As explained by the sociotechnical framework, it is not monolithic but rather has several interrelated yet distinct strands (Markard, Raven and Truffer, 2012). These three different themes, viz., strategic niche management, transition management, and the multilevel perspective on sustainability transitions approach the study of transitions in different ways. Strategic niche management and transition management adopt a cause-and-effect approach to understanding transitions, while the multilevel perspective and the systems of technological innovation provide a systems perspective that enables them to grasp the complexities inherent in the process of change. The systems perspective is better equipped to account for the emergence of changes and their dynamics, given the importance of systemic factors in shaping the outcomes of transitions. However, the most well-known of these approaches is the Multi-Level Perspective (MLP), which views transitions as a non-linear process resulting from the interplay of three analytical levels: niche-level innovations as a seedbed for innovations in protected spaces; sociotechnical regimes as pre-existing sets of rules, regulations, institutions, and practises that facilitate innovations; and landscapes as a representation of fundamental structural conditions of society (Geels, 2002, 2011).

The literature on transitions is unanimous in its conclusion that technical advancements are the driving force behind changes and that a reasonably well-tuned, transparent system is essential to the success of transitions. Despite its widespread acceptance, this strategy has been critiqued for at least two reasons. One, it upholds a systems viewpoint by privileging continuity and familiarity above novelty and innovation. Two, it fails to account for the intricacies of regional considerations (Bridge et al., 2013; Hansen and Coenen, 2015). Both fail to account for the need of justice throughout sociotechnical shifts. Further, this method avoids engaging with energy justice because of its focus on technology, which in turn disregards human-scale experiences coming from technological development (Geels, 2002).

Similarly, in energy transitions (Araújo, 2014), justice isn't included as an analytical criterion, although it is as important as magnitude, structure, and quality of change. It has been stated that there cannot be a sociotechnical bias in energy transitions analysis literature, since climate, energy justice, and sustainability are all intertwined (Dobson, 1999; Eames and Hunt, 2013). Disruptive innovations within a sustainable transition need in-depth life cycle studies of energy infrastructures and governance, but they are not addressed by current institutional logic (Healy and Barry, 2017). The literature on environmental justice, which focuses on unequal impacts of pollution based on factors like race and class, is responsible for these contributions (Byravan, 2014).

2.1.4. Socio-economic dimensions of energy transition

Achieving a fair transition to renewables presents enormous energy justice problems, which must be met to address equity and social justice issues. This is significant because it has been discovered that the social implications of energy transitions are focused on the community level, the site where energy infrastructures are really realised in the physical world (Park, 2012; Seyfang, Park and Smith, 2013). When the advantages and costs of energy systems and other socio-economic and institutional artefacts are considered, as well as their interdependence, we speak about energy justice (Eames and Hunt, 2013). In this respect, the production and consumption of energy are embedded in the processes and infrastructures that comprise replication of the political and economic arrangements, institutions, and practises of contemporary society, along with the corresponding deficiencies at many scales (Shove, 2012; Shirani et al., 2013).

All-encompassing social changes co-evolve with the development of a new energy system as part of an energy transition. Therefore, it is necessary to consider economic, greenhouse gas reduction, and social implications while formulating energy transition plans.

2.2. Unpacking energy justice

Environmental, climate, and energy justice all share the same core principles of procedural and distributive fairness. This raises several interesting considerations, like what is meant by ‘energy

justice', if it is based on the environmental and climate justice frameworks, and whether it is merely a sum of those two concepts.

Another area of concern is how to incorporate the ideas of energy poverty, energy democracy, and energy insecurity into a framework for energy justice that considers many ways in which disadvantaged communities are impacted by environmental and climatic threats. Energy justice necessitates an investigation of the numerous levels of burden that these marginalised groups must bear to provide justification for a top-down shift that empowers them.

Therefore, as shown in the diagram below, a 'just transition' is the organic synthesis of justice notions relating to the environment, climate, and energy. For a holistic model of energy justice to be realised, those on the margins must be included into the conversation about the transition and made beneficiaries.

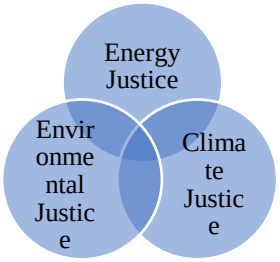

Figure (2b): Interconnectedness between environmental, climate and energy justice.

A rapidly developing field of study, energy justice emerged in the aftermath of the significant evidence that communities of colour experienced disproportionately life-threatening environmental burdens in the 1980s in the United States (Bullard et al., 2007). While questions have been raised by scholars on the efficacy and success of the environmental justice movement (Jenkins, 2018), significant importance too has been given to them for they have played a major role in informing the current transition away from fossil fuels (Outka, 2017). While environmental justice in the 1990s and 2000s was primarily concerned with domestic issues in the United States, the emerging field of climate justice has a clearly international focus, as evidenced by the movement's insistent emphasis on the

disproportionate impact of climate change on the poor and vulnerable in the Global South (Jenkins, 2018).

The concept of environmental justice has been crucial in promoting the idea that everyone should be able to share in the benefits of progress without having to shoulder disproportionate amounts of responsibility (McCauley and Heffron, 2018). Environmental justice, then, supplies the foundational ethical concepts of procedural and distributive fairness. A counterargument is made by those who advocate climate justice, who say that those most at risk from climate change should get compensation as a form of distributive justice (Burkett, 2009). Therefore, both environment and climate together in their collective capacities cause justice to be procedural and substantive or distributive. Energy justice, in a genealogical sense, owes its existence to this rich pedagogy preceding its current state of the conceptual development. Stressing on distributive justice (Stein, 2018) argues for energy justice to involve equitable sharing of benefits and burdens in the production and consumption of energy services and treat people and communities fairly by giving them a fair say in energy decision-making.

The field of energy justice, (Stein, 2018) asserts that the issues of access, distribution of harms, and fairness of energy decision-making, do not infringe on human rights and civil liberties. Energy justice is an integral part of the transition that can be considered just. In energy justice there is a heavy emphasis on ‘equity’ which is reflective of need for policy approaches to work towards levelling the playing field for those long disadvantaged under the existing energy system, rather than simply provide for ‘equal’ opportunities for all under the new system. The issues of fairness and equity manifest in a variety of ways, such as (i) energy burden referred to as disproportionate allocation of financial resources among low-income households on energy expense relative to overall household income (Hernández and Bird, 2010), (ii) energy insecurity referred to as the hardships faced in meeting basic household needs, (iii) energy poverty referred to as lack of access to energy (Guruswamy, 2010), and (iv) the notion of energy democracy that communities having a say and agency in shaping their energy future is vital to success of transition (Burke and Stephens, 2017).

Existing literature primarily concerns itself with measures that prevent further entrenchment of pre-existing disparities based on gender, socioeconomic identity, proximity to the workplace, or any other characteristic that may be biased in the workplace. Those who already stand to lose the most from the energy transition may continue to do so if nothing is done to address the underlying behaviours that promote inequality.

As important as it is to make a fair transition to renewable energy, it is also difficult to balance the needs of the environment with those of society. While developing and implementing equitable transition policies, it is important to keep in mind a set of universal principles that have been put out by transition researchers (Piggot et al., 2019). Depending on the ideological framework in which the term 'just transition' has been employed, several different interpretations may emerge. The energy transition is a long-term process that offers great promise for socially responsible ways forward. This highlights the need to include sustainability while establishing national development policies.

The social components of sustainable development are often overlooked while the environmental and economic ones are given more weight (Boström, 2012). For development to be long-lasting and its benefits to be distributed fairly, money, resources, and opportunity must be shared so that all people have a fair shot at a minimum standard of living and the chance to grow to their fullest potential.

Essentialising a framework for in-depth debates about the meaning of justice during and after the transition from a high-carbon to a low-carbon energy economy may help bring about these changes (Morena et al., 2018). That workers and communities whose livelihoods are lost because of an intentional shift away from a fossil fuel-based energy system should receive state support and sacrificing the well-being of vulnerable groups for the sake of a few, seem to be two goals that the labour and environmental movements have championed that are incompatible with one another (Morena et al., 2018; Eisenberg, 2019). In fact, a low-carbon energy system transition must include justice and fairness, and so must involve a radical reorganisation of society and the economy to get at the causes of inequality (Eisenberg, 2019).

A just energy transition is not simply a technological or a socio-technical matter, but an intensely political one. This is so because it is characterised by issues of power dynamics, distribution and access to critical resources, and political economy. Major national energy policy and planning tend to narrowly focus on the issues of economics, energy prices, jobs and, to some extent, energy access, but not on broader social and economic contours of energy systems (Miller and Richter, 2014).

While the literature on socio-technical energy transition and energy justice is extensive, the intersection of politics and social justice is frequently overlooked (Meadowcroft, 2005; Baker, Newell and Phillips, 2014; Jenkins et al., 2016). Historically, discussions of social justice in relation to energy systems date back to the 1970s, even before climate change was recognised as a topic worthy of serious academic investigation.

However, beginning in the middle of the first decade of the 21st century, social justice has begun to emerge as a crucial component of transition in response to the urgent imperatives of climate change. There is no way to minimise the magnitude of the social factor involved in the energy transition. In the future, the most difficult obstacle will be conceiving of a transformation that is fair and equitable for the community as the primary stakeholder.

As pointed out by Ivan Illich and Amory Lovins in their seminal 1970s writings ‘Energy and Equity’ and ‘Soft Energy Paths’, respectively, there is a serious disconnect between economic growth, social fairness, and individual liberty (Illich, 1974). Energy, for Lovins, is a tool for achieving social goals rather than an end in itself, as seen by his claim that the moral and practical value of energy pathways lies not in their techno-economic but in their socio-political consequences. All levels of society, from individuals to families to nations and even the whole global community, are affected by these repercussions. In the same vein, he differentiates between "hard energy tracks" and "soft energy paths" according to factors such as energy efficiency, the variety of energy production technologies, and most crucially, the social and political repercussions. While social transformation is inevitable for all options, the sort of social transformation associated with "hard routes" is more likely to usher in less

desirable, less feasible, and less compatible transformations in both social norms and individual agency than their "soft path" counterparts. Lovins' 'hard' and 'soft' approaches to achieving social objectives are facilitated by the adoption of the latter as a practical value of energy pathways, in addition to the use of energy for broader themes of equality and social justice (Sovacool, 2011; Strachan et al., 2015). The field of energy justice has grown rapidly since the turn of the century, especially in the second half of the first decade as concerns about energy and climate justice became more prominent (Jenkins et al., 2016; McCauley et al., 2019).

An equitable transition away from fossil-based sources is the appropriate solution to the problems of stakeholders' exclusion from social and political engagement. To rephrase, a socially equitable and just transition would include a distribution of the costs and benefits of a world run on renewable energy sources that is fair and reasonable for everyone. By providing new avenues of socioeconomic opportunity, education, skill-building, and sufficient social safety nets, it frees individuals, communities, and regions from the grip of the fossil fuel dynamics. With the help of open and participatory decision-making, the concepts of sustainability, equality, and climate justice may shape a future-focused society throughout a just transition.

Alterations to energy technology, processes, and infrastructures are an integral part of the shift to new energy systems, and these alterations will have far-reaching and nuanced effects on all parties involved. If the future low-carbon energy system is to be successful, it must begin to meet the needs of the poor and disadvantaged in more inclusive and long-lasting ways (Jenkins et al., 2016).

Considering this, the transition to low-carbon energy sources must address the discriminatory and unequal results produced by socio-political and institutional decision-making. The goal of a social justice framework is to promote anti-discriminatory policies and procedures and to raise larger moral concerns about injustice by focusing on equality and diversity as the foundation of a fair society. Indeed, according to Smith, equality is the bedrock of every fair society (Smith, 2000).

Existing research in the field of energy justice presents a conundrum, because, at the ground level it generates better and more equitable justice outcomes, but it does so without taking into account the fact that theoretical perspectives on energy justice support change as a top-down bureaucratic process that is supervised by policy makers and change agents employed by the state. This is in direct contravention of the bottom-up community enacted transition based on energy justice principles. While these perspectives have a clear role to play in the transition, they undermine the importance and potential traction or salience of justice concepts. A common approach to energy justice is fundamentally through a top-down process which my research challenges and provides an alternative approach through bottom-up processes.

2.2.1. Emergence of energy justice: from environment to climate to energy

Even though climate justice forms the backbone of energy policy, there is an overlap between energy, environment, and social justice, each of which compete with one another in renewable energy siting disputes (Bailey and Darkal, 2018). For example, environmental justice hinges on public contribution to environmental decision making and rallying mass support for non-discriminatory protection from environmental risks, particularly for marginalised and disadvantaged groups (Bullard and Johnson, 2000; Bullard, 2001; Eames and Hunt, 2013).

In this regard, environmental justice articulates deep concerns encompassing social and environmental equity in relation to energy and overall effects of energy decisions. Energy justice promotes the values of universal access to safe, affordable, and sustainable energy (McCauley et al., 2013) by going beyond where and why energy injustices occur; this notion of justice integrates a normative focus on reducing injustices in energy systems (Jenkins, Sovacool and McCauley, 2018). Since there is tension between energy, environmental, and social justice, and which one of these must take precedence, it necessitates stakeholder participation and adjudicating between competing viewpoints for deriving ideal distributive and procedural justice (Schlosberg, 2007b; Walker, 2009; Haggett, 2011).

Energy justice research is a dynamic repository of principles of justice, equity, and fairness and their application to achieve socio-technical transition while, at the same time, avoiding the negative pitfalls associated with already existing patterns of conventional energy production and consumption (Newell and Mulvaney, 2013a).

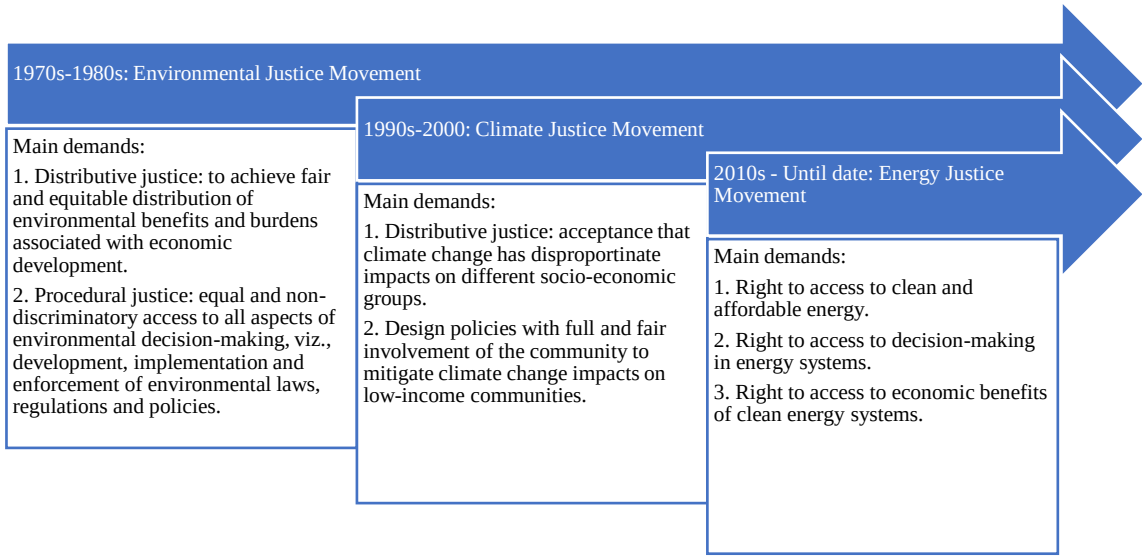

Figure (2c): Parallel and overlapping claims territories of environmental justice, climate justice and energy justice.

Energy justice incorporates various additional goals, such as shifting the transition direction from profit to people, while maintaining the distributive and procedural justice demands of the environmental and justice movements. Resulting from the new balance of power, ownership, decision-making, and centralisation will all undergo shifts. These ideas provide the theoretical basis for devolving authority in the energy sector from large, centralised producers to more decentralised groups. Potentially, this might serve as a catalyst for the elimination of many of the disparities present in our energy system, leading to a revolution in the industry as we know it and a move toward more democratically managed systems with a renewed focus on social inclusivity and equality. For example, community energy is a good representative of democratic and inclusive energy.

Community-based renewable energy (CRE) has consequences for social equity. Furthermore, there is a need for analysing the origins of the CRE idea and its relation to the administration of justice. Consequently, it is important to understand CRE's growth, the nature of community engagement, and

the results within a framework that accounts for the justice implications of this emergent kind of community led and owned energy transition. It's a different strategy that helps us learn more about how community-based strategies might improve our comprehension of energy equity in renewable energy for the public good (Harvey, 1996; Smith, 2000).

Since the 1970s social justice problems have expanded and widened to include concerns about nature and the environment (Gleeson and Low, 1998; Schlosberg, 2007b), climate and eventually energy (Sovacool, 2014; Bombaerts et al., 2019; McCauley et al., 2019). Scholars in the field of energy transition have employed a wide range of conceptual frameworks to analyse the phenomenon, often adopting variants of the much-popular justice idea of redistribution, acknowledgement, and participation proposed by Nancy Fraser (Sovacool and Dworkin, 2015; Veelen, 2015; Jenkins et al., 2016). Scholars have expressed an urgent need for "humanizing" sociotechnical transitions by incorporating justice dimensions into the multi-level perspective (MLP) framework (Jenkins, Sovacool and McCauley, 2018), an attempt to bridge the gap between sociotechnical and energy justice scholarship on sustainable energy transitions. Decarbonisation and environmental sustainability, a key component of transition while circumventing claims of justice and democracy (Healy and Barry, 2017).

2.2.2. 'Humanizing' transitions: in search of social justice

In modern societies, energy transitions are extraordinarily complex and multi-faceted exercises embedded in complex socio-economic, socio-technological, and socio-political contexts. This complexity considered in its distinctive characteristics brings important questions to bear on considerations of justice as the central issue of concern within energy transitions.

In the context of justice, some important questions asked are who benefits, who bears the burden, who participates, in what ways, and to what effect. These questions relate to the issues of voice and authority that matter in the decision making. These are mainly the questions of (in)justice, more particularly when injustice is systematic and seemingly integrated into the design of processes or outcomes.

However, it is becoming increasingly clear that renewable energy sources and their infrastructures come with their own costs and trade-offs, and that critique and resistance are required to forge a truly just transition to renewable energy. This emerging awareness is multifaceted and complicated. Renewable energy transitions today, like previous energy revolutions, are highly materialistic, ecological, power-centric, and culturally significant, as well as substantially geographical with a high degree of differentiations across them (Knuth et al., 2022). It explores site-specific socio-economic and political relations which influences experiences of renewable energy transition on the ground. These include, for instance, racialized extraction, land dispossession and rural transformation in new frontiers of renewable energy expansion.

Energy transition can be considered just and inclusive when transition processes ensure fairness in full and equal participation in decision-making, full and equal distribution of losses and benefits, and full and equal outcomes in capabilities (Newell and Mulvaney, 2013b). Energy transition, in this sense, is not a set of fixed rules, but rather a vision incorporating process, dialogue and a participatory framework that considers the needs and concerns of local vulnerable community members most important. Engaging communities in transition is an inclusive bottom-up process that is critical to realising ‘just’ and full potential of renewable energy sources.

From the time of Aristotle, people have discussed and thought deeply about justice, or more specifically, the questions of what is right and what is unjust. Aristotle's (Aristotle translated by W.D.Ross, no date). Distinction is made in Book V of Nicomachean Ethics between distributive justice, which corresponds to social justice, and corrective justice, which is more like judicial justice today. Philosophers, such as Adam Smith and John Rawls, have spent considerable time debating the meaning of justice and the standards that society should strive to achieve. Rather than seeing energy systems as solely technical means for the supply of low-cost energy, (Sovacool et al., 2016) stress a human-centered perspective of these systems. Scholars in a similar vein have echoed the point that energy decision making is difficult due to the interplay of several factors, including technical and

economic factors, but also psychological, behavioural, ethical, and socio-political concerns (Frigo, 2018). Energy production, distribution, and consumption should be managed in a way that promotes human flourishing if a society is to fulfil its aspirations of justice and fairness (Sovacool, 2014).

Nancy Fraser, a political philosopher, feminist theorist and a powerful thought leader of our times has evolved a theory of justice based on a zeitdiagnose or 'diagnosis of the time' that provides a much deeper and richer sense of social justice where she pushes the alliteration boundaries of 'recognition' and 'redistribution' justice to emphasises that the "recognition problematic" to be not only recognised, but also integrated with the "redistribution problematic" (Fraser, 2011). In her iteration, a major historical shift was the rise of the neoliberalism of the 1990s, which foreshadowed replacement of closing alternatives and social egalitarianism with formation of a nexus between the rise of recognition, decline of redistribution and rise of neoliberalism (Fraser, 2011).

Neoliberalism intensified and amplified the forms of transnational flows of systems and ideas, finance, and technologies, which in turn put a lot of pressure on states and their projects to create more egalitarian systems. Since the advent of neoliberalism, the dissolution of the Westphalian frame of state sovereignty (Fraser, 2011) has been rendered superfluous by the creation of a political space accommodating transnationalism necessitating a theory of social justice for a post-Westphalian democratic politics. In other words, the notion of state sovereignty losing importance in post-Westphalian democratic system needs a new theory of social justice that can accommodate justice implications of a neoliberal economic system operating in a near-borderless state with weakened sovereignty.

Energy justice has is the latest of the justice scholarship undergone significant transformation over the past decade to have emerged as a dynamic area of scholarly inquiry that effectively negotiates and navigates the interaction between dimensions of justice policy related issues on energy systems and transitions (Jenkins et al., 2016). In fact, the emergence of energy justice has been preceded by a long history of protest, resilience, and resistance in the form of persistent demand for environmental justice

and more recently, climate justice (Vanderheiden, 2008; Dawson, 2010; Schlosberg, 2013). Environmental justice is a 1970s American development responding to unequal, unfair distribution of harmful environmental impacts resulting from pollution and waste facilities which were often located closer to the poor people of colour than to the rich white communities (Davies, 2006).

Environmental justice, the precursor to energy justice epitomises a struggle for empowerment, social justice, and public health and just and worthy involvement of people from all segments of society in all matters of development, implementation and enforcement of environmental laws and regulations (Bullard, 2001). Since its early development environmental justice has grown to encapsulate larger concerns for a more democratic and egalitarian world to include local as well as global (Vanderheiden, 2008; Baskin, 2009) concerns over climate and social justice. As an analytical and a decision-making conceptual framework, it serves as a guiding tool during the energy deployment processes (Sovacool and Dworkin, 2015; Jenkins et al., 2016) from production to consumption.

2.2.3. Complementarities between energy transition and energy justice

Energy transitions and the pursuit of energy justice go hand in hand (Geels, 2002; Meadowcroft, 2009a) and there are compelling arguments advanced in their support by various other scholars like Späth and Rohracher (2012) who investigate this connection in detail (Späth and Rohracher, 2012). To ensure that the future transition to low carbon energy does not duplicate the uneven distribution of costs and benefits associated with fossil-fuel transitions, it is crucial that research into energy transitions be guided by concepts of justice and to mainstream these ideas (Eames and Hunt, 2013; Jenkins, Sovacool and McCauley, 2018; Sareen and Haarstad, 2018).

It is proposed that the concepts of energy justice may be integrated into sociotechnical transitions to better negotiate the goals of equality and fairness while also posing a threat to the negative repercussions of currently prevalent energy production and consumption practises (Eames and Hunt, 2013; Newell and Mulvaney, 2013a). While applying these principles of justice, care must be taken

not to repeat the entrenched injustices and externalities of the past, especially with regards to vulnerable and marginalised people (Eames and Hunt, 2013; McCauley et al., 2013; Sovacool, 2016). Understanding the connection between energy, technology, and justice requires paying close attention to the technologically determinist perspective of history. Energy innovations have been associated with larger shifts in society, economy, government, and culture. Similar arguments may be made for the fact that different energy technologies should not be employed alone, since they all form part of larger, more intricate systems of production and consumption.

On closer inspection, much of the dominant strands of transitions literature seem to be oblivious to the issue of justice and say little or nothing about it during the transition process. This is especially true of transition literature concerned mostly with the socio-technical nature of transitions (Geels, 2002, 2018, 2019; Sareen and Haarstad, 2018). There is a near-total absence of insight into the nature and quality of the processes involved, as well as their ultimate unfolding results, in the literature on transition.

Scholars have shown, however, that the uneven distribution of costs and gains connected with past transitions to fossil fuels-based energy sources must be avoided if future transitions to low carbon energy are to be just and equitable (Eames and Hunt, 2013; Jenkins, Sovacool and McCauley, 2018). As a result, energy justice is a strategy for putting the costs and risks of current energy systems at the centre of the transitions debate. By doing so, distribution costs are reduced, distribution benefits are boosted, and energy policymaking begins to adhere to the ideals of representative democracy, providing a safeguard for the powerless, the disadvantaged, and those with insufficient access to electricity (Eames and Hunt, 2013; Sovacool and Geels, 2016).

2.2.4. Energy intersection with human rights and indigenous rights

The grave effects of climate change need an immediate shift away from fossil fuels as a means of combating the problem. Human rights must be respected if this is to occur at the necessary size and speed and to fulfil its promises. Unprecedented efforts are being made to fulfil the transition objectives; however, it is unclear whether human rights and societal ramifications are being considered. The

energy transition was framed as a crucial step in the preservation of human rights during the 2015 United Nations Framework Convention on Climate Change (UNFCCC) conference, where non-governmental organisations (NGOs) applied pressure. The countries were urged, for example, by a joint statement from Amnesty International and Greenpeace, to immediately begin transitioning to a renewable energy system that uses only renewable sources of energy on a global scale by the year 2050 (Pinamonti, 2017).

While it is admirable to aim for a complete switch to renewable energy, former UN High Commissioner for Human Rights Mary Robinson voiced concern about human rights violations occurring during the transition in a speech to the UN Economic and Social Council (ECOSOC). She issued a stern warning: It is important to remain cognizant that not all action which is good for the planet is automatically good for people. We require a just transition where human rights inform all climate action. Recent experience also shows that renewable energy installations can result in human rights being undermined if local communities are not consulted. Recent allegations of human rights infringements by renewable energy companies, have been documented by the Business and Human Rights Resource Centre, showing that land rights, labour rights and indigenous rights can be undermined in the absence of appropriate checks and balances on renewable energy projects. On the other hand, engaging people in climate decision making create more buy in and support for climate action. Governments cannot achieve the SDGs or implement the Paris agreement's goals without the actions of their citizens and the support of civil society (Robinson, 2017).

Since there is no established right to energy in the existing human rights framework, a human rights-based approach that is attentive to social justice of energy is essential. The right to health care, food, water, and a decent quality of life are only some of the other fundamental freedoms that will be realised with this growth (Gonzales, 2016). In a similar spirit, one may argue that the problems of food insecurity, poor health, and a lack of clean water are all made worse by the absence of reliable access to reliable sources of energy.

The second pillar is the principle of "procedural justice," which manifests in the application of equitable procedures in engaging with all stakeholders in a fair, equal, and non-discriminatory way (Walker, 2009) by making procedurally binding participation, impartiality, and full information disclosure by government and industry (Davies, 2006). In this context, procedural justice promotes "fair and meaningful" participation by people of diverse economic, ethnic, and social backgrounds in the creation and implementation of environmental regulations (Bullard, 2001). The third pillar, "recognition justice," reveals itself via the identification of the procedure by which certain persons and places are treated with disdain, insult, degradation, and devaluation in compared to others (Walker, 2009).

Recognition justice seeks equitable representation, including equal political rights and freedom from denigration based on social parameters of poverty, race, culture, ethnicity, and gender, and expresses a variety of opinions rooted in socioeconomic status, race, ethnicity, and gender (McCauley et al., 2013). While recognition justice is related to procedural justice, its primary goal is fair representation, which includes equal political rights and protection against being treated poorly.

Energy transitions scholarship has developed along two distinctly divergent lines of approaches with their own distinct agenda. Despite the obvious benefits to society and the environment from doing so, the two fields remain separate. However, changes to these systems are fundamentally sociotechnical issues because of the inherent interdependence of energy systems and social organisation systems (Bridge et al., 2013; Lockwood et al., 2017). The breadth and character of this knowledge are both excessively narrow, and they need to be revisited in depth. Nonetheless, there is a separate school of thought in the social sciences that asks whether our current approach to energy production, distribution, and consumption is fair and humane (Eames and Hunt, 2013; Jenkins, Sovacool and McCauley, 2018).

2.3. Energy justice principles and implications to society

The idea of energy justice has been voiced by environmental justice advocates for decades, but a true theory of energy justice has only seen light of the day in 2010, and since then the concept has been

used as a theoretical, policy, and political tool. Energy justice is a framework of actions to be applied throughout the energy system to deliver just energy systems (Heffron and McCauley, 2017).

The application of energy justice concept includes but not limited to ensuring positive outcomes at three levels, viz., energy security at the individual level, industry growth (energy), and national economic growth (Heffron and McCauley, 2014). Achieving justice in the energy industry primarily centre around multiple dimensions of energy justice that includes distributive, procedural, recognition, restorative, and cosmopolitan justice. However, the landscape of energy justice is constantly evolving, and there are now two primary schools of thought on what energy justice entails.

Both expand upon long-standing notions of justice in the fields of environmental and climate justice. The "triumvirate of tenets," or the concept of distributional, procedural, and recognitional justice, is central to the concept of energy justice (McCauley et al., 2013). Distributional fairness is the first of these overlapping and interconnected foundations. To investigate the unequal distribution of environmental advantages and damages, and the unequal distribution of obligations related to them, the idea of distributional energy justice is fundamentally geographical (Walker, 2009).

The first stream of energy justice advances the idea that energy justice comprises three central tenets nomenclature as distributive, procedural, and recognition justice (McCauley et al., 2013) of which the first two viz., distributive, and procedural justice owe their theoretical and practical origin to environmental justice movement (Walker, 2009). There are further eight core principles of energy justice, viz., (i) availability, (ii) affordability, (iii) intra-generational equity, (iv) sustainability, (v) due process, (vi) transparency, (vii) accountability, and (viii) responsibility advanced by (Sovacool et al., 2016).

The first three of these goals can't be accomplished without ending energy poverty and making high-quality energy services universally accessible on a fair and just basis. Social and environmental impact assessments, prior informed consent from the impacted communities, extractive industry transparency standards, and international standards for energy subsidies disclosures are just a few examples of the

mechanisms that can be used to guarantee due process, transparency, and accountability (Sovacool et al., 2016). For reasons of both long-term viability and intergenerational fairness, it is essential that energy systems consider the planet's finite resources and the rights of future generations. At the same time, international responsibility requires that all countries do what they can to safeguard the planet's natural ecosystems and lessen the impact.

Energy justice is closely linked to environmental justice, human rights, climate justice, and indigenous rights. It is believed that major energy-related injustices such as the forced eviction and subsequent forced resettlement of vulnerable communities, the imposition of biased and inequitable pollution burdens, and energy poverty need to be addressed through a framework (Salter, Gonzalez and Warner, 2018). There is a clear connection between the environmental justice movement and energy justice, even though the energy sector has a long history of environmental injustice and contributes more to climate change than any other business.

2.3.1. Western notion of justice: 'triumvirate of tenets' of energy justice procedural, distributive, recognitional

The triangulation of procedural, distributive & recognitional justice are elaborately presented below.

2.3.1.1. Distributive justice

The distributive justice theories are old Western philosophical concepts which date back to the Greeks and are closely related to the writings of a prominent contemporary political philosopher John Rawls (Jones and Sidortsov, 2014). These theories examine how social goods are dispersed in society, particularly energy, which humans value as an enabler of human capacities, our culture, and our social relations. How should resources be allocated? Should it be based on need, merit, usefulness, entitlement, or property rights? Distributional justice focuses on energy disparities. Distributional justice is often tied to energy production politics, especially the placement of present and future energy facilities. Distributive justice goes beyond production to include energy consumption in terms of technology location and affordable energy.

There is a huge disconnect between the places where technologies are developed, where their results are disseminated, and where they have the most influence (Sovacool et al., 2016). These areas of injury should be determined in accordance with principles of distributive justice. Transitional justice, or distributive justice, is the equitable distribution of the associated costs and benefits of change. There is no definitive clarity on who should pay for the financial losses incurred by employers and employees due to the potential closure of facilities producing coal, oil, and gas, or for the non-monetary losses, such as the loss of culture or identity, that would be incurred because of such a closure.

Since the effects of energy transitions are likely to be felt by a wide range of people, not just those who work in the coal, oil, and gas industries, Eisenberg (2019) argues that transition planning should be more comprehensive and consider a wider range of actors and issues to ensure that interventions go well beyond job substitution and worker retraining (Eisenberg, 2019). These interventions could range from the introduction of universal basic income to vitalising local communities and economies to nurturing new a relationship with land. These policy measures help create a 'win-win' situation for all stakeholders, particularly beneficial to the local communities who will benefit most from the assistance provided during and after the transition.

2.3.1.2. Recognition justice

Recognitional justice is about ensuring that energy decision-making respects due process and representation. It offers decision-making rights to the stakeholders, especially the communities who have been discriminated against because of their weaker socio-economic and political profile. These justices take the form of a demand for fair procedures that involve all parties, especially without favour or discrimination (Walker, 2009). A persistent pressure from multi-level legal systems, in addition to the influence by softer non-regulatory factors like customs, standards, norms, and behaviours has helped mainstreaming procedural justice as a legitimate demand by communities who have been denied their right to participate in a fair and democratic decision-making (Hall, 2013).

Energy justice necessitates research into determining the precise origins of inequality, with the goal of focusing attention on those who have been harmed by those inequities and, as a result, being able to name those victims (Jones, Sovacool and Sidortsov, 2015). In this sense, the order of the time sequence suggests that recognition justice is post-distributional because it includes during the analysis of distributional inequalities a deep reflection upon where in society, or more specifically, in which parts of society, injustices emerge. In other words, the order of the time sequence suggests that recognition justice comes after distributional justice (Bulkeley, Edwards and Fuller, 2014; Heffron and McCauley, 2017). It is essential for those who formulate public policy to have a framework to guide them in recognition and justice so that they can accurately assess the effects of their decisions on underserved segments of society.

It has been argued that the conclusion that some parts of society will suffer disproportionately more than others is an insufficient one. This is especially the case in relation to the relationship between indigenous people and extractive industries (Fraser, 2009; Acuña, 2015). It is worth emphasizing that energy justice has broadened its approach from that of environmental justice movement which was intended for groups such as the socially deprived or ethnic minorities to that of an institutionalised, wider perspective on who can be disadvantaged by the logics of energy systems (Jenkins, 2018).

2.3.1.3. Procedural justice

The third pillar of energy justice is the procedural justice, which is a right to fair process in decision making owes its parentage to social and environmental justice movement that argued against the sole focus of justice theory on distributional aspects of material goods (Schlosberg, 2007a; Young, 2012) argue that that the notion of procedural justice is incomplete without the inclusion of the process used for taking decisions. It is a place where recognition-based and distributive forms of justice may find common ground, and it was established in response to a widespread need for both formal and informal modes of engagement and participation in decision-making (Ottinger, Hargrave and Hopson, 2014; Otsuki, 2016; Simcock, 2016). The failure of recognition justice, which focuses on pinpointing when

and where wrongdoing occurred and pinpointing who it affected, to bring about a more equitable society serves to underline the need of procedural justice. That's why when people talk about having a "fair" process, they're referring to a formal procedure that involves not just making decisions but also getting everyone involved so that the results are fairer overall.

The procedural justice paradigm recognises that participation in several dimensions, namely, inclusion, influence, and information (Simcock, 2016) are the fundamental conditions for ensuring the fairness of decision-making (Shrader-Frechette, 2002; Eames and Hunt, 2013). Inclusion, presence, and the voice of stakeholder engagement, as well as how they feel about it, might indicate if justice in decision-making processes has been accomplished in each of these aspects (Young, 2002; Smith, 2009; Knudsen et al., 2015; Hunold and Young, 2017). Acceptance that those impacted have the right to be included is insufficient; consequently, it must be assured that they participate in the decision-making process as a component of procedural justice (Fuller and Bulkeley, 2013). Concerns may exist around who is included and who is excluded, the extent of their influence, and the sorts of information to be shared. In addition, partial inclusion may not deliver the intended results compared to those that engage all impacted parties to some degree in making transition choices (Young, 2000; Goodin, 2007).

Within the broad contours of participation, it is important to recognise that different persons and collectives have different abilities and interests, and therefore exercise and exert different degrees of influence through their opinions, suggestions, interests, and concerns in a decision process (Rowe and Frewer, 2005; Smith, 2009; Haggett, 2011). Such stakeholder participation can be based on their impact into three distinct categories, viz., (i) stakeholder as ‘listen as a spectator’, (ii) stakeholder with ‘consultative influence’, and (iii) stakeholder with ‘direct authority’ (Simcock, 2016).

The first group comprises passive participants who are recipients of information about a decision without the ability to influence the decision. The second type of stakeholders has "consultative influence" and has the power to provide their opinion on an issue, while others make the ultimate choice. In this sense, their involvement in the result of the stakeholder engagement process is passive.

The third category describes a circumstance in which a stakeholder is empowered by official or informal methods and procedures to shape and control the result of a choice, either by deciding alone or by sharing power and influence with others in a democratic way. The third dimension of procedural justice framework is about the importance of accurate, appropriate, and sufficient information to help stakeholders reach informed consent and ensure transparency, meaningful and effective participation (Shrader-Frechette, 2002; Knudsen et al., 2015).

The transition entails much needed assistance and support to those impacted - workers, households, communities as well as companies across the fossil-fuel industry. This raises the crucial question of who is responsible for making up for the transition costs. Debate continues as to whether these losses should be covered by the government or by the company's previous earnings. Part of the problem lies in the fact that the term ‘fair’, the deciding criterion for distribution of losses and benefits is vague for fixing financial responsibilities. Justice, according to (Piggot et al., 2019) requires that choices be made based on a knowledge of the mechanisms at play when allocating costs and benefits. Countries worry that a sudden and rapid shift away from fossil fuels would leave their employees, communities, and assets in limbo, but that a long-term transition strategy that is in line with other national social and economic development objectives may accomplish a successful transition.

Energy justice is the use of equity principles to rectify the imbalance of power that has arisen because of the economic and political supremacy and control of electricity generation by social, industrial, and political elites. Because of the substantial profits it generates, corporations and governments have a vested interest in determining who has access to energy resources, how they are extracted, produced, transported, and generated, and whose ownership rights to these assets will be protected (Jones and Sidortsov, 2014).

Regulatory frameworks are often skewed to favour system's elites, quite often at the expense of human rights abuses and the displacement of populations. All these challenges relate to procedural justice, which is concerned with decision-making, free prior informed consent for energy projects,

transparency, and access to high-quality, reliable information regarding energy and related matters. Similarly, social justice should play a significant part in distributing the gains of economic and political power, as well as the social costs that come from these energy-related (re)distribution patterns (Jones and Sidortsov, 2014).

2.3.2. Energy, locale, and justice: why localize energy?

Renewable energy initiatives encourage proactive public engagement with how and by whom energy is utilised and generated. This proactive participation has offered the opportunity for people to make the greatest contribution to climate change mitigation initiatives. Notably different from past social disengagement with centralised energy systems, decarbonisation and decentralisation of energy assets offers an environment for public participation with the energy system (Devine-Wright, 2007). Renewable energy technologies and related infrastructure have several advantages over traditional centralised energy systems, including the potential they provide for public interaction and engagement with the energy system.

There are characteristics of renewable energy systems that allow them to provide possibilities for social participation. Affordability is one characteristic of low carbon technology that enables new kinds of ownership that are not achievable with technologies that cater to fossil fuel-based centralised energy systems (Ellabban, Abu-Rub and Blaabjerg, 2014). This has made ownership of low-carbon technology feasible for a variety of potential owners, including communities, governments, enterprises, and even individual homes. Possibility of a comparable situation including ownership of centralised electrical networks is improbable due to the high capital requirements. In contrast to centralised energy systems, the engagement of many players in renewable energy systems facilitates system stability and the balance of demand and production (Hoggett, 2016).

Community renewables, a localised form of energy, often have challenges of justifying social justice implications of those projects (Berka and Creamer, 2018). However, community level projects are easily noticed and duplicated to other areas. Community renewable energy projects offer several

benefits over large-scale centralised projects, including the fact that transmission losses are kept to a minimum since generating and consumption occur so close together. Although the benefits of community initiatives are clear, little effort has been made to examine the larger implications of energy justice (Forman, 2017; Lacey-Barnacle and Bird, 2018).

2.3.3. Community renewable energy as bottom-up approach for improved justice outcomes

The existing literature on energy transition has not made any credible inroads into the importance of community owned energy production activities as a viable means for improving social justice outcomes in the Indian context. Although there is a sense of importance attached to the emerging body of workabout community renewable energy, there is an imminent need for analysing outcomes, benefits, and associated effects of community renewables (Wyse and Hoicka, 2019).

This research does just that by seeking to analyse how and to what extent community renewables have a direct bearing on enhancement of justice outcomes. The promotion of small-scale, decentralised, and diversely owned kinds of renewable energy infrastructure, including community renewable energy, has been a major focus of research and policymaking as part of the bottom-up process of energy transformation (Walker et al., 2007; Walker and Devine-Wright, 2008; Hoffman and High-Pippert, 2010). Community initiated energy projects have been argued to be significant agents of change for addressing energy-related issues bearing direct consequences on improved justice outcomes including fuel poverty (Martiskainen, Heiskanen and Speciale, 2018). However, the focus has been on policy management and energy technologies which can be described as a "techno-economic determinism" (Lawhon and Murphy, 2012). Such policy management approaches at best can deliver reformist-incrementalistic changes, instead of much needed disruptive socio-energy transformations. This poses a fundamental concern about often-overlooked aspects of energy justice, such as the normative and ethical conflicts resulting from energy extraction, production, and consumption (Miller, Iles and Jones, 2013).

Energy ownership is another dimension that should be added to the issue of justice. Energy justice is global energy system that fairly disseminates both the benefit and costs of energy services, and one that has representative and impartial energy decision-making (Sovacool, 2013). Even though energy engineers, economists, and bureaucrats are the predominant players in energy policy formulation and execution, wider societal engagement in transition decision-making has been a missing link that requires more investigation. However, the landscape of energy decision-making is now confronted with significant obstacles due to the creation of a new political reality in which people are increasingly conscious of energy and energy-related decision-making. There is an urgent need for stronger democratic voice and involvement, as well as a reorganisation of the 'transition arena' from confined places for the principal players to more open spaces for debate, deliberation, and engagement.

Strachan and Foxon (2012) suggest that there are several viable low-carbon energy futures based on 'Market Rules' and 'Central Coordination' or 'Thousand Flowers' scenarios that provide potentially vastly different approaches (Stachan and Foxon, 2012). Will a transition to low-carbon energy be based largely on profit-driven market principles organised by the state or on the innovative efforts of countless organisations and people engaged in various types of civil society activism? Or will this transition consist more realistically of a combination of the two extremes?

Newell and Paterson claim that most initiatives to decrease greenhouse gas emissions have relied on a hyper-financialised type of neoliberalism that has dominated the global political economy over the last two decades. They refer to this as "climate capitalism," which is a paradigm based on continued economic growth that satisfies capitalism's insatiable desire for continuous economic growth while making significant transitions away from carbon-based industrial expansion (Newell and Paterson, 2012). Their study emphasises the need of better governance structures, without which the consequences of market-led policies are likely to result in very uneven, if not dystopian, futures that enrich the privileged while putting the weight of adjustment on the poor and vulnerable.

Each distinct energy-society relationship - including the low-carbon energy transition, energy poverty, energy-for-development, energy justice, and energy security - implies a different policy framing. This relationship extends beyond individual communities and businesses to include corporations and non-governmental organisations. Different political and economic interests, as well as aims and repercussions, inform each of these alternatives to the status quo.

3. An Interdisciplinary Framework and Research Methodology

Introduction

The notion of justice in the energy sector has been a neglected area, which might be attributed to the prevailing dominance of economic interests and large energy conglomerates. The renewed focus on this topic in recent times has highlighted the need for a comprehensive perspective that encompasses human rights and global implications. The present chapter seeks to undertake a critical analysis of the theoretical frameworks that can be used to enquire into the key elements and factors that serve as the foundation for the formulation of the research question(s).

Numerous theoretical frameworks have been conceptualized over time, aimed at explicating the intricacies of societal transitions resulting from change of energy technology. Transition research for the most part have predominantly leaned towards systems change theories to gain a better understanding of the myriad of processes, some of which are the Techno-Economic Paradigm (TEP), Innovation Systems (IS), the Socio-Technical Systems Model, and the Multi-Level Perspective (MLP) to name a few. It should be noted that while these theoretical models were considered during this study, they were deemed deficient in rigour and scope when it came to addressing the co-evolution of technology and its justice implication on society.

The concept of energy justice, the subject of this thesis, has gained traction for a variety reasons, including the unfair benefit distribution during the energy transition. The energy justice concept entails the application of human rights throughout the energy life cycle, encompassing the entire process, ‘from cradle to grave’. It is perplexing that the energy sector, which forms a root cause of various climate and environmental issues, has remained largely unexplored in the context of achieving just outcomes for society. In India the current top-down capitalist structure, coupled with unjust implementation methods and exclusion of some groups from the decision-making process, undermines the efficacy of renewable energy systems. Therefore, an approach, one that is just and equitable,

oriented towards social and environmental justice, is necessary to explore energy transition. The primary objectives of this research encompass characterisation of the negative impacts of energy transition on land use and livelihoods, i.e., the social, ecological, and financial attributes associated with infrastructure development; human rights violations of transboundary workers involved in India's solar supply chain, and a comprehensive analysis of the socio-environmental effects of ultramega solar parks on distributional and procedural aspects of justice. Ultimately, this research strives to address the question of discernible justice implications in India's energy transition.

The study achieves the aforesaid objectives by introducing the theoretical frameworks that attempt at making connections between various key arguments of my research and further asserting that the questions of energy justice and distribution are predominantly important to effect positive change across society. As recalibration of pressing concerns of society, space, economy, and politics unfold in practice; it increasingly implies that no one field, or discipline can or has the capability to encapsulate the diverse field of social studies of energy.

The appropriate approach for this study, therefore, is to cover an entire spectrum of energy relations in an observational and interpretive way reflecting on far-reaching material, ecological, social, and cultural significance (Knuth et al., 2022). This study has considered various bodies of scholarships with their own merits and demerits, insufficient on their own, necessitates a more integrated and interdisciplinary framework that provides analysis of transition that is grounded in different strands of literature from socio-energy systems design to political ecology to political economy more broadly. These frameworks and approaches conceptual frameworks, which deal with in detail later in this chapter may seem to be focusing on different aspects of what is in fact a unified phenomenon of energy transitions. It is important, therefore, that these frameworks together serve to link energy, justice, and human welfare to fully consider energy transformation within the realm of energy and justice as a social objective to be achieved. Similarly, to rectify energy injustice, it is important to recognise non-compliance with cultural identity and the rights of individuals to substantive participation in decision-

making procedures, as well as the significant impact of inefficient access to information in exacerbating injustice during the energy transition. Thus, it is critical to address these inadequacies during the design and execution stages of renewable energy projects. As such, political economy as an interdisciplinary field of enquiry is most appropriately suited to study the allocation at all scale of resources, power, and wealth in economies (Stilwell, 2011). Similarly, Heffron and McCauley (2018) have used legal geography as an interdisciplinary approach to study the concept of justice for it can be applied across space and time, and in particular with relation to climate, environment and energy (Heffron and McCauley, 2018).

3.1 Just transition framework

This research incorporates human rights-centric justice principles, which are increasingly being applied in the extractive industry, into the renewable energy industry in transition. The framework used in this study, on the one hand, derives its theoretical strength from ‘just framework’, and on the other, explore avenues to develop the concept further. For instance, the 'Just Framework' predominantly used in the extractive industry does not currently address cross-border human rights violations associated with silicon mining, a significant component in the production of solar panels. To ensure that energy transitions are both sustainable and just, it is necessary to undertake a critical examination of the advantages and disadvantages associated with such transitions. This entails a comprehensive consideration of the individuals that are either included or excluded from these processes, and an in-depth analysis of the inherent winners and losers. Overall, these factors highlight the essential components of transitioning that are capable of promoting a more sustainable, just and equitable global future (Williams and Doyon, 2019).

This study uses a combined framework of ‘just framework’ that draws on political ecology, political economy, and socio-energy systems to explain land conflicts, forced labour, loss of livelihoods and social justice imperatives by examining the power dynamics and social relations that shape these issues.

In the case of land conflicts, political ecology can help to uncover the underlying power dynamics that lead to the displacement of communities from their land. For example, large-scale renewable energy projects often require vast amounts of land, which can lead to conflicts with local communities who rely on that land for their livelihoods. Political ecology can help to reveal how these conflicts are often shaped by unequal power relations between the state, corporations, and local communities. For instance, the state may prioritize the interests of corporations over the rights of local communities, leading to land grabs and forced displacement. Similarly, political economy can help to explain the role of economic interests in driving land conflicts and forced labour in Chinese imports. For example, the global demand for cheap goods has led to the exploitation of labour in countries like China, where workers are often subjected to poor working conditions and low wages.

Political economy can help to reveal how these issues are shaped by the interests of global corporations and the neoliberal economic policies that prioritize profit over social and environmental concerns. Socio-energy systems can also help to explain land conflicts and forced labour in Chinese imports by examining the social and economic relations that shape energy production and consumption. For example, the demand for cheap goods in the global North has led to the expansion of energy-intensive industries in countries like China, which has contributed to environmental degradation and social inequality. Socio-energy systems can help to reveal how these issues are shaped by the unequal distribution of power and resources between different social groups and regions.

Overall, political ecology, political economy, and socio-energy systems can provide valuable insights into the complex social and environmental issues that underlie land conflicts and forced labour in Chinese imports. By examining the power dynamics and social relations that shape these issues, these frameworks can help to identify potential solutions that prioritize social and environmental justice. Additionally, it aids in our understanding of who determines the parameters of the energy transition and how, whose interests are served therefore, and how power dynamics, i.e., both internal and external, financial, and non-financial act as vital influencer to pursue one energy path over another. In

other words, the best outcomes are achieved by complementing the domestic political economy analysis situated and contextualised within the sovereign state with more macro focus of global political economy on the larger landscape of power (Power et al., 2016), diplomacy, and state interest. Whereas the socio-energy systems design framework used in this study takes into consideration human issues, no longer defines energy in terms of technology, cost, and environmental concerns alone, but is conceptualised and built in a variety of social configurations. However, this framework is used in a wider context to look beyond specific energy resources and available technologies to support carbon emission reductions in the context of prevailing patterns of economic production, employment, and investment (Bridge and Gailing, 2020).

A significant development in the last more than a decade, i.e., since 2013 has been the widespread adoption of the energy justice concept across all disciplines in the energy field. This thesis navigates the ground reality of energy transition in India and how this transition confronts the existing gap between theory and practice. Past studies that have overlooked the role of justice in energy transition mostly focused on issues such as safety, energy security, and affordable energy delivery to the population and infrastructure development have also served the basis for this research. However, there is now a shift towards expanding the scope of research to address critical issues, like energy justice, which has emerged as a central tenet in the energy sector on a global scale, particularly in developed countries. Unfortunately, this has not yet been the case in developing countries where justice concerns in energy transition remain an underrepresented area of study. Therefore, it is both timely and appropriate that this research examines in depth the justice implication of energy transition in India.

3.2 Identification of methodological gaps in energy justice studies

This section addresses the methodological insufficiencies recognized in current literature concerning the implications of energy transition and justice in the Indian context. By bridging these gaps, this research aims to establish a robust and credible foundation for the proposed methodology, providing a compelling rationale for developing and using this methodology. This study strives to comprehend the

justice implications of energy transition and identify the available justice principles that can facilitate an academic comprehension of the current complete monopolisation of the Indian renewable energy transition by large scale private companies. Recognising these principles can aid in the construction of a more equitable and sustainable energy market structure that more effectively incorporates an average citizen into the energy transition process and promotes a more just distribution of resources. While the transformative potential of renewable energy infrastructure in delivering justice has been recognised, priority must be given to prioritisation of human-centric energy studies founded on principles such as equity, ethics, human rights, and justice, rather than techno-economic considerations.

A detailed literature review has revealed that energy transition explored in India has not used 'triumvirate of tenets' as a possible pathway to decentralized energy produced from renewable sources. This leaves an ample ground for a new methodology to be used for India's transition to low-carbon future by not only exploring the concept of energy justice using 'triumvirate of tenets', i.e., distribution justice, procedural justice, and recognitional justice, but also going beyond it and incorporate restorative justice and cosmopolitan justice. It highlights the timely need for research on the negative externalities associated with large, centrally located renewable energy projects and presents a unique analysis of their implications for justice. Furthermore, it underscores the tendency of policymakers and analysts to overlook broader social justice concerns in favour of technical considerations in their discussions of energy policy.

3.3 Energy 'just transition' framework: its usefulness, inadequacies, and the need for further development

Energy justice is equitable distribution of benefits and burdens in the provision of energy services, along with promoting inclusive decision-making processes (Sovacool *et al.,* 2017). The idealised global energy system in question spans across multiple domains and embodies principles of socio-environmental sustainability and human rights. It is predicated on the assumption that energy services should not be available only to the privileged; rather, they should be accessible to all, particularly the

disadvantaged populations. Energy justice, therefore, is reflective of a commitment to forging a path toward a more just, equitable, and sustainable future for all stakeholders involved in the energy sector. The concept of energy justice must centre on the application of human rights across the energy lifecycle from extraction to production, operation and supply, consumption to waste management, and eventually decommissioning.

Energy justice of late has been gaining increasing momentum and warrants the formulation of an encompassing action framework that comprises mainly three key components of justice, i.e., distributive justice, procedural justice, and recognition justice. These three forms of justice, in combination with cosmopolitan justice and restorative justice, have been employed to investigate the areas of justice and critical minerals (Heffron, 2020) from an interdisciplinary legal geography standpoint (Heffron and McCauley, 2017). In other words, the energy justice framework in question when combined with temporal and spatial domains of justice has come to be known as 'Just Framework' which combines five key elements of justice (Heffron, 2021) broadly representing climate, environment, energy. Application of the Just Framework provides a pragmatic approach to addressing research problems, with a particular emphasis on comprehensively examining diverse factors, including, but not limited to, the business supply chains associated with critical minerals, energy, climate, and timeline for transition.

The 'Just Framework' encompasses five fundamental justice components that are crucial for safeguarding human rights in all aspects of the energy life cycle (Heffron and McCauley, 2018). The energy justice framework comprises of five distinct forms of justice, which are interrelated in various ways and are not mutually exclusive. Consequently, assessing the interconnection amongst these forms of justice is critical towards understanding the broader energy justice framework that addresses the distribution of energy benefits and burdens equitably. The interdependence of these forms of justice establishes a comprehensive foundation for evaluating energy practices and policies, ultimately guiding decision-making towards more sustainable, equitable, and inclusive outcomes.

In this context, it is equally crucial that research concerning climate, environment, and energy (CEE), recognises that this area of study requires a comprehensive and global perspective because CEE actions made at a local level can have significant national and international impacts. Agyeman's (2014) work has emphasised that there is a need for environmental justice scholars to adopt a global and human right-centric research perspective (Agyeman, 2014), a perspective similar to one adopted by Heffron and McCauley (2017) that incorporates the human rights across the renewable energy industry in transition (Heffron and McCauley, 2017). Just Framework is although global and human right-centric in scope; it is nevertheless limited in scope as it does not address the issues of human rights violations and forced labour in association with a section of the renewable energy industry in another country. For example, this framework does not address the cross-border violation of human rights associated with silicon mining, a major component in the manufacture of solar panels. These justice principles, primarily used in extractive industry are increasingly finding their application in energy industry are as follows:

• **Distributive justice:** The initial tenet for energy justice is founded upon the principle of distributional justice. Energy justice is a spatial construct that encompasses the uneven appropriation of environmental benefits and detriments, as well as their associated responsibilities, such as exposure to risks (Walker, 2009). Consequently, energy justice may manifest as a condition where "questions concerning the feasibility of technologies become intertwined with local matters" (Owens and Driffill, 2008) thus emphasising the need for an equitable distribution of benefits and detriments across all members of society, irrespective of considerations such as race and income. The focus is on distribution and sharing of benefits from the energy sector. Distributive justice, as one of the three fundamental pillars of justice, is predicated on the necessity of ensuring the impartial allocation of resources within society. This is an issue of considerable significance, particularly in the context of the burgeoning critical minerals industry. Preventing the reoccurrence of challenges previously

encountered in the extractives sector is paramount and therefore demands that the fair distribution of resources be maintained (Heffron, 2021).

• **Procedural justice:** a critical facet of procedural justice is ascertaining whether all stakeholders are provided a legitimate opportunity to participate in a non-discriminatory way (Walker, 2009) and be represented during all phases of project, ranging from construction stage to operation and eventually decommissioning stage. This principle emphasises on the legal processes and questions concerning whether processes have been followed and access to justice provided.

To promote energy justice, it is critical for all relevant stakeholders to actively participate in decision-making processes, and their inputs must be duly considered throughout. Additionally, this invokes the ideals of impartiality, full information disclosure by both government and industry entities (Davies, 2006), as well as the need for appropriate and sympathetic engagement mechanisms (Todd, 2005) to facilitate inclusive participation in energy transition processes. An essential aspect of addressing energy justice is the disclosure of comprehensive information to the public. Specifically, there is a need to ascertain whether the public is fully informed of the subsidies allocated to different energy sources within the energy sector. This raises pertinent questions regarding the level playing field maintained amongst various energy sources and stakeholders. This has not been rigorously investigated in prior research.

Procedural justice finds its application through the Environmental Impact Assessment (EIA) in critical minerals projects at international, national, and local levels. An EIA must obtain under the international banking standards - the ‘Equator Principles’ for obtaining project finance. In the same manner, the project has to abide by the EIA legislations and stakeholder participation at the national and local level respectively before it can start (Heffron, 2021).

• **Recognition justice:** recognition justice pertains to the recognition of the rights of various groups during project development. In the context of the energy sector, recognition justice has primarily been concerned with the impact of energy developments and activities on indigenous communities

(McCauley *et al.*, 2016). The notion of recognition holds a crucial position in the realm of energy justice and diverges from participation in its significance. Participation accentuates the ability of individuals to engage in decision-making processes, whereas recognition concerns the problem of disrespect, derogation, and belittlement that undervalue the identities of certain individuals and places in comparison to others (Walker, 2009). The principles of recognition justice embrace a broad scope that transcends mere tolerance, promoting equal socio-political rights, protection against physical threats, and accurate representation in decision-making processes (Schlosberg, 2004). Thus, the absence of recognition may take various forms, including political and cultural domination, ridicule, and slander, and may materialise as an outright lack of acknowledgment as well as misrecognition that may include a distortion of individuals' outlooks that may be perceived as derogatory or demeaning (Schlosberg, 2004).

• **Restorative justice:** in essence, restorative justice is injustice(s) caused by the energy sector should be rectified. Over the years, the concept of energy justice has been guided primarily by three primary tenets. However, recent scholarly works have shed light on a fourth tenet: restorative justice. This paradigm shift focuses on restoring the needs of victims such as nations, citizens, and the environment to their original state prior to activities within the energy sector (Hazrati and Heffron, 2021). The significance of restorative justice in the energy context is thus underscored by its potential to promote equitable and sustainable energy practices by reconciling the interests of various stakeholders involved.

• **Cosmopolitan justice:** It is in the context of critical minerals development that the association between cosmopolitan justice and its central tenet that all individuals are global citizens becomes apparent. The critical minerals industry is a global industry that underpins the production of numerous daily-use products; therefore, the impact of our actions has far-reaching global ramifications. Consequently, recognising the plural cross-border repercussions of our activities within the framework of global supply and business value chains is imperative. This acknowledgment underscores the need

for a comprehensive integration of cosmopolitan justice principles in the development of critical minerals, to ensure equitable and sustainable practices that advance everyone's interests without prejudice or bias (Heffron, 2021).

Contrary to popular belief and findings from previous research, energy systems are not confined to national boundaries but possess a global character and comprise a multifaceted network of actors and activities involved in the process of energy production and consumption beyond political borders and geographical locations. Nonetheless, the preoccupation of energy programs with national issues often causes them to overlook pertinent challenges such as the exploitation of forced labour in certain points of India's energy supply chain continuum. The 'just framework' identifies five fundamental justice components that are crucial for safeguarding human rights in the energy life cycle. To promote human rights more effectively, it may be useful to apply these principles across the entire supply chain of renewable energy technologies, from the mining of raw materials to the end-of-life disposal of products. This could involve creating a system of traceability and accountability to ensure that companies are upholding human rights standards at every stage of the production and consumption process.

According to Hefforn, energy justice constitutes 5 core life cycle energy activities, 5 forms of justice in the energy sector, viz., distributive justice, procedural justice, restorative justice, recognition justice, and cosmopolitan justice and human need protection of all human rights (Heffron, 2022). In other words, these include distributive justice, procedural justice, restorative justice, recognition justice, and cosmopolitan justice. Integrating these justice forms into the project life cycle of the energy industry, comprising planning, construction, operation, and decommissioning, can foster persistent social approval and attainment of energy justice goals. Energy companies have a critical responsibility to ensure these justice forms are implemented throughout their operational framework, to promote equitable and sustainable energy practices that address the interests of all stakeholder (Heffron, 2022). Heffron's energy justice circle as below best represents this framework.

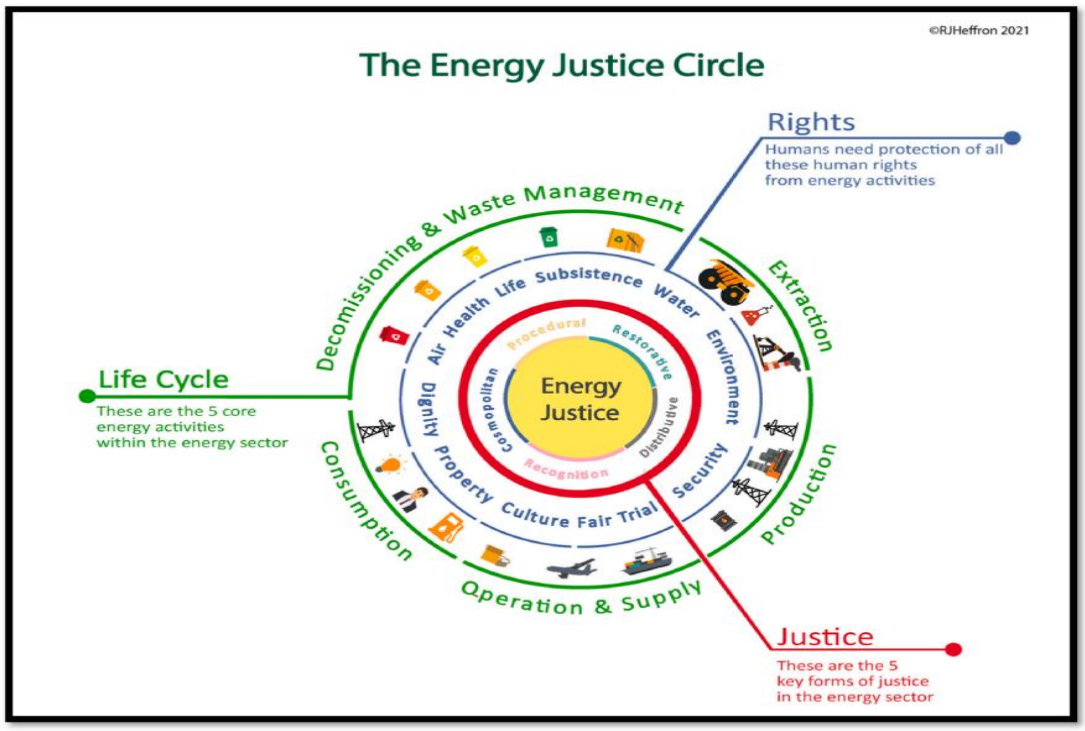

Figure (3a). Energy Justice Circle constituting 5 core life cycle energy activities.
Source: (Heffron, 2022).

In the light of the energy justice circle any injustice triggered by the energy sector must be addressed, including the decommissioning of harmful energy infrastructure. Furthermore, recognition justice must acknowledge the rights of local and/or indigenous groups or in other words, the tribes or *Aadivasis*. Finally, the cross-border renewable energy industry activities need to be recognised and addressed.

3.3.1 Establishing conceptual context using political economy dimensions of a developmental state in a neoliberal economy and processes to transition

It has become evident that the ever-increasing social, economic, and environmental crises we face are incompatible with global sustainable development. The environmental crises can be attributed in part to the artificial division created between society and nature, which enables the exploitation of nature as a key element in the accumulation of capital in the modern world. This binary has resulted in the degradation and destruction of natural resources and ecosystems, leading to a range of negative consequences including climate change, loss of biodiversity, and environmental pollution (Moore, 2015). In recognition of these complex sustainability issues, particularly climate change, the energy

transition has become the focal point of global conversation. While the bulk of these discussions promote the notion that transition, at most, is a movement from one energy equilibrium to another, there are a few exceptions. It is unclear what else is changing and how it is changing except the energy system. Nonetheless, it is evident from these discourses that a large, major transformation is now underway, while its ultimate results are quite unpredictable. Policy experts have characterised energy systems in a very narrow sense in terms of a change in fuel sources utilising a new technology, based on the experience of previous transitions (Laird, 2013). The use of such phrasing serves to minimize the potential for significant disruption associated with the energy transition. It is essential to acknowledge the profound and far-reaching impacts of this transition, including but not limited to economic, social, and environmental considerations.

Considered as a socio-energy system where human beings, their rights, and their well-being are central, contrary to energy as a product of neoliberal market exchange as 'an ethic in itself' able to guide all human action and replace all previously held ethical beliefs, such an exchange places a lot of importance on contractual relationships in the marketplace and holds that the social good will be maximised by maximising the reach and frequency of market transactions to bring all human action into the domain of market (Harvey, 2005). Harvey compares two perspectives on energy production and consumption, one of which places human beings, their rights, and their well-being at the centre of a socio-energy system; the other, which places the environment and its preservation at the centre of the system, explores the different philosophy and values entrenched in energy systems within the context of a discourse around energy policy, economics, or ethics. The second perspective sees energy as something that can be bought and sold on the neoliberal market that prioritises commercial contracts and the idea that all human behaviour should be subject to market forces. This contrast draws attention to the divergent values and beliefs that shape energy production and use, between those that prioritise human flourishing and those that prioritise profit maximisation via free market exchanges. The ethical consequences of reducing all human activity to market forces are also called into question here.

Social justice may not be realised if the society is not organised in a way that permit everyone to participate fully on terms of "parity" in social life (Fraser, 2011). There is an inherent contradiction between neoliberalism and social justice when the latter is understood as an overarching framework of justice with economic, political, cultural, and legal dimensions playing dominant role in a society. Society today is immersed in deeply unjust conditions of economic, political and status hierarchies, which are predominant forms of obstacles in "parity of participation" and hampering society's collective capability (Fraser, 2011). In the absence of parity of participation, the clear winner in economic affairs of a society is capitalism, which can justify linking personal gains to some larger objective of the common good as it may motivate individuals to engage in activities that benefit society (Chiapello and Elliot, 2018).

The unregulated use of natural resources by the West's three centuries of industrial growth has had negative impacts on the environment, political systems, economic development, and socio-cultural dynamics of human well-being around the world. The neoliberalisation in its wake has, however, brought 'creative destruction', of prior institutional frameworks and powers and state sovereignty, but also of social relations, welfare provisions, technological mixes, and attachments to the land and matters of emotional relevance (Harvey, 2005).

The neoliberalism as a theory of political economic practices proposes not only an institutional framework for strong private property rights, free markets, and free trade, but also a guarantee by state force if need for the optimal functioning and creation of new markets in areas, such as land, water, education, health care, social security, or environmental pollution. However, the hypocrisy of the neoliberals' stance on democracy is glaringly apparent in their notion that individual rights and basic liberties are at risk when the majority rules (Harvey, 2005). Neoliberals strongly favour expert and elite authority as they can better achieve their interests through executive orders and judicial decisions over democratic and legislative decision-making. This is exactly the case in the renewable energy sector too, which relies on state sponsored neoliberalism as a market ideology that upholds the norms

of the free market based on the classical liberal ideal of the natural harmony of the market. In addition, neoliberalism's ideal of unrestricted market has an optimal impact on resource allocation for maximising the economic gains of individual participants (Przeworski, 1992). Engaging with political economy helps us understand the discourses, institutions, and interests that shape energy transitions. It also helps us figure out who sets the terms of energy transition and how, whose interests are served as a result, and how power relations within and outside of the state affect the choice of one energy path over another (Power et al., 2016). This is all the truer for the concept of justice pertaining to the renewable energy has always remained confined to the geographical boundaries of a country that calls for extension of the concept of the supply chain as a source-to-sink concept.

Such an analysis of the transnational spaces of transition calls for greater attention to questions of geopolitics, diplomacy, and state interest in the broader scheme of international relations. But at the same time, it also helps to situate, and contextualise the macro focus of global political economy on the broader landscape of power and the 'Foucauldian' idea of "governmentalities" pertaining to certain modes of neoliberal governance based on power relations (Steger and Roy, 2010). Neoliberal modes of governance also promote institutional and individual conformity to market standards in addition to restricting the authority of the state via the use of individual freedoms and rights (Larner, 2000).

Much of research on energy transitions ignores relations of power structures, and when it does, it invokes neoclassical economic interpretations (Newell, 2019). Energy transition is deeply political. Although, politics is a critical component in the transitions approach, it is often obliterated from much of the existing analysis of transitions and energy justice literature (Meadowcroft, 2005, 2009b; Baker, Newell and Phillips, 2014).

Decarbonisation is generally aligned with wider social objectives like enhancing societal welfare, and lowering socio-spatial inequities, the power of influence and narrative framing. In such narrative framing the state plays an important role to protect productive capital by deploying discourses of accommodation around green growth and climate-compatible development (Newell, 2019). Gramsci

refers to such transformation as ‘trasformismo’ as the latter protects existing structures of power from the increasing threats of credibility and profitability which climate change presents. These alignment efforts are important because they allow for the consideration of the energy transition within the framework of a political economy that may be embedded in a geographical space. In this context, maximum emphasis should be placed on the political blind spots in the socio-technical approaches to energy transition, which often ignore the plural, messy and contested nature of transition processes (Avelino et al., 2016; Newell, 2019). Smith and Stirling (2010) have argued that it is important to ask the questions like who governs, whose system framings count, and whose sustainability gets prioritized (Smith and Stirling, 2010).

The global political economy of energy is shaped by interests of elites and the powerful, which often comes into conflict with the energy requirements and environmental vulnerabilities of the poor (Newell and Mulvaney, 2013a). Therefore, changes to energy regimes must address power disparities and inequities across the whole of socio-energy economic systems. These are justice concerns of energy transition that must be considered. In general, the energy companies have succeeded in monopolising the structural power over state functionaries and gained the ability to convince them of their ability to stimulate the economy (Newell and Paterson, 2010). From this viewpoint, the capitalist narrative establishes that transition to a low-carbon economy can only be achieved by serving the interests of capital and the state buys into this capitalist manoeuvring. The state in such a scenario undertakes low-carbon energy pathway by aligning with broader social and developmental goals, where emphasis is on a broader social compact (Newell and Mulvaney, 2013a).

The Indian approach to renewable energy development, akin to that of China and Brazil, entails a proactive industrial policy closely aligned with nationally determined developmental objectives. Such an approach is underpinned by a broad social compact, reflective of the spirit of a developmental state (Leftwich, 2000). By balancing the interests of the individual with national developmental goals, the Indian model seeks to achieve a sustainable energy system that supports economic growth and

development. In this context, the location of existing energy policy processes has shifted from power plant siting and planning decisions to the site of energy legislation. This has limited public participation and engagement in energy transition. This is a reconfiguration of ‘transition arenas’ from more open spaces of dialogue and deliberation to formal spaces of legislative power concentration (Healy and Barry, 2017).

The neoliberal mode of profit-making is through the privatisation of public resources. Assigning private property rights is proposed as a safeguard against the 'tragedy of the commons,' the phenomenon whereby humans overexploit shared resources like land and water (Harvey, 2005). This is the rationale behind neoliberalism's unending pursuit of wealth and power via the exploitation of commons resources. In other words, the state-controlled or regulated industries, in effect, need to be deregulated, or set free from government oversight, so that they may flourish in the private sector.

An integrated framework that encompasses multiple frameworks and diverse strands scholarships to better understand how politics and economic interest secure and negotiate outcomes in a particular socio-economic set up, while propagating deepening of neoliberal values across the state’s functionalities.

This framework serves to link energy, justice, human welfare, and the capability to fully consider when designing and planning energy transformation within the realm of energy and justice, as a social objective to be achieved. In accordance with Moore's (2015) conceptualisation of the "double internality", the complex interdependency between capitalism and nature allows for a continuous exchange of influences upon one another (Moore, 2015). As such, the interdependent coexistence of these two systems characterises a mutually reinforcing feedback loop that cannot be accurately perceived through an isolated analysis of either. The economy and the environment are inextricably intertwined. Capitalism is neither an economic nor a social system; rather it is a way of organising nature. The perception of nature as external is a fundamental prerequisite for wealth accumulation. This has become even more critical in the 21st century marked by a ‘convergence of triple crises’ of

food, energy, and finance. The underlying presumption of capitalism is that it is free to exploit nature in any way it sees fit, that nature is an external factor that can be classified, quantified, and rationalised to advance economic growth, social progress, or some other kind of greater good (Moore, 2015).

In a reconfigured energy policy, goals and objectives are very clearly defined. In the light of objectives of energy apparently at variance with the socio-energy systems design (S-ESD) framework, the latter in no way reduces the significance of the earlier. Adoption of S-ESD framework, in fact, is an acknowledgement of the need to factor in social changes and associated risks, such as social alienation and civic protest arising out of energy transitions (Miller, Richter and O'Leary, 2015).

The political economy framework of a developmental state in a neoliberal economy energy transition is useful in stimulating the growth of green energy, promoting energy security, reducing greenhouse gas emissions, and promoting social justice in the renewable energy sector. The political economy framework sheds light on the processes to energy transition that may face resistance from powerful interests in the fossil fuel industry, who may use their political and economic influence to undermine renewable energy initiatives. Additionally, the framework may become challenging to implement in countries with weak institutions and an inadequate regulatory environment, which is not the case in India.

3.3.2 Establishing conceptual context using political ecology dimensions and processes to transition

The existing energy transition models have inherent biases and shortcomings, such as who gains or losses from initiatives to decrease greenhouse gas emissions; who has the authority to drive or halt these transitions? Political ecology as framework serves well to explore the social, economic, and political imbalances associated with energy projects and access to resources. To analyse these issues, especially in the light of social and political power dynamics, political ecology offers a valuable framework.

Political ecology endeavours to look at decisions and changes to the human-environment interface considering the costs and benefits for key actors and institutions and how they together steer resource

utilisation. While political ecology framework in its effort to unearth uneven power dynamics entrenched in natural resource access highlights power dynamics across formal, informal, and extra-legal processes, the same is neglected in other theories (Andrews and McCarthy, 2014; Bedi, 2022). Among others, political ecology is one such well-positioned framework to lead critical research in favour of energy justice (Newell and Mulvaney, 2013c). The need for political ecological critique and engagement around such trajectories becomes even more pressing as renewable energy becomes a priority for both private capital and governments, resulting in strong and manifest preferences for forms of renewable energy development that are most conducive to new accumulation. In this context, political ecology framework is ideally positioned to critique a transition to renewable energy.

This approach appeals for more fairness and democracy in conceiving and constructing renewable energy forms, infrastructures, and production geographies are gaining traction in many parts of the world, mainly because of socially unequal and geographically uneven distribution of gains and losses related to economic activities materialised under capitalist system of production (Temper, Daniela and Joan, 2015). However, this is not limited to unjust burdens of externalities alone but extends to include uneven access to natural resources. Further, it is argued that the neoliberal institutions have reshaped global capitalist dynamics with serious repercussion on the environmental conflicts (Martinez-Alier and OÇonnor, 1996).

In essence, the neoliberal approach to nature, sustainability, and the private property rights are in line with privatisation, enclosure of common assets, and commodification of nature (Heynen and Robbins, 2005). Renewable energy projects are land-intensive, often capturing major rents for landowners in the process (Hughes, 2021), so much so that as these projects scale up and develop into mass production geographies and become dramatically cheaper eventually (Knuth et al., 2022). Critical political ecology scholarship is important to maintain a focus on renewable energy transition's potential for both good and bad in the context of socioecological necessity of decarbonizing energy systems and resistance to unjust, maladaptive versions of those transitions. In a similar vein, Robins

credits political ecology for it is endowed with a dual mandate of critique and reimagination (Robbins, 2011). Therefore, it is both a ground for critiquing and creativity. Usually, most academic endeavours in most fields are about observation, assimilation of information and then critiquing, but political ecology furthers our understanding of complex, mercurial terrains of energy politics and power relations on the ground. It is the political ecology lens that helps navigate the subtle nuances of social processes and power relations to help in decision-making and implementation of new renewable energy technology and infrastructure.

It is often the case that the dominant narrative for the energy transition is marshalled by very powerful elite actors, such as scientists, companies, and policymakers, who are spatially and emotionally far separated from those suffering from the negative externalities of the energy infrastructure (Lawhon and Murphy, 2012). Political ecology is well positioned to lead critical and engaged scholarship in support of a more just renewable energy transition. As contributions here demonstrate, calls for greater justice and democracy in conceptualizing and developing renewable energy forms, infrastructures and production geographies are gaining strength in many places worldwide.

In conclusion, the existing energy transition models have shortcomings that need to be addressed, with a focus on who benefits or loses from greenhouse gas emissions reduction initiatives and who drives the energy transition. Political ecology framework offers a valuable lens for exploring social, economic, and political imbalances associated with energy projects, resource access, and distribution of gains and losses. This framework is well positioned to lead critical research in support of energy justice, especially in a context where renewable energy is becoming a priority for private capital and governments. It allows a focus on the subtle nuances of social processes and power relations to navigate decision-making and implementation of new renewable energy technology and infrastructure. With calls for greater justice and democracy in developing renewable energy forms and infrastructure gaining momentum worldwide, political ecology can lead critical and engaged scholarship to support a more just renewable energy transition.

Usefulness and shortcomings: While the application of political ecology framework to energy transition is useful in promoting social and environmental justice, recognising the interdependence of ecological, social, and economic aspects of energy transition, and engaging with communities that may be adversely affected by renewable energy projects, it may lack a clear roadmap for transitioning to renewable energy and addressing the inherent conflicts that arise from competing resource demands. It may also require a considerable amount of time to build consensus among the diverse stakeholders involved in energy transition.

3.3.3 Establishing conceptual context using socio-energy systems design framework

To organise energy transition, policy analyses and decisions that have substantial scope for the complex human and social dimensions of energy, adopting the concept of socio-energy systems as a design framework is important. A conventional approach to energy does not provide social implications of energy transition and as such leaves untouched the issues of income distribution, unemployment in industries affected by transition, and the loss of land-use by communities etc.

In a basic sense, the socio-energy systems design framework is a set of interlinked 'arrangements and assemblages' of man and machine as part of the production, distribution, and consumption of energy, in their supply chains, as well as in the lifecycles of their technologies and organisations. However, it has been recognised that linkages and interconnectedness in socio-energy systems may manifest entirely through social dynamics and during this process of manifestation, socio-energy systems dynamically influence and get influenced by the larger social, cultural, and political systemic structures in which they are entrenched (Mitchell, 2011; Miller, Richter and O'Leary, 2015). It is most often the case that the inherent dynamism and complexity of social worlds and associated institutions that energy policy acts upon, particularly in large-scale centralised energy transitions.

This research integrates the relationship between energy, justice, human wellbeing, and resources appropriation to factor in fully into the design and planning of energy change. Energy systems are much more than assortments of fuels and technologies. Energy transitions raise important but often

neglected questions of ethics and justice, especially in large-scale transformations of energy systems. A more all-encompassing strategy with public involvement in policy debates and the design, implementation, and evaluation of energy projects would make them more acceptable and ethical. Activities associated with energy transition, including but not limited to greening of energy production, smart grids, use of electric and hybrid-electric vehicles, and the invention of unconventional oil and gas have the potential to influence not only energy production and delivery but also the social, economic, and political organisation of the energy sector as well as its impact on the larger society (Miller, 2014).

This transition may even impact the very fabric of society through which it organises itself around collective values, behaviours, relationships, and institutions. Rooted in this notion of energy, there is a growing awareness of the connections between energy and social justice. Miller, Richter and O'Leary (2015) have proposed a new framework that encourages energy policy organisations to embrace a comprehensive and wide conceptual framework that more effectively includes social factors into energy analysis and decision-making (Miller, Richter and O'Leary, 2015).

A socio-energy system perspective illuminates key facets of the energy transition that are overlooked by traditional analytical methods that just concentrate on the technology involved. From this vantage point, we can learn more about the social processes that drive and direct the energy transition through the decisions and actions of the social agents, viz., business leaders, policymakers, consumers, etc., who are part of it. We can also learn more about the social changes that accompany shifts in energy technologies, which in turn reshape social practices, values, relationships, and institutions, as well as the social outcomes that result from these transformations.

The ideas of socio-technical systems have been used to construct a more refined framework, the socio-energy systems design framework, which considers human factors. It is hoped that by adopting this framework, energy policy would no longer be framed so narrowly in terms of technology, cost, and environmental concerns but rather in a way that allows for the conceptualisation and construction of a

variety of social arrangements. Numerous attempts have been made to explain past energy sector trends using socio-technical system theories (Hirsh and Jones, 2014).

Although, the socio-energy systems design (S-ESD) framework is built on the socio-technical systems framework, it differs in one major respect, and that is, it is a progressive and forward-looking design approach that can provide alternative tools for policymakers to view energy policy choices more broadly by enlarging the range of analyses and presenting an alternative face of energy policy and how it impacts individuals, families, and communities. In other words, it serves to interconnect and integrate social, economic, and political dynamics in the design and operation of technological systems (Miller, Richter and O'Leary, 2015).

Energy, in all its manifestations, has a profound effect on civilisation. Society, the economy, and political life, and organisation are all interconnected because of the role that energy plays in each. Any major transition to a new technology of energy generation is nearly always accompanied by socio-economic and political developments with far-reaching effects on everything that lives or sustains life on Earth. Energy infrastructure like any other infrastructure is an ensemble of well-functioning systems and services that are typically hidden from public view yet highly significant in structuring social, political, and economic organization for many decades to come. Its durability means that it can influence socio-political and economic development of a society for a long time (Edwards et al., 2009). Until recently, except for parts of Europe, the social science study of energy had little to no impact on the formulation of energy policy. The human and social components of energy have been largely excluded from normal energy policy studies and choices. However, this has begun to change as the social and human components of energy have taken on a greater role in gaining public support for energy.

Another distinct advantage of S-ESD framework is it can unfold a large spectrum of possible social objectives which transition policies could potentially achieve, such as bridging rising income inequality confronting most nations (Chin and Culotta, 2014). Energy policy, therefore, should have

an explicit target of socio-economic inequality reduction, and rightly so because of the very nature of energy technologies being embeddedness in complex socioeconomic arrangements. While equality has always been the regulators' central guiding principle in the design of electrical facilities, they need to recontextualize and factor in equality in the emerging energy transitions the world over, and more so in the Global South.

The S-ESD framework offers the possibility of more sophisticated treatment of social goals within energy policy. For example, the economic argument advanced in favour of job creation in renewable energy sector, according to S-ESD framework, is a relatively poor proxy for the deeper goals that communities ultimately care about, such as health, stability, and wellbeing (Eames and Hunt, 2013; Miller, Richter and O'Leary, 2015). Questions are also raised over the nature of jobs, who secures them and for how long how they can be measured and analysed through a reformulated and reframed energy policy in alignment with socio-energy systems design (S-SED) framework. A socio-energy system approach allows identification of factors that are often overlooked by other analytical approaches that concentrate primarily on the technical aspects.

Miller, Iles, and Jones (213) have argued that energy transitions when considered in terms of socio-energy systems, change in use of fuel and technology is quite a narrow and less diagnostic of energy transitions (Miller, Iles and Jones, 2013). Replacing a coal-fired power plant with a gas or nuclear-fired or even with solar or wind may have huge impact on carbon emissions, but little to negligible impact on the overall energy regime. Replacing a coal-fired power plant with a gas or nuclear-fired or even with solar or wind may lead to huge carbon emission reductions without necessarily producing any changes in the fundamentals of an energy regime which may continue to be centralised with mass distribution networks. The centralised electrical utility operating as a regulated monopoly energy producer and distributor remains unchanged post-transition.

It is important to raise questions on how different the current large-centralised electricity plants connected to the end consumer through a vast network of transmission and distribution lines are to

large-centralised solar energy systems without a widely distributed generation with correspondingly different social implications in the ways energy impacts human life (Laird, 2013).Large-scale changes to an energy system in the current transition is largely confined to changes in fuels and technologies and not in the nature of distribution networks or the centralised character of the renewable energy systems. Understood in this sense, it defeats the purpose of social outcomes envisioned in energy transition. Technological systems, in addition to devices and machines (Bijker et al., 2012) argue contain organisations and laws, which interact in diverse and complex ways often producing unintended outcomes with lasting impacts across the society.

The current centralisation and concentration of energy production in fewer hands is the opposite of what renewable energy transition ideally hoped to achieve through a decentralised production system, unfortunately hardly ever visible in most parts of the world. Apart from the possibility of distributed and democratic power, the renewable energy regime is substantially different from the fossil fuel based one as the changes in energy technology have the effect of reshaping social practices, values, relationships, and quite importantly institutions. These changes include the development of new economic models, modes of work, and ways of knowing and living. These shifts, when compounded over time, have the potential to contribute to the genesis of or to the reinforcement of unequal power and wealth distributions in industrial societies.

The current energy transitions are not only changing technologies and economics of energy but also the way we produce, distribute, and consume energy and how this change changes social and political organisation. Most major forms of energy technology have confronted and catalysed considerable socio-political resistance and controversies around the globe. These conflicts over energy transitions, however, can be minimised by reimagining and reconceiving energy in social terms. (Abramsky, 2010; Miller, Iles and Jones, 2013). The socio-energy systems design framework does just that by reframing energy in terms of a social system so much so that it encapsulates not only how energy is produced, distributed, and consumed but what energy production and consumption means for the diverse

stakeholder groups and communities who inhabit energy systems (Miller, Richter and O'Leary, 2015). The recognition of social dimensions of energy systems and the embeddedness of human affairs in the energy systems is key to the conception of energy as a socio-energy system. A major difference between the traditional energy policy and the socio-energy systems framework is that while the former considers the human and social dimensions of energy to be externalities, the latter internalises these factors (Miller, Richter and O'Leary, 2015).

In brief, the framework can be summarised as an integrated socio-energy systems design framework and the political ecology framework. The socio-energy systems design framework emphasizes the importance of considering the complex human and social dimensions of energy in policy analysis and decision-making. It recognizes the interlinked arrangements and assemblages of man and machine involved in the production, distribution, and consumption of energy, as well as the social dynamics and interconnectedness that manifest during this process. The framework also highlights the need for a more all-encompassing strategy with public involvement in policy debates and the design, implementation, and evaluation of energy projects to make them more acceptable and ethical. The political ecology framework, on the other hand, serves well to explore the social, economic, and political imbalances associated with energy projects and access to resources. It looks at decisions and changes to the human-environment interface considering the costs and benefits for key actors and institutions and how they together steer resource utilization. Political ecology framework is ideally positioned to critique a transition to renewable energy and appeals for more fairness and democracy in conceiving and constructing renewable energy forms, infrastructures, and production geographies. It is both a ground for critiquing and creativity.

Usefulness and shortcomings: The socio-energy systems design framework is useful in fostering innovation, ensuring energy justice, and addressing systemic barriers to energy transition. It recognises the importance of co-creation and collaboration, which enhances ownership and sustainability of renewable energy initiatives. However, the socio-energy systems design framework may not address

the economic and political barriers that may hinder the implementation of renewable energy initiatives, such as fossil fuel subsidies and political power relations.

3.4 Research design, data collection and research methods

While primary data collection is widely acknowledged as the preferred method for data collection, the importance of secondary data in providing context and background information on a research topic cannot be understated, particularly under circumstances when the collection of primary data is not feasible. Through comprehensive and rigorous analysis of secondary data sources, researchers can gain invaluable insights into complex issues, and develop more comprehensive and nuanced analyses that are grounded in historical and social context. Overall, the use of secondary data is an essential tool for contemporary research, and one that should be considered a fundamental aspect of any robust and academically sound research methodology.

The current study has adopted qualitative methods approach to evaluate the justice implications of energy transition in India. The research methodology adopted in this study has involved the collection of secondary data from multiple published sources. These sources include but are not limited to academic journals, books, research reports, and newspapers, which have been obtained from a variety of sources available in the public domain. These sources include online repositories such as websites, databases, and online archives, as well as government and commercial publications and portals. The secondary data obtained from these diverse sources have emerged as a veritable goldmine of invaluable information and knowledge, which has been instrumental in informing the conceptual framework and analytical approach of this study. The use of secondary data has allowed for the exploration of a wide range of perspectives and viewpoints on the topic under investigation, thus enabling a thorough and comprehensive understanding of the subject matter in question.

Through the rigorous and systematic collection of secondary data from these sources, this study has been able to effectively triangulate and cross-validate the information obtained, thereby ensuring the reliability and validity of the findings. By leveraging the rich and diverse sources of secondary data

available, this study has been able to yield novel insights and in-depth analyses. Overall, this approach has enabled the study to derive reliable, valid, and robust conclusions, which can inform future scholarship and policymaking in the renewable energy justice field.

3.4.1 Data analysis methods

This study employs a suite of diverse and complementary data analysis methods, including content analysis, spatial analysis, and meta-analysis. Each of these methodologies has a distinct set of strengths and weaknesses, and by utilizing multiple approaches, the study can gain a more comprehensive and nuanced understanding of the complex relationships between energy transition and social justice associated with these transitions. Content analysis, for example, has emerged as particularly germane to the study, offering a powerful research method for analysing textual, visual, and graphical data related to energy transition and social justice. Undoubtedly, content analysis is an incredibly powerful, highly flexible, and adaptable research method for understanding complex issues related to the energy transition and social justice. Its ability to offer a systematic and quantitative analysis of textual, visual, and graphical data has helped to identify key areas of concern in this research whose results can be used to develop informed policy and analytical frameworks that can help shape the transition to a more just and equitable energy system. In conclusion, the use of content analysis in this study reflects a rigorous and comprehensive approach to data analysis that recognizes the essential importance of a robust theoretical and methodological framework.

Another research method employed in this research is spatial analysis, which involves analysing data in relation to geographic locations, land use patterns, and the effects of environmental factors on health outcomes etc. The application of spatial analysis method in two chapters of this research has yielded significant advantage and contributed to the accuracy and comprehensiveness of the results produced. By leveraging pre-installation and post-installation satellite imagery, I have been able to assess whether solar projects were constructed on fertile lands capable of supporting healthy crop growth, as well as to analyse patterns and trends related to the establishment of forced labour camps intended for

Uyghur Muslims in the Xinjiang province of China. The application of spatial analysis methods has resulted in significant insights and outcomes in comprehending the intricate connection between the energy transition and its social justice implications. This has proven to be a valuable analysis too in arriving at verifiable outcomes in the current research.

The application of spatial analysis techniques has produced valuable insights and outcomes of considerable significance for a comprehensive understanding of direct relationship between energy transition and social justice implications. Overall, meta-analysis has the potential to contribute significantly to furthering our understanding of renewable energy transition and social justice. By synthesising and evaluating data from multiple studies, meta-analysis can help illuminate the complexity of these issues and identify opportunities for future study and further policy development. Therefore, meta-analysis can be a valuable tool in identifying commonalities and validating results related to energy transition and social justice. By leveraging diverse and complementary methods such as content analysis, spatial analysis, and meta-analysis, this study can offer a thorough and nuanced analysis of the complex issues at the heart of the relationship between energy transition and social justice.

3.4.2 Research methodological limitations

The present study has been undertaken during the unprecedented and challenging Covid-19 period, which has presented significant obstacles to outdoor activities, social interactions, and international travel. Consequently, the prospect of conducting field research in India has been severely curtailed, rendering it an unfeasible option. The pandemic has severely disrupted all spheres of life and as a result, I had to rely primarily on secondary data sources, which have proven to be an invaluable source of critical insights and information. The use of secondary data has enabled me to overcome the limitations imposed by the pandemic and to undertake a comprehensive and robust analysis of the topic under investigation. Furthermore, the use of secondary data has facilitated a rigorous examination of the literature, thus enriching the study with multiple perspectives and viewpoints on the subject

matter under study. Through an intensive and systematic review of secondary data, I have been able to gain significant insight into the research questions and draw meaningful conclusions.

In conclusion, the unavoidable constraints imposed by the Covid-19 pandemic have necessitated the reliance on secondary data sources instead of the primary sources. Despite the limitations imposed, this methodology has proven to be a highly effective means of collecting information and has enabled me to draw robust and reliable conclusions.

Conclusion

This present chapter encapsulates the fundamental research methodology and analytical frameworks employed in this study. The study's primary objective is to unravel the intricate causal relationship that may exist between the transition to renewable energy sources and the consequential social justice implications that may arise as a result. To achieve this research aim, a rigorous and systematic approach was undertaken, incorporating a variety of research methods, mainly qualitative. The research design adopted in this study is fundamentally grounded on a positivist research paradigm, utilising an explanatory research strategy that aims to explore the possible causal mechanisms that may underlie the complex interactions between renewable energy and social justice outcomes.

Furthermore, the research that underlies this chapter was guided by a comprehensive theoretical framework that integrates insights from interdisciplinary fields such as sustainability, renewable energy, social justice using ‘triumvirate of tenets’ and ‘just framework’, political economy, political ecology, socio-energy systems design framework, and environmental policy. This has provided a robust foundation for analysing the dynamic interactions between renewable energy and social justice, providing a comprehensive understanding of the research phenomenon.

4. Anatomy of India's Energy

Introduction

This chapter is a detailed historical account of India's electricity dating back to the pre-independence (1947) era. It covers the history of India's electricity and electricity policies and how electricity came to be conceived as the sole means of nation building and development in India's development discourse amongst the policy pundits and the government, and how power generation became a major development plank for the government under the combined responsibility of both the state and central government agencies. This chapter takes the reader through historical transformation embodied in electricity from being a symbol of the benefits of an independent nation at the heart of the grand project of national development to electricity invoking grand narratives of promoting economic growth, securing energy supply, and more recently transitioning to more environmentally sustainable energy systems in which the fate of the nation is closely tied to infrastructural development.

The knowledge of electricity dates back to ancient times its power, however, has only been harnessed for less than three hundred years, coinciding with the beginning of the industrial revolution in the United Kingdom. Electricity like colonialism reached India to deepen the exploitation of the land and people to fuel industrial revolution back home in England. India, the major trading hub, and the most valuable colony for the Empire was amongst the first countries to have electricity introduced by the British during colonial period. From a few light bulbs in the city of Calcutta in 1879 to Leisang, the last of India's 600,000 plus villages to be electrified in 2018, the journey of India's electricity has been rough, bumpy road of power, politics, and poverty (D'Cunha, 2018). This is an epic story of access and denial, dynamism and apathy, power, and politics and much more in between. The history of Indian electricity starts with P.W. Fleury & Company's first demonstration of electric lights in Calcutta on July 24, 1879 (Das, 2009).

The next major development was the first electric supply station constructed in Surat in the current state of Gujarat in 1883 to light the main streets of the city by arc lamps. This was followed by the Calcutta Electric Lighting Act of 1998 (Mukherjee, 2017). The early power generating stations in India were British owned private companies with hydro-electric generation catering to urban areas, mostly major cities, office centres and ports, whereas electrification of the villages was done after 1947 (Madan, Manimuthu and Thiruvengadam, 2007). During the 'long walk to freedom' in 1947 and beyond India aspired for electricity as an emancipatory force for achieving human development, but the access was illusive to many until very recently.

At the time of independence, the country had a power generating capacity of 1,362 MW generated by privately owned hydro and coal based thermal power projects (History of Indian Power Sector, no date). The first thermal power plant commissioned by the Calcutta Electric Supply Corporation Limited in Calcutta in April 1899 (CESC, no date), which is still in use heralded the beginning of thermal power generation in India and with that the beginning of electricity related carbon emissions. The first government installation was Kateri hydro-electric power station in Aruvankadu, Nilgiris in Tamil Nadu in 1902 (Conoor in Tamil Nadu, no date). After independence in 1947, the Indian state faced the challenge of huge capital investment in the electricity. The first landmark legislation after independence was the 1948 Electricity Supply Act which stipulated that all generation, transmission and distribution facilities would be within the state's purview (The Government of India, 1948). This led to the establishment of government-controlled public-sector electricity boards with vertically integrated power sectors consisting of generation, transmission, and distribution.

The power sector was a state-controlled enterprise from its early days of growth in the 1940s to the late 1990s, when privatisation began in tandem with the rest of the Indian economy. The Indian energy sector policy has developed through some pivotal junctures in time, dealing with challenging problems and coming up with multifaceted solutions (Bardhan, Debnath and Jana, 2020). These pivotal junctures have also been accompanied with the prevalence of one or more energy justice elements in overall

policymaking. Based on what lay in the soul of its policy, the chronology of India's energy development can be separated into three major time periods, i.e., 1947-1998, 1998- 2014 or call it the end of Congress era, post-2014 era that marks the start of Prime Minister Modi's sustainable development agenda.

4.1 The initial development stage of the sector - the first five decades (1948-1991)

After independence in 1947, power generation became a major development plank for the government under the combined responsibility of both the state and central government agencies since the constitution of India defines the sector as a "concurrent subject". For the first couple of decades following independence, making electricity available to the maximum possible citizens has dominated Indian energy policy, even while the global conversation on sustainability had begun to take form. It was not until the start of the century that sustainability became part of the availability driven energy policy in India. For a major part of post-independence period energy supply has been at the centre of India's developmental goal (Khosla and Navroz, 2020). As a result, the availability agenda dominated in the first 40 years following independence in 1947, with efforts concentrated on assuring energy supply and security. The need to secure energy supplies and develop sovereign energy sources increased because of the global oil shock of the 1970s and the poor performance of the private companies. This led to a change from a largely privately owned energy sector to one that was almost entirely under state dominance (Bardhan, Debnath and Jana, 2020).

The Indian electricity sector, primarily a publicly owned vertically integrated monopolistic structure for a major part of the 20th century came to reflect the philosophy of the state led Nehruvian economic policy model. This vision of treating electricity as a prime vehicle of growth also reflects in the 1948 electricity legislation, which emphasised primacy of public ownership (Kale, 2004). Electricity is a major political issue in India. "Bijli-sadak-pani", meaning electricity-roads-water is often an attractive election campaigns slogan for political parties during most general elections since first election in 1951-52. Electricity is a politically sensitive and economically critical area entwined with India's

political economy, the reason why the passage in 1948 of the Electricity Act was one of the first acts in the newly independent India. The act has been recognised in India's policy space as one of critical importance for the country's development.

Development of a mature, efficient, and dynamic power sector is the key to the economic development of a country. And to achieve this, national imaginaries are created around energy infrastructures as vital national projects for nation's future (Bridge, Özkaynak and Turhan, 2018). India's electricity sector has evolved over the years in a hugely path-dependent manner, deeply associated with regional evolution of politics, and its roots in pre-independent India. Electricity sector in the post-independence India operated primarily as a vertically integrated publicly owned inefficient monopolistic structure with weak foundations for the national development. The foundation of India's industrial development was laid by the Industrial Policy Resolution of 1956 which envisaged the generation of power almost exclusively in the public sector. This resolution together with the Electricity (Supply) Act, 1948 provided an elaborate institutional framework and financing structure of the electricity industry.

The provision of electricity to its citizens was not only among the most powerful symbols of the benefits of an independent nation but also central to the grand project of national development for a newly independent country (Dubash, Swain and Bhatia, 2019). Justification of large-scale projects such as electricity as a matter of fact are justified by invoking grand narratives of promoting economic growth, securing energy supply, and more recently transitioning to more environmentally sustainable energy systems in which the fate of the nation is closely tied to infrastructural development (Bridge, Özkaynak and Turhan, 2018).

The electricity sector had enjoyed wide ranging government protection until 1991. The Indian Electricity (Supply) Act, 1948 which had governed the sector for more than four decades was amended to pave the way for the formation of private electricity generating companies. A variety of competitive market forms of transactions have increasingly replaced the regulated regime of 1948 (Sarangi, Mishra and Farhad, 2019). The electricity policy making in the country has been marred with inconsistencies,

short-sightedness and ad-hocism. Electricity sector policies changed little until the foreign exchange crisis of 1991 which brought a new focus to the power sector's deteriorating state. However, several patchy and sporadic efforts were made in the past for course correction and removal of the prevailing distortions, but none of them were able to generate the much-needed change. The 1991 Act simplified the legal and administrative frameworks and procedures for faster clearances of projects. The policy of liberalisation the Government of India announced in 1991 and consequent amendments in Electricity (Supply) Act have opened new vistas to involve private efforts and investments in electricity industry. The Act also paved the way for a new financial ecosystem streamlining investment and permitting 100% equity in the sector.

4.1.1 The challenges before India's electricity sector

By the 1990s, the energy sector in India took a turn to fall in line with the government's overall policy of growth, efficiency and cut back on subsidies. It was about time to put an end to the misgovernance in the sector, particularly in the form of opaque subsidies and corrupt behaviour (Dubash, 2011). Connecting the Indian economy with the global market as part of a larger economic agenda resulted in efforts to attract private investment, which in turn led to the liberalisation of the energy industry. Despite these efforts, privatisation was incapable of lessening the negative effects of poor governance, previous subsidies, backward infrastructure, and a lack of transparency. This required a well-framed and powerful state role for energy (Dubash, 2011).

Over the years, the state-owned vertically integrated electricity system riddled with systemic malaise and financial mismanagement had proven to be unsustainable (Reddy, 2002). The power sector of India has undergone a transformative change in its organisational forms and functioning since 1991. The electricity sector has been at the center of conflicting interests between economic growth, climate change and human development on one hand, and contemporary capital accumulation, state power and technology on the other. These interests are aligned in different ways depending on the priorities of the state. The post-reform era is marked by reconfigured forms of regulatory agencies, corporatised

state-owned enterprises, and public-private arrangements welded onto the older system in the name of institutional change and reforms.

The form of state operation that has emerged because of the state-business collaboration and prioritisation of rapid economic growth is distinct both from a market-oriented liberal model and from India's old state-controlled model. However, these state-market hybrids emerged in an ad-hoc manner are distinctively dysfunctional as they don't provide a functional alternative to the old model. The sector, as a result, continues to stymie the development impetus it could otherwise has the potential to provide an unhindered growth of the economy. The power sector, due to a high degree of political interference and pre-existing liabilities, has continued to be functioning as an amalgamation of old statist institution and the new which impedes, in a large measure, the scope, speed and a true character of reforms. All this has created is a dysfunctional state-market hybrid system, in which the state remains both indispensable and fragmented.

Electricity in India has always been a tool of political appeasement to a vast section of electoral clientele in India. This may lead to an assumption that electricity must be delinked from the political influence to better serve the interest of the people. On the contrary, far from de-politicising the sector, reforms must be cognizant of the fact that the electoral and electricity politics are intertwined and hence necessitating careful engagement with politics. Electricity is an inalienably integral part of Indian electoral politics. Lofty promises of free electricity and subsidies to farmers are part and parcel of electoral campaign in most states. Post-1991 Indian economy marked by sweeping reforms across sectors including market-based reforms and technocratic governance in the electricity sector have sought to delink electricity from politics. Yet, the intractable relationship between the two has stubbornly persisted. (Dubash, Swain and Bhatia, 2019).

The 25 July 1991, Industrial Policy Statement (IPS) of the Government of India for liberalisation of industrial licensing, and exemption of power generation and distribution from the list of industries hitherto reserved for the public sector under the Industrial Policy Resolution 1956 heralded a new era

for the country's economic development. The IPS has introduced comprehensive changes in economic regulation of the country. Private sector was welcomed in major industries previously reserved for the public sector. In the same vein, foreign investment was welcomed.

Ending the practice of industrial licensing represented by red tapism has been the most important reform measure under the new industrial policy (Jose, 2016). There was another milestone that transformed India's power sector, the Electricity Regulatory Commissions Act 1998 which together with the Industrial Policy Statement 1991 promoted a range of reforms, including simplification of licensing process, opening the door for private investment in power sector, facilitating the entry of private generators, introduction of autonomous regulation under the aegis of central and state regulatory commissions, and unbundling of the electricity supply chain to promote competition (Government of India, 1998; Ahluwalia, 2021).

These reforms spanning a period of 30 years now are credited with 46% of private generation of the total utility capacity, an achievement that demonstrates how far India has journeyed from extreme deficit to current surplus. However, 55% of the installed generation capacity is on account of coal (Ahluwalia, 2021). The Indian economy given its size and an impressive growth in the last two decades requires a healthy electricity sector that can meet the increased demands in an environmentally sustainable way.

The sector in its current form is far from being a healthy thriving modern sector it aspires to become since it can neither meet the consumers' demand of a reliable universal 24x7 supplier of electricity nor its finances are in a good health, and most problematic of all is the underutilised capacities. The sector, far from being a harbinger of growth, is rotting in inefficiencies and dragging the economic growth of the country because of its poor finances reverberating across the banking sector in the form of non-performing assets (Dubash, Kale and Bharvirkar, 2018). The distribution segment of the industry has a long history of deep-seated financial malaise, and this dismal state of malfunctioning continues

largely due to problems with delayed payments, lack of tariff rationalisation, and political economy constraints arising out of subsidy disbursements.

The current debt of the distributing companies known as DISCOMs stands at a whopping INR 4.3 lakh crores, September 2021 equivalent to 58.521 billion USD (Sarangi, Mishra and Farhad, 2019). It's not only the financial liabilities alone, but the poor quality and reliability of the supply are some of the major infirmities the sector suffers from. The government agency (Central Electricity Authority Government of India, 2019) as recent as 2019 has accepted that more than 50% of households in the country receive less than 12 hours of electricity in a day and six hours of power supply has become the norm rather than the exception in rural areas of the country.

It is worth noting that all these infirmities are deeply entrenched in the power sector's historical development. An increasing population and a fast-growing economy have raised serious questions on the existing energy system's viability. In this given situation, a note must be taken of the fact that the per capita consumption of electricity in the country is among the lowest which stands at a meagre 1,149 kWh, one-third of the global average (Sarangi, Mishra and Farhad, 2019). Considering the geopolitical nature of energy, and it being subject to international sanctions further adds to the challenges of skyrocketing energy bills and oil price shocks.

4.1.2 Era of energy access and sustainability integrated into India's energy policy (1991-2014)

In the first decade of this century, the industry underwent significant innovation, privatisation, and renewable energy also started to be introduced in the mainstream energy system. It was also around this time that electricity ceased being seen as a force for social good, which ran counter to the pro-poor ethos of the Indian state. As India pursues a leadership role in climate change debates, its energy policies have undergone significant changes to incorporate sustainability dynamics within its overall approach to energy. This shift highlights the increasingly complex nature of the electricity sector and the growing recognition of the sector's role in shaping the country's long-term economic, social, and environmental goals.

For long India remained committed to its Common but Differentiated Responsibility (CBDR) policy in international climate fora. The worldwide pressure on India increased despite the CBDR protection used to advance its stand and by the 2000s, the country's protection from the global climate policy had progressively diminished (Dubash and Joseph, 2016). However, India's energy policy began to be entangled with the larger global climate politics as it began to play more active role in them (Goodman, 2016). As India began to aspire for a leadership role in the global climate debates, its energy policy too started to undergo changes to incorporate sustainability dynamics in its overall energy policy. From here on, it became extremely difficult for India to stave off the global pressure for reducing its glasshouse gas (GHG) emissions, which are mostly brought on by energy-intensive development for the world's second-most populated country.

To overcome international pressure and keep pushing energy-intensive economic development, India established a co-benefits strategy that struck a balance between initiatives that provide both developmental and climatic advantages (Dubash and Joseph, 2016). An important and long evaded consequence can be seen in India's domestic energy policy gradually becoming more involved in climate politics during this time, as evidenced by increased commitments to boosting renewable energy, particularly as part of the National Action Plan on Climate Change (NAPCC), which was introduced in 2008 in preparation for the Copenhagen Conference of Parties (COP) in 2009 (Shukla and Swarnakar, 2022). Around this time, despite the internal disagreements, India managed to develop a clarity of vision and strategy on climate related challenges that directly impinged on sectors that were heavily energy reliant. India under National Action Plan on Climate Change (NAPCC) has designed eight sectoral missions (India Today, 2018). The plan is basically a pledge that India will actively participate in multilateral discussions under the UN Framework Convention on Climate Change (UNFCCC) in a positive, productive, and forward-looking way, acknowledging that climate change is a worldwide concern and India is a responsible member of the comity of nations in combating climate change.

NAPCC's main objectives were aimed at raising awareness among representatives of the public, various government agencies, scientists, industry, and the community at large about the threat posed by climate change. The table below presents in a nutshell government's sectoral strategy to combat climate change.

	Name of the Sectoral Mission	**Mission Purpose**	**Year Started**
1.	National Solar Mission	to promote the use of solar power	2010
2.	National Mission for Enhanced Energy Efficiency	to promote the market for energy efficiency by developing innovative policies	2009
3.	National Mission on Sustainable Habitat	to make cities sustainable through improvements in energy efficiency in buildings, management of solid waste and change to public transport	2011
4.	National Water Mission	to achieve integrated water resource management and help water conservation, waste reduction, and more equal distribution both between and within states	2011
5.	National Mission for Sustaining the Himalayan Ecosystem	to facilitate collaboration between governmental and non-governmental organisations to safeguard the Himalayas	2014
6.	National Mission for a Green India	to protect, restore and enhance India's diminishing forest cover and respond to climate change by a combination of adaptation and mitigation measures	2014
7.	National Mission for Sustainable Agriculture	To enhance agricultural productivity, particularly in rain-fed areas focusing on integrated farming, water use efficiency, soil health management and synergising resource conservation	2010
8	National Mission on Strategic Knowledge for Climate Change	to create a dynamic and robust knowledge system that supports and informs national policy and action for successfully addressing the problems of climate change without sacrificing the country's economic objectives	2010

Figure (4a): The government of India's NAPCC, 8 sectoral missions to combat climate change, 2008.
Source: My own construct.

The issue of climate change, which was a peripheral concern for the government of India in the 1990s, has now acquired prominence. This change of focus is reflected in the constitution of inter-ministerial committees and organisations that concentrated on energy sector changes to achieve the sustainability envisioned in NAPCC (Bardhan, Debnath and Jana, 2020). The same change of focus led to the constitution of the Prime Minister's Council on Climate Change (PMCCC) in 2008 to (a) "evolve a coordinated response to issues relating to climate change at the national level; (b) provide oversight

for formulation of action plans in the area of assessment, adaptation and mitigation of climate change; and (c) periodically monitor key policy decisions" (Prime Minister's Office of India, 2008).

4.1.3 Post-2014: integration of availability, access, and sustainability in India's net-zero energy policy

India has a long-held conviction that nature and human well-being are interdependent. This conviction has been reinforced by Indian philosophy that humans have an obligation to the environment, community, and family (Rajeev, 2013). It was in this spirit that India announced its ambitious goals to reclaim environment from the fossil fuel emissions at the COP21 Paris Agreement in 2015.

It has been observed that despite government's 100% electrification claims as announced by the Prime Minister on 27 April 2018, as many as 5,000 villages were yet to be electrified according to The New Indian Express revelation on July 8, 2018, according to an internal report by the union rural development ministry. The ministry further clarified that a certain percentage of villages in almost every state were not connected by electricity (Tripathi, 2018). As of July 2018, Uttar Pradesh stood at the top of the list of villages without electricity followed by Odisha and Bihar with 1,044, 666 and 533 villages respectively (Banakar, 2018). In the same year a survey of 360,000 villages was conducted by the central rural development ministry which found more than 14,700 villages without electricity (Tripathi, 2018).

India saw a significant change since 2014 in its climate change policies and commitments to emissions reduction targets in line with the Paris Agreement 2015, which brought about a paradigm shift in India's renewable energy policy. In 2014, the Narendra Modi administration came into office, ushering in a change of government. To boost India's international standing before the impending COP 21 in Paris in 2015, the sustainability agenda began to be pushed with fresh vigour (Pillai and Dubash, 2021). During COP21 in Paris, India pressed for the new global agreement to be comprehensive, balanced, equitable, and practical. India advocated for inclusion of adaptation, mitigation, finance, technology transfer, capacity building, and transparency of action and support. While the right to develop, equity, and the principles of CBDR remain sacrosanct to India's climate policy, its ambitious commitment to

renewable energy has given an impetus and a new lease of life to mainstreaming sustainability central to a dedicated energy policy (Jairaj and Kumar, 2019).

India championed the cause of emerging nations for an equal and equitable opportunity for them to achieve sustainable development. In lead up to the Paris Agreement, India committed in its Intended Nationally Determined Contributions (INDC) installation of 100 GW of solar energy, contributing to 175 GW total renewable energy capacity by 2022, and 40% of that energy to come from non-fossil fuels by 2030. Prime Minister Modi at the Paris COP21 declared that India needed to "grow rapidly to meet the aspirations of 1.25 billion people, 300 million of whom were without access to energy" (IBTimes, 2015). By 2030, India will have reduced emissions by 33 to 35% compared to 2005 levels, and non-fossil fuels will account for 40% of installed capacity. While India with a total of 2,597 mega tonnes emissions of carbon dioxide ranks 4th in the world the per capita emission is 1.9 tonnes which is much less than the global average of 4.79 tonnes (Worldometer, 2022a). India appears to have found the middle ground for climate change mitigation without compromising the economic potential. India's current population is 1.4103 billion (Worldometers, 2022) and this huge population needs energy that will increase its emissions above the current level of 1.9 tons.

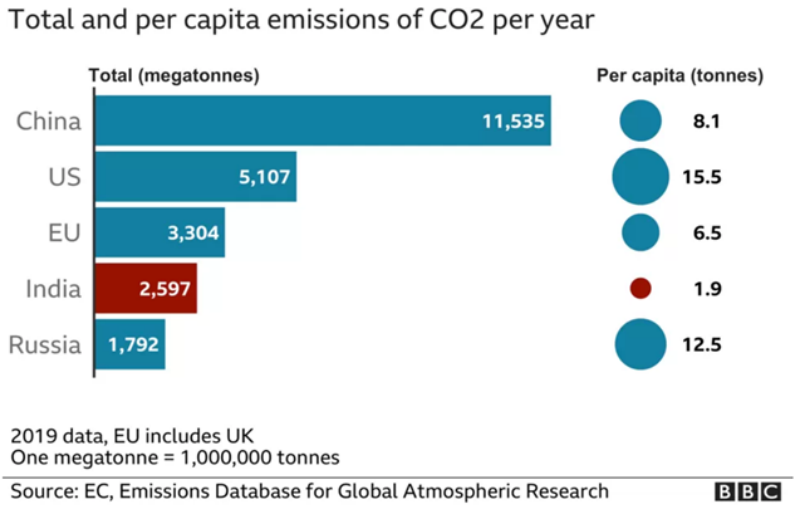

Figure (4b). Total and per capita emissions for the 5 largest emitters, where EU is treated as one emitter.
Source: (McGrath, 2021).

Prime Minister Modi, in his address at the COP26 at Glasgow in 2021, announced India's climate commitments emissions, revised from the earlier Paris Agreement. He called these revised

commitments the “five elixirs” - (1) India will increase its non-fossil capacity to 500 gigawatt by 2030; (2) India will meet 50% of its energy needs from renewable sources (3); India will reduce at least one billion tonnes of total projected emissions between now and 2030; (4) India will reduce the country’s carbon intensity to less than 45%; (5) India will achieve a net-zero emissions target by 2070 (The Weather Channel, 2021). Net-zero refers to the removal from the atmosphere the carbon dioxide emissions produced in it.

4.2 1990s: Privatisation and electricity reforms: the dawn of India’s development(al) story

Governments have historically played a significant role in the ownership and operation of electricity infrastructure throughout industry’s history. The necessity to provide a fair and affordable price for energy, as well as the perceived strategic relevance of a secure and stable electrical supply, are only some of the many factors that are responsible for this engagement. Reforms in electricity sector have been widely seen as part of broader agenda to organise economic life and ensure public interest in transformation of electricity provision into a business venture to achieve greater efficiency and dynamism with a corresponding public benefit in the form of lower prices and better service. There is an intersection of energy infrastructures with national development, the reason governments invoke the logic of energy occupying national significance. Governments across the globe have relinquished control over electricity to boost efficiency and dynamism in the system. Examples include Chilean electricity wholesale marketgoing private in 1978 and the comprehensive electricity and gas sector privatisation in the UK in the 1980s. These two examples are akin to gas and electricity being treated as a key experimental site for economic deregulation and the introduction of market principles, commercial logics, and private capital into national economies (Bridge, Özkaynak and Turhan, 2018). In the wake of 1990 economic crisis of the Indian economy, the government of India undertook a massive economic deregulation drive and welcomed private capital into energy infrastructure, due partly to learning from the experiences of these countries. Energy infrastructures, therefore, have been a key frontier in the evolution of economic organisation of a state so much so that they can be

considered integral to the reproduction of economic power. In 1991, India embarked on a significant and transformative path with landmark economic reforms aimed at liberalizing the country's economy and transitioning it towards a market- and services-based model. This was a pivotal moment in India's economic history, as it marked a significant departure from the country's previous socialist policies leading to higher levels of investment from both domestic and overseas sources, stimulating competition, enhanced new manufacturing capacity, start of a new service-sector industry, productivity gains and a falling poverty rate (International Energy Agency, 2021a). This progress has fueled an unprecedented demand for energy, and the growing supply of energy has fueled India's economic growth. India has registered an impressive progress in economic growth and Human Development Index improvement from 0.43 in 1990 to 0.65 in 2018 since 1990s representing a growth in life expectancy, education access and incomes.

4.2.1 State acting as an extended arm of the private sector

Some scholars have gone to the extent of describing the Indian state as nothing more than an agency like many other agencies, organisations and associations that operate in the political firmament (Chandhoke, 2003). The decade saw the very fabric of the global political economy undergo a fundamental tectonic shift in its very nature which the poststructuralist scholars viewed as dilution of the very idea of the 'sublime', unitary state. The job of the new state, i.e., the post-structuralist 'activist state' was to provide the institutional and regulatory framework in which businesses and people could operate to their best benefit.

The post-structuralist 'activist state' framework was designed to ensure the economy was suited to realise its growth potential without resorting to state intervention. Simultaneously, the international financial institutions, transnational corporations, and financial markets also put pressure on the governments of the global South to abide by Washington Consensus, liberalisation, and state rollback. It has been argued that the growth of Indian economy was set on a growth trajectory a decade before the full-scale implementation of economic reforms in 1991. The pronounced shift towards a market-

oriented pro-business model of economic development in India was largely a result of the state's prioritization of growth and its alignment with capital (Kohli, 2006). This pro-business tilt of the Indian state, in effect, dissolves the division between state and market with a clear signal for a predominant role reserved for the private sector.

The issue of insufficient low-quality power has been a focus of industry lobbying since the 1980s, when the state's propensity to favour corporate policies gathered traction. The Indian power sector reform began with the passage of the Electricity (Supply) Act of 1991, which permitted private sector participation in generating. The primary objective of the act was to implement comprehensive power sector reforms, including the establishment of an independent regulatory commission, the separation of vertically integrated utilities into separate generation, transmission, and distribution entities, and the eventual privatisation of distribution. These reforms were meant to improve the technical and financial performance of the cash-strapped state-owned utilities known as the distribution companies (discoms). Prior to reforms, much of the investment by the developing countries in power sector was mainly provided by international public financial institutions like the World Bank. By the 1990s, these institutions increasingly withdrew their financial support from public utilities trapped in high debt, low performance structures.

In 1993, a World Bank policy paper made reform and greater private participation in the electricity sector a mandatory requirement for continued lending for the sector (The World Bank, 1993). A similar energy sector policy paper with similar reform oriented mandatory requirements was produced by the Asian Development Bank. The 1990s marked an era that expanded the role for private corporations with corresponding recalibration of role of the state in economic activity.

Reflecting on a growing sense developing among Indian leaders, Atul Kohli (2004), a prominent historical-structuralist scholar reiterates that there was a growing sense developing among Indian leaders that a limited alternative to liberalization was the driving force behind the shift in India's development strategy towards dominant interests and ideas. Kohli argues that India's previous policy

of "statism" or in other words, the government's policy to own and control country's industry and economy, along with the presence of a mature Indian capital provided a framework for the emergence of a largely capitalist economy in India where leaders now find it difficult to maintain an anti-capitalist stance. In other words, the previous approach, which emphasised state control of the economy, limited the growth and development of capitalism in India. The shift towards liberalisation and pro-business policies was seen as the solution to the economy's limitations and paved the way for a capitalist economy in India (Kohli, 2004).

The dominant institutions in India's contemporary capitalist system are hegemonized by corporations that have money and power with which they overwhelmingly influence policies. However, it must be emphasised that despite opening to economic liberalisation, India's political economy to a large extent is still statist and the government has maintained a considerable amount of control over the selection of energy from the available choices, development of energy markets and deployment of associated technologies. It is, in fact, within the prerogative of any country to achieve its wider objectives of economic growth, enhancement of quality of life and clean environment. Like everywhere else, in the case of India too, energy choices are inextricably linked to wider socio-economic and environmental developmental goals.

4.2.2 The state, and the politico-economic rationale for privatisation and sectoral development

It became evident, from around the late 1980s, that the electricity sector was in desperate need of reforms, but it was not until the early 1990s it became evident that privatisation was critical to the sector's survival and an ideological shift toward greater reliance on market mechanisms was inevitable. The focus of reforms in the initial stage was privatisation of generation segment by creating legislative provisions for independent power producers (IPPs) who signed opportunistic power purchase agreements (PPAs) designed to minimise their risks and guarantee returns on their investment. These PPAs included, but not limited to distribution companies to comply with a set payment for power, whether used or not, and government guarantees against non-payment for electricity. As a result, IPPs

have been criticised as being built on the ‘socialisation of loss, but privatisation of profit’ (Colley, 1997). However, these measures failed due to policy-level incoherence and inconsistencies. A lack of clarity in procedural matters led to major roadblocks and further hindering private investors from foraying into the sector (Shukla and Thampy, 2011).

Over the years, the state-owned utility system with state electricity boards (SEBs) as the key state-owned agency for sectoral development and management had become financially unsustainable and politically subordinate to narrow political agenda of the party in power (Reddy, 2002). Due to state governments' excessive intervention and catering to the political constituencies of the affluent and important voters, including major landholding farmers, these SEBs constitute the weakest link in the financial governance framework of the industry. This has resulted in long-term, irreparable damage to the sector and its functioning, which shows up in a variety of ways, including inadequate annual capacity additions, rising frequency of power outages, poor and unreliable quality of the power supply, and inadequate provisioning of the rural electricity supply.

In most states, SEBs face considerable government meddling, which has a negative impact on their bottom lines and threatens their very survival. Dismal results from the industry have shown up as chronic power outages, low-quality energy that goes out often, and a lack of access to electricity in remote areas. The industry has a lengthy history of causing various problems, including those listed above. The role of the state in the sector reveals that electricity sector reforms, contrary to largely held belief, were unavoidable not because of need for an alternative technical and institutional model but for the sake of integrating the sector into larger globalisation process. The involvement of the state in the electricity sector indicates that contrary to prevailing assumptions, reforms to this sector were not necessarily due to a need for an alternative technical or institutional model. Rather, the reforms were motivated by the objective of integrating the sector into the government’s wider privatisation effort. The sector like most other sectors has become predisposed to market forces, the growing role of international private capital and the neoliberal efforts to make it an integral part of international

economy since early 1990s. Unchecked and profit led transition to privatisation and competition betrays the broader public objectives, such as social and environmental goals.

The analysis of the Indian power sector reforms reveals that although the sector is fraught with political resistance and contestation, compromise, and continuity, it does not yield to a direct threat to its existence, but it only creates a space and enlarges the scope for certain segments of the economy where private market can effectively exercise control and authority without constraints (Thelen, 2012). The emergence of Indian liberalisation including the power sector has been sporadic, incomplete, and mostly caught up in the logic of endogeneity can best be explained through the historical-institutionalist analysis of gradual institutional change as propounded by leading historical institutionalists like Eric Schickler, Kathleen Thelen, Wolfgang Streeck, Stephen Skowronek, and Paul Pierson (Streeck and Thelen, et al., 2005). These scholars have identified, defined, and developed mechanisms of incremental institutional change.

An important mechanism that characterises institutional change is 'layering' (Thelen, 1999, 2003). Thelen goes on to explain the slow, gradual and a fragmented institutional transformation through a process in which new elements are layered or attached to prevailing institutions and by doing so changing their status and structure. This process, therefore, is not one that replaces the old with the new, but rather metamorphosises into an amalgamation, a new arrangement on top of pre-existing structures. However, this process also creates a space for the market governed segment in parallel to the existing one. Over a period, this new segment starts to encroach and usurp the old system in a way different from an overt dismantling of the older institutions through direct action (Mahoney and Thelen, 2012).

4.2.3 The turning point in India's economy and the state's withdrawal from the past baggage

The year 1991 brought for India the most difficult economic crisis that was brewing at least since 1980 when the foreign debt stood at $20.5 billion rising to a whopping $72 billion in 1991. India had only $1.1 billion in its hard-currency reserves, just enough for two weeks of imports. This was a result of

decades of bad policies and increasing oil import bills. Considering changing global circumstances, it was felt that excessive bureaucracy and stringent policies imposed significant damage upon the economy. As such, it was deemed necessary to confront the "realities of failed policies" and attract foreign investment, as stated by the then Finance Minister, Dr. Manmohan Singh (Weinraub, 1991).

With a severe liquidity crisis looming large and time running out, the prospects of a default in sovereign payments became real. To come out of this crisis, the worst since independence, India had to resort to sweeping economic reforms, mortgage 46.91 tons of gold to the Bank of England for $405 million and the biggest loan worth $1.8 billion from the International Monetary Fund hinged on a set of conditions demanding India to reduce its budget deficit, open its markets to foreign competition, diminish its maze of licensing requirements, cut subsidies, and liberalise investment (Weinraub, 1991; Vikraman, 2017). India, a country characterised by its socialist political fabric regarded these arrangements with pain and embarrassment. However, with the onset of an era of economic reforms, India embarked upon a comprehensive programme to modernise and liberalise its economy.

This was a momentous time in the history of Indian economy as it stood on the cusp of a major overhaul of its structure, including electricity. This change, which largely came about because of exogeneous financial shock of 1991 eventually laid down the foundation of incremental changes in the Indian economy. This change although spurred by exogeneous shock, characterised by institutional stability, 'stickiness' of institutional cultures, and vested interests made it difficult to change the existing institutions at the desired speed (Pierson, 2004).

This is suggestive of institutions' relative long-term stability which can be 'punctured' by sudden shifts and shocks in government or society without losing its major character. The long-term institutional stability is safeguarded by 'layering' of new institutional components, such as new rules, policy processes, or actors (Mahoney and Thelen, 2012). Other institutional change mechanisms include redeployment of existing institutions for new purposes, the abolishment of old institutions, introduction of new ones, often alongside the old, the rearrangement of institutional principles and

practices in new and creative ways and the blending of new elements into already existing institutional arrangements (Morgan et al., 2010).

Thelen's layering mechanism of institutional change provides a good partial lens to evaluate electricity reforms in India. Partial because it provides an incremental and endogenous rather than a radical and exogeneous change. The case of Indian electricity reforms, however, is endogenous and incremental, but the developments in the initial stage were more a result of exogenous stimulants made unavoidable due to an unprecedented economic crisis of 1990-91. This crisis necessitated a plethora of reforms in the Indian economy, albeit in a slow and incremental way.

However, in her later work, there is a shift of focus to the importance of institutions' political context, the characteristics of the institutions themselves, and the actors that aim to change or preserve the institutions. A broad interpretation of Thelen's incremental and endogenous mechanisms and Schickler's notion of institutional creation without 'displacing' or destroying the old institutions capture the notion of India's electricity reforms. The import of the Western models of independent regulatory agencies in Indian electricity sector evokes the notion of displacement by invasion, which has largely muted into a co-opted rather than supplanting the indigenous system (Streeck and Thelen, 2005; Dubash and Morgan, 2013).

In the year 1990, an economic and political rationale emerged for the state to relinquish its role as the protector of the economy, and to embrace a hands-off approach. The state believed its interventions were impeding the efficient and equitable production of goods and services, and its withdrawal would result in increased productivity, investment, and employment. This could be achieved through regulations supporting more flexible labour markets, a simpler tax system or less red tape, divestment of state assets and making it easier for companies to conduct business and plan for the future.

In addition, reforms were targeted at specific sectors, such as those encouraging reforms and innovation in key industries, such as electricity. The debate around energy at that time hinged on whether state-led or market-led approaches to investment help in materialising energy infrastructures,

and whether this would be achieved with an entrepreneurial spirit of profit-generation motives of corporate actors or linked to the notion of a public or common good, and related to the developmentalist state ideal (Bridge, Özkaynak and Turhan, 2018)? Scholars on both the sides of the political spectrum were convinced and agreed that the importance of the state was fast waning and being reduced to the role of helpless spectators. According to Hall (1993) there are two theories of modern state, viz., pluralist, and developmental. The pluralist model is a bottom-up policy framework which in essence is an algebraic sum of the competing interests and influences of various domestic interest groups (Hess, 2014; Breetz, Mildenberger and Stokes, 2018).

The policy outcomes, therefore, are a result of the relative power and efficacy of these interest groups. The other theory that captures the pro-development aspect of the modern state is state led development model with the state acting as an autonomous actor driven solely by its own preferences and national goals. The modern state in the developing countries have been referred to as predatory and developmental by (Kohli, 2004). A predatory state is a rent-seeking corrupt state that subjugates national development to narrow, private interest by siphoning off national resources. Whereas the developmental state led by a powerful politico-bureaucratic class aims at achieving specific development objectives is characterized by strong state intervention and regulation. The Indian state is a combination of a semi-autonomous and semi-developmental at the federal level, but this characteristic of the state at the subnational levels is quite complicated.

4.2.4 Relocation of energy from state domain to reconfiguration of wider social interests

The claims for energy infrastructure's national significance are achieved through creation of common interests' platforms and by reproduction of political power to secure prioritisation of specific interests over others. Energy policy making in India like in most countries remains centralised and divorced from public participation. This has created a legitimate space for alternative claims on more inclusive policy making processes. This alternative approach is framed in terms of democratic participation, citizenship, and social justice. This alternative approach raises questions about the socially constitutive

power of energy systems and the reproduction of social power with the potentiality of shaping the political and economic outcomes (Mitchell, 2011; Bridge, Özkaynak and Turhan, 2018).

Energy transition has opened avenues for discourse away from government dominance to the need of combining energy justice with climate justice, and in the process, to promote decentralised democratisation of energy resources. The energy transition can potentially respond to the pressing issues of development, growth, human rights, and community development by reconfiguring the organisation of interests of different stakeholders. This reconfiguration of interests entails greater scope for meaningful popular participation in the governance of new energy systems in terms of policy design, implementation, social justice which collectively can lead to better outcomes in development, human rights, and in particular, the human right to participation.

India's transition to renewable sources of electricity generation is due to its climate change commitments to reduce Greenhouse Gases (GHG) and in part due to national priority to improve energy security. This has resulted into country's shift towards renewable energy sources, such as wind and solar. The process of electricity transition involves complex dynamics shaped by public and private actors operating in a quasi-liberalised market system, while the government policies overwhelmingly support this transition to the extent that it is akin to state-sponsored renewable niche development.

Analysis of these dynamics provides essential understanding into how governmental strategies contribute to the promotion of positive developments. India's vision of transition to a low-carbon economy viewed through the dynamics of institutional change is not without challenges since the dominant players in the energy generation are 'semi-rational and self-interested actors' operating in partially market conditions with an aim to maximise their profits. The government influence in the renewable energy, therefore, is unavoidable (Moallemi et al., 2014, 2017). The concepts and processes that are used to explain these dynamics are varied and complex operating at different levels of aggregation, viz., micro-level actors' behaviours, meso-level emerging systems' formation, and macro-level existing systems' interactions (Moallemi et al., 2014).

4.3 The electricity act of 2003

Over five decades of legislation, policymaking, and reforms culminated in the comprehensive reform action architecture that culminated in the Electricity Act 2003, which aimed to bring in much-needed improvements. The goal of this Act was to increase competition, safeguard consumer interests, and provide everyone access to power. The Act contains provisions for a national energy strategy, progressive open access in transmission and distribution, license-free production and distribution, power trading, required metering, and harsh penalties for electricity theft. This comprehensive piece of legislation replaces the Electricity Act of 1910, the Electricity Supply Act of 1948, and the Electricity Regulatory Commission Act of 1998 (Ministry of Power Government of India, 2022).

The Act, together with the previous Electricity Regulatory Commissions Act of 1998, was lauded as institutional innovation and a new governance vehicle for the intended sectoral reforms (Kumar and Chatterjee, 2012). These Acts contained a range of mechanisms and instruments to remedy historical distortions and were geared towards commercial and corporate functioning, as well as offering a route for deep continuous involvement with both consumers and private participants (Dubash, 2007). Over time, their sphere of influence expanded beyond traditional regulatory functions to include environmental sustainability and consumer welfare aims.

The reforms called for the establishment of new oversight agencies, the separation of the power industry into three functionally distinct segments (generation, transmission, and distribution), and, most significantly, the introduction of competition using a wide range of instruments, mechanisms, and apparatus into each of the verticals (The Government of India, 2003). The creation of new regulatory entities at both the federal and state level was based on the premise that the regulator would create an apolitical techno-economic sphere of operation to deliberate on the matters of electricity consumers' protection as well as safeguarding private investors' interest (Dubash, 2007).

These reforms are expected to enable the sector to promote competition, ensure balanced economic growth and development. These power sector reforms have the potential to metamorphose the sector

in ways that can catapult the country to a new level of development which was held hostage to lack of progressive sectoral reforms. Reforms initiated in the electricity sector were also due to external factors, spurred by international development agencies, such as the World Bank and DFID which used condition-based reform packages largely targeted at states like Odisha (earlier known as Orissa), Andhra Pradesh and Haryana (Sarangi, Mishra and Farhad, 2019). The Government of India's efforts to modernise the sector and make it more market oriented led to the drafting of the Electricity Commissions Act 1998. But what was really needed was a complete overhaul of the sector which never happened. However, it has been observed that the age-old malaise of political intrusions in the sector has persisted unabated (Dubash, Swain and Bhatia, 2019).

Electricity by virtue of its organisation as a vertically integrated and publicly owned utility in both industrialised and developing countries has enjoyed protection at the cost of innovation. However, the era following the early 1990s, characterized by liberalization, privatization of industry, and heightened competition, gave rise to novel deliberations surrounding the need for regulatory reform, institutional framework, and the optimal sequencing of privatisation and sector unbundling (Joskow, P.L., 1998; Bacon and Besant-Jones, 2001). Electricity reforms during their early phase mostly confined to technical and economic concerns with little or no concern for the society and environment suggested a need for more focused attention on the social and environmental implications of electricity reforms.

4.4 Electricity as agent of social good for human development: the fate of social contract!

In most developing countries, the social contract has been embedded across the entire value chain of electricity as state's broad social responsibility to serve especially its poorer citizens. In these countries, electricity has always been a politicised commodity as well as an economic good proper. In countries like India, the connections, and low tariffs for politically well-organised groups, especially the rich farmers are commonplace and as a result the concerns about erosion of social contract due to market reforms has forestalled and shaped the process of reform. However, the reform process in the industrialised countries has been markedly different with considerable importance given to incentives

for investment in renewable power, energy efficiency through competition, and environmental protection. The governance of the electricity sector in industrialised countries is no longer guided by social compact, as they have effectively met the requisites of social compact – universal public access, reliability, affordable supply for economic growth. The developing countries like India, on the other hand, present a different scenario with problems of financial mismanagement, poor governance, and a failure to meet the social contract are still a big challenge.

Electricity and the state have been inextricably bound together in terms of state's ability and responsibility to shape society and society in return asserting pressure to obtain favours in the form of 'populist' subsidises. This link between electric and political power has been recognised as fundamental to economic development. Inadequate supply of electricity across much of the developing world, and South Asia in particular, is the major bottleneck in the region's economic development and for this reason electricity has become the major target of industrial lobbying. The magnitude of these subsidies is huge and have a debilitating impact on the state's ability to invest on social development projects.

Electricity in India is arguably central to its economy, society, state, and politics, but what is not arguable is its central role in contributing to modern human development. It is, indeed, as important as wheel, agriculture, writing, and printing are to contemporary civilisation. Without electricity, none of these can be put to their optimal potential. It is the centrality of electricity, along with land, labour, and capital as key input in contemporary capital accumulation which in effect makes it a structural feature of modern capitalism (McDonald, 2008). In the similar vein, development is assumed to be a subset of economic growth which in turn is positively corelated with electricity consumption. In the grand design of India's effort to script its post-1990 development a market-oriented, pro-business society model was envisioned based on the state embracing capital as its main ally. Can community owned energy transition be the starting point of a countervailing balance to corporate power?

Larkins describes energy infrastructures as an object of desire for national development and societal progress representative of possibilities to be modern and foreclosing an experience of abjection (Larkin, 2013). The provision of infrastructures therefore is so intimately linked to the idea of shaping modern society and realising the future. In fact, infrastructure to people's progress and mechanisms to control time has its conceptual roots in the Enlightenment idea. Infrastructure in its diverse forms, such as electricity, railways, and communication are representative of civilisation itself (Graham and Marvin, 1996; Mattelart, 1996). Given the crucial role it plays in the contemporary human development, governments have constructed a broad 'social contract' with the electricity industry, thereby facilitating protection of the environment, access to electric services, and investment in innovation for the future. Governments have employed a variety of regulations to ensure citizens' access to electric services at an affordable cost while being able to undertake long-term innovation of improved technologies in electricity systems.

Until the early 1990s, electricity in developing countries was considered a natural monopoly of governments as they were considered best capable of mobilising the large capital investments and long-term recovery of costs (Navroz, 2003). Constructing and honouring a social contract was relatively easy for governments over the last century, as the sector in most instances was state-owned and enjoyed government protection and state monopoly. However, the social contracts have been under great stress in the last couple of decades, as a new wave of industrial organisation based on market driven philosophy across the sector has taken roots and pose a challenge to the very fate of social contract (Heller, Tjiong and Victor, 2003). Scholars have a divided view on the actual stress restructuring has put on the social contract – one, because restructuring has not followed the real market principles, and two governments and stakeholders have managed the co-evolution of market reforms and reconstruction of the social contract not much different from the old one.

The conventional electricity restructuring involved a two-pronged process starting with freeing the state-owned enterprises from government control and transforming them into independent legal

businesses. The second part consisted of making these newly made independent enterprises enter market and compete against each other. This was designed to induce accountability and efficiency through competition for capital and customers. However, the challenge of complementary reforms in the spheres of liberalised access to capital markets and creation of independent regulatory institutions that could enable access to transmission lines and distribution networks considered state's natural monopoly remained (Heller, Tjiong and Victor, 2003).

The real-world application of such a theoretical model has rarely been seen anywhere in the world, let alone India. However, the first of its type of experiment in India was unsuccessfully carried out in the mid-1990s in the state of Odisha, where state-owned generators and distribution companies were sold to foreign private investors in the hope that along with efficiency gains, they would help reduce the opportunity cost of other critical development projects.

4.5 Energy transition dynamics in a state-influenced electricity sector

Humanity has been harnessing renewables, the world's oldest and newest energy sources from the sun, wind, and water for thousands of years, with new evolving technologies these ancient energy types have developed into state-of-the-art innovative power generation sources. The existential threat caused by climate change requires a rapid transition from fossil-fuel energy to low-carbon systems. This can be achieved by green technologies, shifts in people's consumer practices and behaviours, and a new level of interspecies relationship. The current energy transition is underway while there is increasing inequality in income, wealth, and resource ownership. Consequently, this warrants an analysis of where and how policies meant for decarbonising the economy can address the range of injustices and impacts of such a socio-energy transition while renewable energy becomes a new site of capitalist production (Sovacool, 2014; McCauley et al., 2019). India's push for leapfrogging into a renewable energy system while these anomalies prevail presents a noteworthy case for worth scrutiny.

Concerns about energy transition began to gain ground around the world from the 1990s, but India refrained from any constructive action. Although a separate ministry, the Ministry of Non-

Conventional Energy Sources (MNES) formed in 1992 later renamed to Ministry of New and Renewable Energy (MNRE) in 2006 to investigate alternative energy sources. These initiatives were motivated primarily by government's concern for energy security than by sustainability. Overall, climate policy and the renewable energy remained largely diplomatic concerns as India championed the concepts of equity and climatic justice for industrialised nations to integrate in their energy policies and help reduce the burdens of previous and current emissions, they were responsible for (Vihma, 2011). Notwithstanding its criticism, India vehemently supported the concept - "common but differentiated responsibility" (CBDR), which now has become a timeless principle to uphold the true intent of justice in climate change debates. The principle of shared but differentiated responsibilities (CBDR) requires industrialised countries to cut back on their emissions of glasshouse gases while enabling underdeveloped countries to continue pursuing their own development goals. For India, lack of energy availability is one of the biggest developmental obstacles as a reason to maintain the North-South divide in global climate policy (Joshi, 2013).

It was the 1973 oil embargo, aided by strong support from national leadership, domestic environmental lobbies, and interest groups, which paved the way for renewable's acceptance into the market by providing a strong rationale for diversification from fossil fuels. However, the Indian case of energy transition is quite different. The 2014 Indian decision to scale-up solar as part of energy transition is not a story triggered by a crisis, nor was there an environmental lobby with significant clout in favour of scale-up. What then explains this extraordinary push for energy transition in India? Is it global pressures for climate action and an Indian desire for enhanced partnerships with major powers such as the US and France, a key motivator of India's ambitions?

Over time, consistently pushed by varied interest groups the renewable industries created a built-in constituency for their continuation (Breetz, Mildenberger and Stokes, 2018). Due to legacy effects, barring a small portion of power generation, transmission and distribution remains state-owned in India. Therefore, the state turns out to be both a critical enabler and potential deterrent in shaping

India’s embrace of renewable energy. The accelerated pace and scale of policy execution since 2014 by the central government has a strong political logic, without which the scale-up would have been much more modest.

The question arises what explains India’s energy transition? It is the combination of political with the techno-economic that captures India’s energy transition. The socio-technical framework is less representative of India's energy transition, since the country imports 90% of its panels from China; it is largely an “innovation-taker” rather than “innovation-maker” (Shidore and Busby, 2019). Meadowcroft has emphasised that it is the everyday politics that stands in support of everyday policy (Meadowcroft, 2009a). Given those renewable technologies are still governed by governmental support mechanisms such as subsidies, quotas, power purchasing agreements etc., the role of political drivers behind the formulation of pro-renewables policies is vital for their continuance and longer-term sustainability. This is especially true of energy transitions whose timeline is anything from 25 to 50 years or even more (Fouquet and Pearson, 2012) while the speed of a potential clean energy transition remains uncertain, unpredictable, and highly contested (Sovacool, 2016; Sovacool and Geels, 2016). The relationship between government and civil society stakeholders has acquired an essential role in cultivating a market for commodities that are typically classified as private, but possess significant practical and consequential public utility, notably in the domains of healthcare and energy (Ethan and Busby, 2014).

Conclusion

True to its name the chapter journeyed through India’s history and body of electricity policies from the time it made “its tryst with destiny” at the stroke of midnight hour on 15 August 1947. The historical account presented reveals the power sector to be a state-controlled enterprise from the beginning, which proved a great help in meeting the aspirational needs of the common milieu, the poor and the powerless.

The industry, despite its status as a state enterprise, provided exemplary service to the nation in fulfilling its critical duties. It is noteworthy that the period of state control was not bound to persist indefinitely, as it eventually subsided in the 1990s, coinciding with the dawn of India's economic privatisation era. This led to significant innovations, privatisation, and inclusion of renewable energy in the mainstream energy system. It was also at this time that electricity ceased being seen as a force for social good, which ran counter to the pro-poor ethos of the Indian state. The latest avatar of Indian electricity came in the form of deployment of renewable energy to meet the Paris Agreement 2015.

5 Indian Energy in Transition: Current Status - the very Soul on the Periphery

Introduction

This chapter analyses how India's beleaguered energy sector confronted with issues of heavy dependence on fossil-fuels, lack of access, and steeply increasing energy demand is transforming the energy sector to emerge as one of the most successful stories of renewable infrastructure development in the world today. Gaining access to energy is critical for socioeconomic development and unfettered rapid economic growth. Universal access to low-cost, dependable, and environmentally friendly energy services is directly linked to several different indicators of development, including employment, education, health, female emancipation, and even mental wellness. Decentralised and distributed renewable energy system is the more suited for India's development.

India's adoption of renewable energy efforts so far has been primarily motivated by government's development drive and cost-effectiveness, private sector capture rather than sustainability and distributional gains of energy transition that can be shared with the citizens. The existing energy systems lack opportunities for participatory control and citizen participation as reflected in an increasing number of organisations all over the world to have started rallying around the concept of energy democracy to address these problems (Becker and Naumann, 2017).

A large proportion of Indians have significant difficulty accessing electricity, mainly due to financial or geographical constraints that necessitate costly capital expenditures. This leads to a lack demand by households in far flung areas giving rise to a vicious cycle of low to no investment in rural electrification. It has been demonstrated that decentralised renewable energy (DRE) sources, such as rooftop solar panels, micro and mini grids have the potential to ensure access to energy which is both equitable and sustainable. Implementation of DRE sources in India is generally seen as a stopgap measure and not an alternative to large scale centralised grid (Mitra, 2021). In the line of the above

argument and in the subsequent iterations the current Indian energy transition overlooks the social justice implications embedded in transition, especially one that overlooks decentralisation and stakeholder participation. Successful energy transformation entails active participation of the people affected by these transitions. Participation is important as something that is right and worth pursuing. A normative justification for participation is derived by rereferring to Western values of democracy that people have an innate right to decision making in matters that affect their lives (Renn, 2008).

India is at the cusp of becoming a global economic powerhouse, and for this to come to fruition the government has realised that energy will lie at the heart of this transformation. This chapter analyses how India's beleaguered energy sector confronted with issues of heavy dependence on fossil-fuels, lack of access, and steeply increasing energy demand is transforming the energy sector to emerge as one of the most successful stories of renewable infrastructure development in the world today. Does India have enough land and other natural resources to execute these renewable projects? For India, renewable energy is the answer to this conundrum and its already in a fast-forward mode to implement this. However, what has been lost in this transition is the justice dimensions of the large-scale renewable energy projects. In essence, what has been lost in India's transition is the decentralised character, the very soul of renewable energy.

As far as electricity including the renewables is concerned in India, the Electricity Act of 2003 is the mother of all legislations that regulates the production, distribution, transmission, trade, and use of electricity at both the state and the federal levels (The Government of India, 2003). It was a historical act in more than one sense for it obligated, as per the 'Renewable Purchase Obligations' (RPOs), all distribution utilities and captive-power users to purchase part of their power need from renewable sources (Dibyananshu, Rastogi and Nair, 2021), progressively rising to higher share from the initial 17%.

India has a clear set of policies regarding climate change objectives which are intended to meet both the developmental and environmental goals. The country has undertaken a twofold, co-benefit

approach to meet country's development needs and global climate goals agreed during the Paris Agreement of 2015. At the core of its climate policy, India has development priorities which are non-negotiable. The country is currently striving to meet its prime objectives of accomplishing poverty alleviation and food security with a mere minimum impact to climate change. This, the government is doing with focus on identifying gaps to determine the requirements and financial implications for the existing schemes and programmes already under the UN Sustainable Development Goals (UNSDG). Since the country mainly relies on domestic finances for its climate policies, India has a system of levy which it has increased on use of coal to finance a Disaster Relief Fund to address emergency situations during climate induced calamities (Hirsch, Matthess and Funfgelt, 2017).

Energy is critical to economic development for a modern nation, and it has a significant impact on the socio-economic development of the people. Policy leadership at the government levels, development priorities, and the supportive financing environment are the major determinants for facilitating the economic growth and well-being of a nation. The fast-developing Indian economy and strong growth prospects over the coming years will contribute to consistently increasing high electricity demand from passive consumption to more proactive participation.

India's beleaguered energy sector is confronted with issues of poverty in rural areas, steeply increasing energy demand and the resulting carbon emissions, and strong dependence on oil imports. Rural areas in India are still energy deficient as they rely on polluting biomass as energy source. The country has undertaken a series of policies with purported goals of providing access to energy at prices affordable by the poor, improve energy security and break free of oil imports without compromising on either economic growth or climate change commitments made at the international fora, the Paris Agreement of 2015 where India played a key leadership role in forging this agreement (Croonenbroeck, Carsten Lowitzsch, 2019).

5.1 Compelling rationale for India's energy transition

So far, renewable energy has been a subset of the larger electricity sector as both the conventional and the renewables are coexisting side-by-side. While the primary source of electricity in India continues to be coal, fossil fuels are likely to continue growing even as the clean energy business grows since the demand for electricity is anticipated to triple by 2040 as India's population continues to move upward. In 2020, India announced historic supply agreements for flexible renewable energy, which proved to be a crucial step in overcoming the shortcomings of erratic wind and solar power. The grid favoured low-cost renewable energy sources, which led to a decrease in coal consumption as energy demand fell due to the global economic recession. In 2020, bids for new solar projects fell to all-time lows, demonstrating that coal is no longer the least expensive source of electricity. In December 2020, a 500-megawatt solar auction held by Gujarat's utility, one of India's leading states, Gujarat Urja Vikas Nigam Limited set a record for the lowest price in India of ₹1.99 ($0.0269) per kilowatt-hour (Pyper, 2021). The figure (5a) depicts a sharp decline in the bid offers for solar project in Gujarat from INR 2.36 to INR 1.99/kwh between June 2020 and December 2020. This is the lowest solar price in the world.

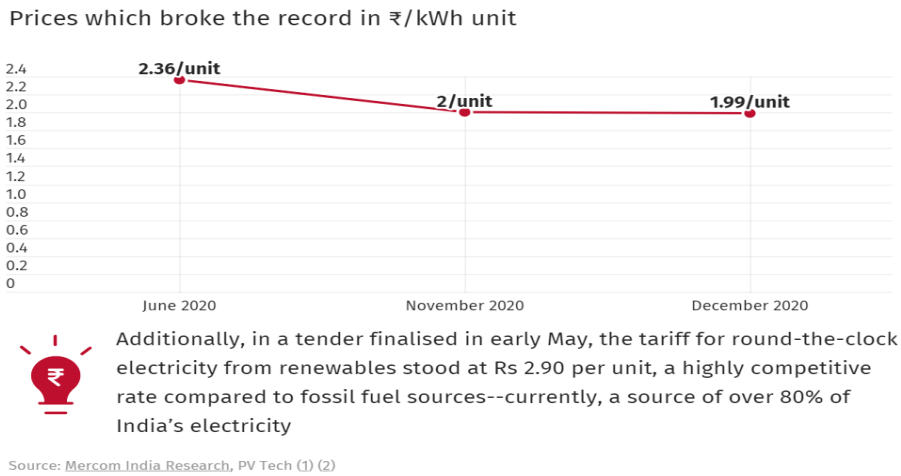

Figure (5a). The bid lowest solar project bid offer in the world by Gujarat Urja Vikas Nigam Limited in Gujarat from at INR 1.99/kwh in December 2020. Only 6 months ago it was INR 2.36/kwh.
Source: (Pyper, 2021).

How quickly the use of renewables and related clean energy technologies can scale up and how much they can reduce the rise in the usage of fossil fuels are two pressing challenges for India that need immediate resolution. India's transition away from carbon-intensive resources is a crucial front to combat global climate change as it is the second-largest producer and consumer of coal on earth, as well as the third-largest emitter of glasshouse gases (Pyper, 2021).

Solar energy is currently by far the least expensive source of electricity in India. Sharp fall in solar prices is the reason behind India’s steep increase in solar installations as depicted in the figure 4e. Solar is aiding in the achievement of the nation's goal of making electricity accessible to people on modest incomes. Over the coming decades as the Indian economy is expected to grow at a very high rate and a concomitant energy consumption will require the country to improve its energy security. This will also help reduce air pollution because the country has a serious problem with it. India for sure has the auxiliary benefit of aiding in the global climate issues.

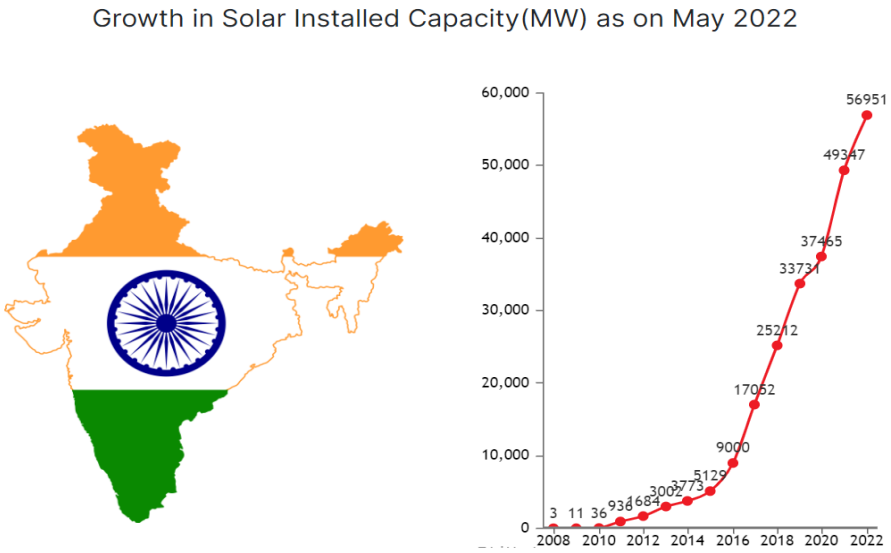

Figure (5b). Solar installed capacity in India as of May 2022. Source: (NSEFI, 2021).

In India's case, energy transition endeavours have remained largely limited to creating supportive environment by removing bureaucratic and technical hurdles for investors and renewable technology developers at the cost of (i) building institutional capacity, (ii) developing and enhancing strong stakeholder processes, and (iii) developing mechanisms for sector transparency. In this regard, India

needs to reinforce its commitment to the inclusion of a wider range of stakeholder voices concerning participation in decision-making and ownership in renewable infrastructures, as well as addressing the governance challenges of limited capacity in key government and regulatory agencies, particularly at the subnational level (Kumar and Jairaj, 2020). It stands to reason that the shortcomings in policymaking, planning, and regulations and issues of inefficiencies, short-term gains, and suboptimal decisions can be best addressed by opening the decision-making processes in these institutions to a broad and diverse range of stakeholders. The success of India's transition, including the residential rooftop solar installations will be determined by the extent of decision makers' engagement with consumers (Jairaj et al., 2016).

India with the second largest population is the world's third-largest energy consuming country whose energy use has doubled since 2000 with 80% of demand met by coal, oil, and solid biomass, implying huge emissions, but it is still less than half of the world average (International Energy Agency, 2021b). India has used these population-energy dynamics for long to refuse international climate change obligations for adoption of targeted carbon emissions and has argued that the developing countries do not have to respond as rapidly as wealthy industrialised countries given the reality of their pressing need for development and low share of historical emissions by the former (Kanitkar and Jayaraman, 2019; Sengupta, 2019).

India has been making strident efforts to transit to renewables, while continuing to provide direct subsidies, fiscal incentives, price regulation and various other government support for fossil fuels, 35% higher than for the renewables (Climate Action Tracker, 2021). The price is the fundamental arbiter for the success of an energy transition, and if a full transition must happen, it must happen either through efficiency improvements or price decline, but realistically through the combination of both (Fouquet, 2016). India needs to change its approach by transferring subsidies, price support and feed-in-tariffs from fossil to non-fossil sources as an important driver of higher penetration of renewables in energy mix. Climate change is a serious problem that requires serious solutions.

The Paris Agreement's principal contribution was committing all countries to limiting global warming to within 2 degrees Celsius, a threshold past which climate change disruption, if allowed to become even more frequent, severe, and unrelentless, is predicted to wreak havoc on all life forms on earth. Fortunately, incredible visionary approaches, governmental support, initiatives at all levels of energy governance, from local to national to the global, and of course due to plummeting costs, renewable energy has grown at an astonishing pace in recent years everywhere in the world, including India. A good example of this is India's impressive renewable energy story which has more than doubled its stock of wind and solar power since 2016.

The question arises; what drives this transition as well as what are the impediments to this transition? India's adoption of renewable energy efforts so far has been primarily motivated by government's development drive and cost-effectiveness rather than sustainability (Kay, 2021). India's 'development-first' strategy to everyone's chagrin has seen a development in the year 2022 reaching a capacity of 17.76% of the global coal-fired power capacity under construction, which is significantly higher than expected. However, it should be seen in comparison to its 587.231 GW cancelled project capacity equivalent to 35.53% of the global total (see figure 2). This is indicative of India's current energy transition compatible with a rapid shift toward decarbonising its energy sector, one that constitutes the single largest source of its carbon emissions (Lavasa, 2019). In this context, seen in comparison to the global renewables capacity in the last ten years (2012-2021), India from 60.456 GW to 147.122 GW has registered a 143% increase, while the world capacity registered an increase of 112% from 1443.923 GW to 3063.926 GW (IRENA, 2022).

Land acquisition is an enormous hurdle to the rapid adoption of renewable energy technologies (Ghosh, 2015). Although energy specialists keep insisting that it is theoretically conceivable to meet most or perhaps the whole of the present global energy demand from renewable sources at affordable rates, but in doing so it would take massive amounts of land, labour, and money, as well as other resources, to create both geographically large production facilities and newly configured

infrastructures and consumption networks (Harvey, 2010; Jacobson and Delucchi, 2011). This would entail not only utilising predetermined static areas of land and sea in new ways, but also fundamentally altering economic, geopolitical, and material relationships and configurations in a variety of different ways (Huber and McCarthy, 2017).

The story of coal in India has run parallel to India's growth story, and it's highly unlikely that it will change anytime soon in the future. India continues to expand its coal capacity, as several coal projects are currently under construction and several others have been announced, despite the utilisation rate of coal power plants falling (Climate Action Tracker, 2021). Based on the Global Energy Monitor's Coal Plant Tracker, India's coal capacity would increase from current (January 2022) levels of 231.947 GW (Global Energy Monitor, 2022) to almost 266 GW (Climate Action Tracker, 2021) by 2029-30. An increase of 14.681% over a period of 8 years. This underlines the economy's need for energy to sustain the current or even better economic growth rate the government desires. For India, this means heavy opposition from the climate change lobby as it prepares to increase domestic coal production by opening coal mining to private investors, worsening a fossil fuel lock-in and environmental damage. Whereas, to adhere to a 1.5°C emissions trajectory, India needs to phase out old, high-emissions power plans and replace them with low-emissions, high-efficiency plants (Kay, 2021).

	Announced	Shelved	Cancelled	Under Construction	In Operation	Operational Capacity +Under Construction
India	2.92	20.45	587.231	31.34	231.947	263.287
Global	107.693	107.283	1751.502	176.438	2074.732	2251.17
India's share (%) of the Global	2.71	19.06	33.53	17.76	11.18	28.94

Figure (5c): India's coal-fired power capacity (GW) compared with global capacity as of January 2022.
Source: My own construction using data from (Global Energy Monitor, 2022)

India is at the cusp of becoming a global economic powerhouse, and for this to come to fruition the government understands that energy will lie at the heart of this transformation. While electrification, energy access and affordability are primary concerns, India is cognizant of the effects of environmental degradation and global warming and their impact on economy if it did not transit to renewable energy.

Furthermore, it is notable that the situation has been further exacerbated by the escalating importation of fossil fuels, which account for approximately half of India's energy consumption. This prominent factor has spurred the Indian authorities to advance a series of ambitious energy transition policies (Waldron, 2017). For a country of 1.4 billion people (Worldometers, 2022) consuming just 6% of the world's energy and unreliable electricity supplies hinders its development. Renewable energy is an opportunity for India to meet the twin objectives of growing demand and improving energy security, while reducing environmental impacts (Waldron, 2017). From the point of fact, India's adoption of renewable energy to date has been motivated primarily by development concerns rather than sustainability.

5.1.1 The social rationale: increase energy access and reduce energy poverty

Despite energy being an embodiment of social attributes, energy policies often neglect the social dimensions in both conventional and non-conventional energy systems alike. Incorporation of social dimensions in energy transition can produce better societal outcomes. Reduced energy prices, job creation and energy access are some of the examples of better societal outcomes as critical components of energy transition, which affects full depth, breadth, and intensity of social issues as integral to social-energy systems (Laird, 2013). Failure to achieve these societal outcomes is largely due to neglect of social dimensions in the existing energy governance institutions and approaches (Hill and Olson, 2013). Energy systems are more than mere assemblage of fuels and associated technologies as against their portrayal by policy elites in terms of one type of source of fuel replaced with another, e.g., wood with coal, coal with petroleum and more recently petroleum with the renewables. The European Union, for example, while devising an energy regulatory framework for energy transition, envisaged citizens at its core so that they could benefit from new technologies in the form of reduced bills, participate in the energy market and protected from energy poverty where applicable (European Commission, 2015). The pursuit of an energy transition along a decentralized trajectory is currently being implemented in numerous countries. These transitions enabled by small-scale renewable energy technologies (RETs)

are replacing the conventional heavy centralised supply infrastructures with small and medium scale renewable projects (Arnold and Yildiz, 2015). These projects are geared to suit citizen participation and citizen ownership as against established energy companies and associated technologies for they are 'locked-in' to fossil fuel-based infrastructures due to their long-term heavy financial commitments (Unruh, 2002).

Citizenship ownership of energy as a concept is best understood when development of property is understood as both a legal and a socio-economic concept (Lowitzsch, 2019) as well as an important element of political stability in a functioning democracy. Who benefits, who loses, how, and why in relation to the current energy transition, who is affected by its sites of extraction, production, and generation, and who will be responsible for the social costs of decarbonizing energy sources and economies will all be central issues in the just transition's practice (Newell and Mulvaney, 2013a). It is particularly evident in the energy sector that the decisions made by owners wield a significant influence on the development trajectory as well as the living conditions of both individuals and society. It has been observed that basing consumer ownership rights in the local community produces higher acceptance of renewable energy projects when all citizens regardless of their income participate. It is the participation and decision-making approaches of renewable energy that distinguishes conventional investment models from participatory ownership (Rommel et al., 2018). In the light of attenuated sustainability obligation into property law, renewable energy projects that confer direct local consumer ownership are an alternative for community development.

5.1.2 External factors and India's changing position on climate change imperatives

India for long had refused adoption of specific commitments and target-based reduction in its carbon emissions in international negotiations, arguing that the developing countries' low share of historical emissions and their pressing development needs nullify their liability to respond to climate change as rapidly as wealthy industrialised countries need to do. A close inspection of India's energy generation capacity in the last decade and the projection for the current decade until 2030 suggests its impressive

progress in the renewables arena. The West fears that India's development in the first instance might jeopardise international cooperation on climate change, necessitating a rapid transitioning towards decarbonisation of its energy sector, the single largest source of its carbon emissions (Jayaram, 2018). India's massive drive for installation of new generating capacity for renewable energy outpacing the fossil fuels in recent years has made the country home to the 5th largest supply of renewable energy in the world (International Energy Agency, 2021a). At the UN Climate Change Conference (COP21) in Paris, India had committed its Nationally Determined Contributions (NDCs) to reach 40% (see figure 1) of electricity from non-fossil fuel energy sources (UNFCCC, 2015a) and which was upwardly revised to even reach 500 GW non-fossil energy capacity or 50% of its energy requirements from renewable energy by the year 2030 (Government of India, 2022).

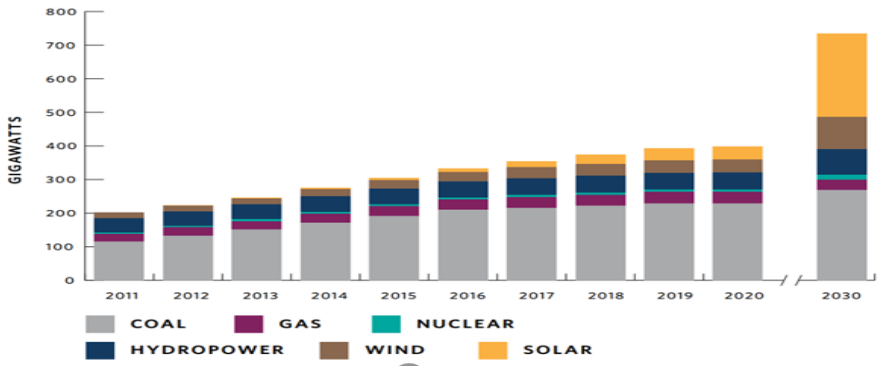

Figure. (5d). India's energy capacity, past and projected.
Source: IRENS (2021), IEA (2021), Global Energy Monitor (2021), MOSPI (2021) in (Kay, 2021)

5.2 India's energy in transition: reality on the ground vs. ideal to be achieved

An energy transition is a difficult, expensive, and complex socio-technological system of setting up new energy system that can potentially change the way economic activities of a country are evolved away from the fossil-fuel energy over a long period of time. The location of renewable resources is typically remote from major population centres, and the variability of power generation is quite high (Crabtree and Misewich, 2010). Also, what remains under researched is that minor penetrations of renewable energy on the grid may be seamlessly integrated, supporting more than about 30% of

electricity output from these renewable sources would need novel ways to expanding and running the carrying capacity of the grid quite significantly (Crabtree and Misewich, 2010)

In a world that is climate-challenged, the issues of access to energy and energy poverty are real for a large section of the populace, especially in the Global South that need urgent solution. The motivating factors driving the transition to alternative energy sources in each country are multifaceted and varied in nature. India, for instance, is making tremendous efforts to address this twin challenge of climate change and meeting energy needs of the people in a way that it doesn't jeopardise its development agenda. India has institutionalised renewable energy with the promulgation of the Government of India Electricity Act 2003, particularly Section 2(63) which promotes distributed generation through standalone energy systems (The Government of India, 2003).

Aimed at bringing about sweeping reforms in India's electricity sector, the Act also paved the way for the government's systematic and structured attempt at institutionalising decentralised energy in India. The Act was also directly responsible for coming into effect two policies, viz., Rural Electrification Policy-2006 (Plutshack, 2018) and National Electricity Policy-2005 (Ministry of Power India, 2005) which accelerated the (Sarangi et al., 2017) process of rural electrification through renewable energy based on decentralised energy systems in the country. While grid expansion is a commonly favored approach to enhance electrification rates, the implementation of renewable energy sources is increasingly being explored as an attractive alternative option for rural communities (International Energy Agency, 2017).

In the case of Indian decentralisation, Tariff Policy 2006 amended in 2016 and National Policy for Renewable Energy based Micro and Mini Grids 2016 stress the importance of supply of power to remote unconnected villages through decentralised off-grid networks. The policies initiated by the central government have spill-over effects on the state governments too. For example, the state of Gujarat had introduced a participatory scheme between the state government and local communities called 'Jyotigram Yojana' (light up the village scheme) in 2003. Another state called Odisha

introduced a similar scheme with 100% budgetary support for electrifying villages with a population less than 100 in 2007-08 (Sarangi et al., 2017).

5.2.1 The defining features of India's energy in transition - I: how democratic is it?

Energy transition is fundamentally a democracy issue (Sweeney, 2013) and the struggle to achieve the democratic outcomes of an energy transition at the community level are community resilience, community involvement, community decision making, community ownership and community empowerment, and at the economy level a just, ecologically sound, equitable, and life-sustaining economy.

A true energy transition akin to energy democracy is supposed to occur when there is a decisive shift in balance of power from private hands to workers, communities and the public, and a transfer of ownership of resources from private sector to a democratically controlled public sector and citizens (Sweeney, 2013). Furthermore, he contends that a strategic approach is required to democratise the energy sector, with the overarching goals of resisting and reconfiguring the prevailing fossil fuel energy paradigm and reclaiming the privately owned market-driven elements within the energy economy, in order to prevent the continued accumulation of wealth and power in the hands of private interests. For this to come to fruition, energy systems need to be restructured not only to shift from fossil-fuel power to renewable power, but also the shift from corporate control to more democratically controlled energy systems. Democratic control of renewable energy resources and related infrastructure is reinforced by their inherent characteristics of being geographically distributed. This property facilitates decentralised development of these resources at the local level through local initiatives by local people and communities.

The renewable projects in India follow an approach that supports large utility-scale energy parks which are quite antithetical to the very idea of a decentralised renewable energy system. In a 2020 official memorandum by the government of India's Ministry of New & Renewable Energy (MNRE), 19 sites across 7 states were selected for the development wind parks and/or wind-solar parks for generation

of 54Gigawatts (GW) of energy (MNRE Government of India, 2020). Each park should typically have a capacity of 500MW or more, but under no circumstances less than 50 MW. Furthermore, although solar power projects are built on contiguous ground, wind power projects require scattered land based on footprint, and substantially increase the cost of transmission as well as the likelihood of land-related problems. This is a clear deviation from any semblance of a distributed renewable energy system. How far removed the Indian energy transition is from a democratic distributed energy system can be gauged from who the energy transition is left with or who the decision makers are for developing the solar parks? The players who are entrusted with park development are (i) any agency of state government, (ii) any agency of central government, (iii) joint venture or Special Purpose Vehicle (SPV) of (i) and (ii), and (iv) private developer. These park developers are entrusted with preparation of Detailed Project Report (DPR) depending upon the availability of land and resource (MNRE Government of India, 2020).

As per the government stipulated guidelines, the park developers are required to prepare a Detailed Project Report (DPR) that covers all the aspects related to the development of park, such as technical, economic, environmental, and social aspects. Broadly, the DPR is concerned with 11 main issues it is mandated to address. Of the 11, the first two, i.e., identification of site/land and feedback from farmers regarding acquisition/lease reflect on the highhandedness of the land acquisition process, which takes place in a top-down manner without the involvement or participation of the landowners. Instead of engaging with the farmers, they are being treated as a party of least importance from whom "feedback" is sought after land has been acquired. In fact, farmers by virtue of their ownership of land, should be treated as principal stakeholders and land acquisition should be in full compliance with the due process of law.

The experience of India's energy transition shows that this transition is an extension of the existing unsustainable economic practices and acceptance of an idea that the commodification of natural resources is key to solving the climate change crisis. The commodification of natural resource, such

as renewable energy sources simply mean opening of new areas for economic and consequently social exploitation, marketisation, and privatisation.

The centralised energy systems are aligned with the shared interests of powerful economic forces and corporate state apparatus, both acting in defiance of democratic restraints if any. Decentralised energy system, on the other hand, is a provision of an alternative energy model critical for communities to participate in the control of their energy resources and wrest control, ownership and entitlement rights of energy resources and energy policy away from the dominant corporate energy establishment (Weinrub, 2014). An ideal decentralised energy model approaches energy as a democratised means of collectively or cooperatively developing, owning, operating, and generating electricity.

The global energy is under tremendous strain as it is facing numerous challenges on multiple fronts. These fronts include man pitted against nature, global North against global South, fossil-fuels against renewables, extractive economy against regenerative economy, and globalisation against local moments reclaiming sovereignty over their energy sources. There is much more to energy transition than 100% transition to renewables since the cultural, political, economic, and social dimensions offer a framework for deeper understanding of the climate change problem.

With these dimensions incorporated into transition framework, it provides a good justification for an alternative approach to the economic and environmental crisis. This approach reflects by citizens taking back control over energy resources as this is the only way people could exercise control over energy decisions and self-determine a sustainable and life-supporting energy future (Fairchild and Weinrub, 2017). Transition to 100% renewables is technologically possible, but then the question arises who will develop and control that energy and who will benefit from this?

If the motivation for the transition is decarbonisation of the economy alone then the basic social and economic system and the institutional framework remains intact because it fails to challenge the relentless capitalist growth that exploits natural resources and endangers the global ecosystem. Whereas a deep transformation of the economic system requires not only opposition to fossil fuel

capitalism, i.e., an economic system of capital accumulation which is premised on fossil fuel energy, ecosystem destruction, and social exploitation, but also a systemic transformation (Weinrub, 2014) that can infuse a positive change in community health, community resilience, and community empowerment. Therefore, an alternative to the fossil fuel energy based global economic system is the one that is based on renewables, rooted in justice, and responsive to people. This alternative represents addressing climate and energy issues at the community level in ways that meet community needs and the state's empowerment obligations to its people.

5.2.2 The defining features of India's energy in transition - II: people's energy in the hands of private sector - a case of commons turned into commodification

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5.2.3 The defining features of India's energy in transition –III: the missing decentralisation, ownership and social justice

Transitions involve complex and dynamic interplay between multiple technical, economic, political, and societal systems in conditions of deep uncertainty. The transition in India is assumed to be the continuation of historical transitions, started in 1990. The question then arises what does the development of sustainable energy transition rest on in India? Adoption of Mitchell's Regulatory State Paradigm (RSP) as a model used in the context of the UK is a good state regulated framework to

understand sustainable energy transition in India (Mitchell, 2011). Such a paradigm, she argues, has a danger of ideological lock-in as it creates its own institutions and policies arising out of these institutions based on the principles established by this paradigm, i.e., reliance on 'market competition as the main arbiter of value' (Mitchell, 2011). She further reiterates her contention that policies arising out of such a paradigm at best promote narrow, short-term, economic considerations which fall short of delivering technical, industrial, institutional, and human innovations required for a minimum standard of human rights, energy security and social wellbeing.

Policies are a by-product of the prevailing dominant paradigm. To facilitate a more comprehensive socio-economic transformation that promotes the implementation, dissemination, and adoption of energy transition, she contends that a political paradigm shift is required, one that is grounded in a holistic systems perspective rather than a narrow focus on technology alone. Speaking in a similar vein, Pope Francis' opined that the root cause of our present failures lies in the direction, goals, and social impacts of technological and economic growth (Kirby and O'mahony, 2018).

As a fast-growing economy, India is faced with a two-pronged unique dilemma of addressing growing carbon emissions, while maintaining persistent efforts at economic and social development to respond to pressing demands for poverty alleviation and energy access. Ahluwalia, Kanbur and Mohanty (2014) have used the 2011 census data to reveal a notable acceleration in urbanization trends in India with the urban population rising from 286 million in 2001 to 377 million in 2011. Projections indicate that the urban population is expected to surge to 600 million (representing 40% of India's total population) by 2031, accompanied by a commensurate increase in the GDP's urban sector share from its current 66% to an anticipated 75% by 2031 (Ahluwalia, Kanbur and Mohanty, 2014). The magnitude of this transformation, significant challenges and opportunities are likely to arise in bridging the rural-urban gap in India. The development pathway of India like that of the developed countries is based on the fossil fuel use and therefore needs transition to renewable or less carbon intensive sources, such as solar and wind.

Considering the unprecedented appetite for energy demand of a fast-growing major economy producing high volume of emissions, India is currently in the process of overhauling the conventional path of economic development by switching over to environment friendly, less carbon intensive energy system. The way out of the energy-environment-economy trilemma is not the decoupling of economic growth from energy consumption but the reigning in of unabated emissions by transiting to a clean energy economy through deployment of renewable energy technologies. The rapid innovation and fall of prices in renewable energy technologies has made adoption of renewable energy both economically and technologically more feasible (Lee, 2013). This will help reduce emissions while keeping socio-economic growth intact (Altenburg and Pegels, 2012).

India's energy transition involves multiple challenges with multi-layered governance being an obstacle to Indian ambition has a mixed record of success. The sharing of power between the centre and the state governments has produced a mixed record of success. Overall, the multi-layered governance has had a varied record of achievement. The "devolution" of power from the federal government to the states works in some instances, but it has a detrimental impact on the outcomes in others. States frequently struggle with developing mechanisms and local protocols to execute central policies. The example of electricity demonstrates that state-level application of national legislation is not always simple (Sartori and Bianchi, 2018). The failure of federal policies to be implemented at the state level is hampered by ambiguous processes and procedures.

Implementation of climate policy and financial allocations that may not be adequate to meet climate risk and challenges encountered by particular sectors varies greatly across states, regardless of actual requirements (Kumar, 2018). Additionally, issues can also emerge when funding mechanisms are unclear or blurred. For example, the federal government receives the project plans created by the state DISCOMs and electricity agencies and assesses and approves their viability without first allocating funds to state companies and organisation. India's multi-layered governance system prevents the full implementation of policies, for instance, the often-cited problems states face at the local level is

devising mechanisms and procedures to implement central government policies. This is largely due to inadequate local institutional capacities, lack of coordination among layers of national, regional, and local institutional capacities, and unclear processes for the execution of central government policies.

A wide-spread decentralised energy transition entails significant systemic institutional transformation including the potential for undermining the viability of traditional large power plants. The institutional architecture to facilitate and coordinate transition to a decentralised sector, an area of neglect, is central to the realisation of such a transition (Geels and Deuten, 2006; Hargreaves et al., 2013).

The existing centralised energy system making way for the emerging renewable energy infrastructures are geared to favour large-scale generation and corporate ownership which can be detrimental to building strong alternative energy systems (Breukers and Wolsink, 2007; Bolton and Foxon, 2015). The energy transitions can follow multiple transition pathways through dynamic interaction at and between different levels between technology and social factors within an 'action space'. These three actors, viz., government actors, market actors - large energy firms, and civil society actors, such as community and environmental groups have fundamentally different 'logics or framings of the key energy challenges (Foxon, 2013).

Justice is integral to transition, and it implies decentralised control and citizen ownership of energy. The major impediment against development of these decentralised energy is the large, utility scale, centralised generating systems which are based on concentrated financial and economic power. The conventional energy systems are framed by the 'energy trilemma', i.e., energy security, government's commitment to the climate mitigation efforts as enshrined in the Paris Agreement (UNFCCC, 2015b), and concerns regarding affordability without jeopardising economic growth. This framework which has been the all-important determinant of country's energy policy has come under increasing scrutiny in the light of falling real incomes for bottom 50% of India's population as it mainly addresses the concerns of a market friendly economic model based on corporate profit (Chancel et al., 2022).

The dominance of economic thinking in India's politics obliterates socio-technological interlinkages in the energy sphere, which creates larger governance difficulties. However, these debates are crucial for a future roadmap of alternative energy future under different governance arrangements (Foxon, 2013). Most notable in this new paradigm of civilisational transformation is the lack of a discourse on the 'civic energy sector' - municipal energy firms, regional energy planning, community energy schemes, and alternative energy funding. No significant effort has been made in India to question and understand the absence of this debate that could provide an alternative to the existing development paradigm that, under the right circumstances, 'civic energy sector' could become a substantial element of the entire energy system with the potential to steer the wheel of national development more equitably.

An energy transition driven by corporate energy agenda subverts the possibilities of a social and economic transformation as it is often undermined by corporate control of the state machinery (Sweeney, 2013). The centralised, corporate driven renewable energy system is ill suited to address the socio-economic transformation as it is primarily aligned with the “decarbonised growth strategy”, while keeping the fundamentals of the existing capitalist economic system intact representing different political economies and the potentials for democratic control heavily undermined (Weinrub, 2014).

In this context, the centralised renewable energy system is industrial-scale carbon neutral, while maintaining high energy consumption, capital accumulation, and wealth and power concentration. The decentralised renewable energy model is a powerful substitute to the current centralised energy model, effective in local job creation and bound by democratic controls. It's aligned with climate justice and a new economic arrangement unlike the current capitalist one. Although scholars are beginning to examine the social impacts of community energy (Nolden, 2013) and drivers of participation (Hoffman and High-Pippert, 2010; Hargreaves et al., 2013) the current debate has remained silent on the wider distributional impacts driven by existing structural and spatial inequalities.

Humanity’s common destiny largely guided by ‘economistic prejudice’ as Polanyi puts it in his influential book ‘The Great Transformation’ remains indeterminate and contested (Polanyi, 1944). The present energy transition through 'green' investment opportunities is controlled by private market processes that are insufficient to move human civilization towards a more balanced and regenerative connection with the environment.

The ideal shift or 'Great Transition' reimagines the relationship between man and nature, individual and community on a new paradigm of compassion, justice, and equality at all levels, local to global. This transition is based on a new development paradigm that redirects global development toward a socially equitable, culturally enriching, and ecologically resilient civilisation. The new paradigm replaces the traditional trinity of individuality, consumerism, and natural dominance because it prioritises profits above needs and economic expansion over ecological resilience. The new paradigm implies that wealth, resources, and economic opportunity must be shared between community members on minimum security, human rights, and social benefits. (Panula-Ontto et al., 2015).

Climate change is the biggest challenge humankind is facing today; thus, we have no choice but to decarbonise the earth. Therefore, the renewable industry must continue to expand sans replication of fossil fuel-based energy. Large-scale renewable energy is likely to deliver various significant advantages to help the country achieve the country global and national development and environmental concerns goals.

The spread of renewable energy is undoubtedly a crucial component of global mitigation efforts, but there are growing worries that some of these projects do not adequately consider human rights. At the heart of India’s renewable energy transition are multiple objectives of meeting the country’s electrical demands, foster domestic employment possibilities, and decarbonise its economy. For these projects to succeed and avoid suffering the fate of conventional fossil-fuel based power projects in terms of land, social, and environmental catastrophe, they must really accomplish these goals. This might endanger the entire energy transition.

The connection between modern energy and modern economies is a co-evolutionary outcome of synergistic relationship and not easy to separate one from the other (Byrne and Toly, 2006). This has led to a global climate change catastrophe, i.e., high levels of greenhouse gases in the atmosphere owing to fossil fuel usage All come from current energy systems. The move to renewable energy is inevitable. This transition, however, is taking shape differently in different parts of the world (Stephens, Wilson and Peterson, 2015). Energy transition has not kept up with a just transition whose implementation can benefit collective interest of community. In this context, energy transition embodies massive scales of social and economic transformations.

Transition has progressed from being viewed with distrust by business and government to being welcomed by everybody. A fair, development-oriented, low-carbon energy transition requires an alternative to centralised power production and distribution from conventional and renewable sources (Boamah, 2020). Current energy paradigms are regressive and have not been scrutinised as a contemporary energy system should be if a society characterised by large-scale centralised energy projects is to be organised. Modern energy systems fail to evaluate social initiatives like self-determination and local control over conventional and non-conventional energy supplies.

When a change or transformation takes place in energy technologies, there is a corresponding change in people's social practices, customs, values, relationships, and institutions, such as new forms of work and business models, and the ways in which people live, know, and understand things around them. The central characteristics and a conclusive outcome of the changes in energy systems is that, over time, these changes can lead to generating and reinforcing unequal distributions of power and wealth across the society.

The important questions that arise then, are who will comprise the energy 'haves' and 'have-nots' in a world consuming renewable energy; who will control access to affordable, reliable, decentralised sustainable energy supplies and who will not, and why so; who will benefit from new energy systems and who will lose (Miller, Iles and Jones, 2013)? These scholars further reiterate that although the

energy systems play a crucial role in deep structuring of social and economic arrangements, they are relatively hidden from public enquiry and scrutiny which can effectively choke alternatives.

5.3 Negotiating energy justice: key energy challenges for India

Given the critical nature of the global green transition, India faces a significant responsibility to consider the implications for the welfare of individuals, local communities, and broader social structures. In this context, India must engage in careful deliberation to determine what specific outcomes and equity considerations should guide its approach to the green transition. Here, to help fill that gap, this research uses justice domain scholarship to achieve socially just outcomes of energy transition from fossil-based energy generation to the one dominated by non-fossil sources, such as solar and wind based renewable energy currently underway in India. This transition is evident from India's expeditious march forward on its energy transition journey. India has crossed the 160 GW of installed renewable energy capacity (IREC), including large hydro, of which 100 GW is installed renewable power generation capacity (IRPGC) as of August 2022.

India has achieved its Nationally Determined Contributions (NDCs) target with a share of total non-fossil based installed energy capacity of 159.95 GW which is 41.4% of the total installed electricity capacity (Manohar, 2022). India has achieved the 40% target 8 years before 2030, the year Paris Agreement (Article 4, paragraph 2) requires "each Party to prepare, communicate and maintain successive nationally determined contributions that it intends to achieve" (UNFCCC, 2015b). Parties (countries) in adherence to the Paris Agreement were required to pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions. The Government of India in pursuance of its NDCs (UNFCCC, 2015a) under the Paris Agreement it set out to achieve the following three main goals, which are as follows:

(I). An economy-wide emissions intensity target of 33%–35% below 2005 levels;

(II). An electric power capacity target of 40% installed capacity from non-fossil-based energy resources by 2030, to be achieve with internationally support); and

(III). A carbon sink expansion target of creating an additional (cumulative) carbon sink of 2.5–3 GtCO2e through additional forest and tree cover by 2030.

Point (II) of India's NDCs, which pertains to electricity from renewable energy will form a point of reference for this research. Although successful in achieving the Paris Agreement targets well before 2030, a transition that puts people at the heart is missing significantly. This dichotomy has become glaringly evident by over emphasis on estimations, figures, and numbers to measure success of the energy transition mainly controlled by government, experts, policymakers, businesses, and environmental activists (Shukla and Sharma, 2021). To give an idea on India's transition approach that relies heavily on inanimate estimates, targets, the figure below capture this reality.

Category	Details	Estimates/Data
Targets for India	Reduce emission intensity of GDP by 2030 on 2005 levels	33 percent to 35 percent emission intensity
	Share of non-fossils in cumulative installed power generation capacity	40 percent
	Capacity of carbon sink to be created by means of increasing tree cover and forest area	2.5–3 billion tonnes of CO2
	Capacity of renewable energy power generation to be deployed by 2030	450GW
Investment / Finance	Funds need to be mobilised to attain India's NDC goal of reducing 33-35 percent emissions intensity of GDP	US $2.5 trillion
	Finance needed to meet India's requirement for supporting clean energy technologies in upcoming two decades	US $1.4 trillion for next two decades
	Investment required in renewable energy sector to meet India's 2030 target	US $500 billion
	Savings on decommissioning of coal assets older than 25 years with a total capacity of 35 GW	INR 377.5 billion
Employment Estimates	Global job losses by 2030 in fossil fuel-based industries owing to adoption of climate policies	6 million
	Global job creation by 2030 if right climate policies are adopted	24 million (including 2.5 million jobs in renewables)
	Number of people employed in India's coal sector	12 million
	Number of people employed in India's renewable sector (only direct renewable energy jobs as of 2017)	0.43 million
	Job creation if India deploys 450GW of renewables by 2030	0.5 million
	Job addition in India's renewable energy sector by 2042 under an "optimistic but realistic scenario"	4.5 million

Figure (5e). India's emissions reduction and renewable energy targets, employment, and investments requirements. Source: (Shukla and Sharma, 2021).

The content in the above table reflects the importance of what matters most for India is emissions reduction and renewable energy targets, investments required to meet these targets, and the projected employment estimates. It appears that the importance of the human element has been undervalued

amidst the numerical quantification, objectives, and projections associated with transitioning to a cleaner, sustainable future. Furthermore, the individuals whose lives will be most affected by this initiative are often regarded simply as statistical entities within the larger context of a nation's environmental objectives. This sheds light on the importance of mechanisms, motives, and overarching aims that guide and shape the actions of significant actors who wield considerable influence in driving transformative change (Shukla and Sharma, 2021).

5.3.1 Hiding social change behind the conflicting agenda of transition objectives and capitalist assumptions

The current energy discourse assessed in political-economic terms is symptomatic of a state of impoverishment. The strong voices within both conventional and sustainable energy camps advocate great rewards for society if their strategies are accepted, yet not realising that their assertion has not stood the test of social and political-economic power dynamics of the energy regime. However, there is a more acceptable and politically correct middle ground that accepts energy regime as an evolutionary product of larger institutional forms and formations that produce capitalist political-economic power structures of which energy regime is one component. This notion extends the logic that the global economy can strive to promote the sustainability agenda if the ‘raison de market’ succeeds in leading the energy policy debate.

The advocates for or against conventional energy sources claim that sustainability drive will trigger a trade-off between the environment and the economy suggesting that profit and decrease in carbon can co-exist (Lovins, 2005). This approach carefully is crafted to suit the capitalist political economy interest of the emerging renewable energy regime which strangles a reasonably pragmatic social response that otherwise could open the doorway to new future pathways (Martinez-Alier, 2006). In this regard, a social analysis of political economy of modernist energy transition leaves the status-quo uninterrupted. Since the technical developments are manifested in social, material, ecological, intellectual, and moral domains, they have the potential to give rise to a wholly or partially different

development pathway (Toly, 2005), but it is also possible that these technologies get appropriated by social forces acting to thwart social promises attached to them.

Large-scale changes in the energy systems go beyond the changes in fuels and related technologies. The prevailing discourse on energy transitions falls short in addressing vital debates concerning the distribution of income, marginalization or threats of complete occupation loss, and the autonomy of communities in exercising control over their land-use patterns. These matters warrant serious investigation and analysis. The most important commitment a government takes upon itself is meeting electorates' aspirations for an energy intensive prosperous lifestyle which it thinks can be best met by pursuing a high growth economy.

While governments relentlessly pursue high economic growth, they choose to be mindful of the impact transition might have on the growth in both short and long run. In relation to the transitional impact on economic growth, there are two conflicting narratives - that the transition is an opportunity to boost economic growth and increase employment, and a counter argument that advances the narrative that transition is too expensive. There is indeed a majoritarian expert opinion that adapting to climate change might be more expensive than mitigation measures. However, equally strong arguments are put forward against mitigation which might negatively impact economic well-being, disposable income, income growth, and the distribution of burdens arising out of transition (Luciani, 2020).

The key role and purpose of energy, regardless of its source has been to support ongoing and expanding economic activity whose success is measured solely on Gross Domestic Product (GDP) growth and pushing it to higher levels to fulfil greed and development aspirations of the people. The political impetus towards sustained economic growth, predicated in great part upon the centrality of energy, has materialised into a widespread construct of energy as both a strategic resource and marketable commodity. This makes it more difficult to make our economies less energy intensive or to start consuming less energy.

Access to energy is another important objective and a key determinant of energy transition. Ensuring reliable affordable energy services and combating energy poverty entail a crucial infrastructure component. When this takes priority, energy is considered a social necessity, especially among developing countries where people are still without access to modern energy sources. Although eradication of poverty is a high priority concern on the international development agenda, poverty-energy linkages are not. Viewed from the perspective of national growth, there is a strong correlation between the quantum of energy consumption, economic growth (Feinstein, 2002; Dubash and Florini, 2011) and human development (Martínez and Ebenhack, 2008).

Reduction in carbon emissions and striving for environmental sustainability form the last of the objectives responsible for energy transition. The importance assigned to environmental sustainability is arguably the single most dramatic shift in the global energy governance landscape since the 1990s (Dubash and Florini, 2011). Energy, viewed through an ecological lens, has gained traction on the back of mounting apprehensions linked to global climate change, along with regional anxieties surrounding pollution and environmental degradation. This objective, however, has its origin in energy concerns of the 1970s and has garnered global attention of mammoth proportion since early 1990s (Cherp, Jewell and Goldthau, 2011).

There persists a lot of confusion and uncertainty about which of these three - economic growth, energy access, and climate change determine energy transition and whether renewable energy is primarily about economic opportunity or human survival or both. While these uncertainties surround energy transition, renewable energy deployment becomes the principal unifying force for these goals which may appear to be at cross purposes with each other. While the rationale for energy transition is to provide energy for economic growth, reducing poverty and climate change related environmental degradation (Roehrkasten, 2015), these objectives are a camouflaged narrative for an idealised future energy pathway.

These divergent transition objectives converge around a consensual agreement for a centralised top-down renewable energy system of the future which obscures potential for alternative models. This approach is favoured by many major carbon emitting countries as they believe that the renewable transition can be best achieved through an ideal combination of corporate ownership and government governance. Such a model of transition is best suited to facilitate large-scale, remotely sited centralised top-down electricity facilities (in this case solar and wind turbines) through a smart network of interregional, interstate, and intercontinental transmission lines. Since centralised electricity generation has attributes of top-down planning, centralised control, and negative local impacts at the generation facilities' sites (Klagge et al., 2020), emergence of a counter narrative paves the way for an alternative model associated with bottom-up planning, decentralised control, and positive local impacts. Centralised energy like other infrastructure projects is complex, multilayered, and heterogenous system that can neither be planned nor implemented and governed in a top-down fashion (Harvey, Jensen and Morita, 2016).

5.3.2 Unpacking transformative social change dynamics of energy transition

Unmitigated climate change is a looming existential threat to life, not just human but all life forms. A popular mainstream framework offered as solutions to climate change is the technocratic and market-mechanism based responses including switching to renewable energy. In contrast to much of the academic discourse around energy transition which mainly draws on techno-economic dynamics, political economy approach sheds light on the dynamic interaction between technology, politics, culture, economics, and power (Kirby and O'mahony, 2018). A clear strategy to conceptualising and placing the energy transition away from a technocratic realm is desired and inevitable.

Kirby and O'Mahony (2018) object to the rising tendency of developing complicated and abstract quantitative scenarios via "black box modelling". Their method distinguishes transition from transformation, which they defend as more than semantics and a vision that challenges the established paradigm. Transitions seek for modest improvements inside the current paradigm, while

transformations revolutionise it into a system with new values, ideas, institutions, and vision. This new paradigm sparks conversations about power, equality, and social and political challenges. Neo-corporatism has become a barrier to essential transitions owing to the contemporary state's capacity to incorporate well-organized interests into political decision-making (Kirby and O'mahony, 2018).

Energy scholarship since the 1970s has sought to establish a deep entrenched relationship between energy use and societal structures (White, 1943; Cottrell, 1956) with immense potential for social transformation. However, analysed from the social transformation point of view, in most part, the forms of changes refer to innovations that focus on technological aspects of change and do not affect the existing power players of the energy systems in any significant way (Child and Breyer, 2017).

The concept of transformation, generally assumed as an outcome of sustainability transitions across domains and disciplines, does not necessarily guarantee a shift that characterises a complete, comprehensive, and all-encompassing transformation in the very institutions and socio-political hegemonic relations that perpetuate them in the first place. In addition, such transformations cause empowerment or disempowerment of social actors and the emergence of co-evolutionary changes in energy systems and the way they relate to social-material context (Schota and Kanger, 2018; Avelino et al., 2019).

The nexus between energy and society extends to communities, companies, and non-governmental organisations, with various consequences for policy framings. In this context, energy-society issues such as low-carbon energy transition, energy poverty, energy-for-development, energy justice, and energy security produce alternative visions of a desirable energy future with different political and economic interests, targets, and consequences for different actors.

The present energy transition is geared to achieve sustainability without addressing socio-political change within a development agenda, which undermines the transition aims of social transformation (Klein, 2014). To avoid becoming a mere add-on to existing energy infrastructure, we must increase our commitment to the ways in which the co-evolutionary dynamics of transition and transformation

fundamentally enable collective empowerment through the creation of new possibilities for radical societal transformation. Norgard (1994) and Cederlöf (2015) agree with Klein (2014) that if energy transition is only a technological transition, then the social transformation opportunities for collective choice of energy futures will be lost and the injustices associated with the fossil fuel regime will continue unabated (Norgaard, 1994; Cederlöf, 2015).

Laird argues that there is an acute need for energy policy to have a critical insight into the nature and implications of energy transitions because of the profound social and political disruptions such energy changes portend (Laird, 2013). He maintains that transition assumes a transient movement from one equilibrium to another. What's changing during this transitional period? Policymakers describe energy systems as an interacting system between technology and fuel sources, e.g., a wood-, coal-, or petroleum-based civilization. Energy systems go beyond fuel and technology. From a socio-technological systems perspective, this framing of energy transitions undermines the inevitability of widespread social, economic, and political transformations that need to be included into energy systems change discourse. Replacing coal and natural gas-fired power facilities with wind and solar is a system shift, but it's fundamentally different from replacing a substantial chunk of centralised production with more dispersed generation (Miller, Iles and Jones, 2013).

The renewable energy goal has been confined to balancing economic development and climate change mitigation, while the fundamental motivation is centralised profit maximisation by huge multinational enterprises. Energy transition based on these premises offers little opportunity for social transformational potential and highlights an alternate logic for picking energy futures based on political economics and social consequences of larger socio-political aspects. Despite energy's prominence in human civilization, the relationship between energy transition and social development has been overlooked (Agustoni and Maretti, 2012). The broader socio-political dimensions include the consequences implicit in how, by whom, and in whose interests the energy transition is underway.

Different forms of change in energy system produce changes with different implications for society, for example, market driven, top-down incremental changes managed smoothly but rapidly through technical compliance, social control, and a sense of urgency are fundamentally different from those that have been forged through democratic social struggles (Child and Breyer, 2017). The uncertainties regarding the impacts of renewable technologies and shortcomings of current governance dynamics necessitate the importance of a comprehensive scrutiny of realising social performance potential of renewable energy futures.

As a co-evolutionary process and agent of change, energy transition may lead to new infrastructure and economic assets, as well as a basis for social transformation centred on equality and justice. In the context of climate change-induced energy transition driven by a capitalist-industrialist political economy, a change in the present energy system is unavoidable, but a social transformation is in question. Societal changes arising from energy system transformation have been infrequently examined, and when they have, the scope has been narrowing, focusing on fuels and related technology or public opinion and public acceptance. The relationship between energy transitions and cultural and social consequences has often been neglected (Agustoni and Maretti, 2012; Jasanoff and Kim, 2013), mainly because transitions are treated as business-as-usual forms of capitalist modernisation. Social consequences of energy transition from centralised to decentralised energy production that might turn energy consumers to energy producers, and the specific human development outcomes are little explored areas of transition studies (Miller, Iles and Jones, 2013).

5.3.3 Community energy: the alternative pathways to energy transition

Community Renewable Energy (CRE) projects play a central role in shaping and mediating social justice issues and a subject for wide relevance in the pursuit of a just and holistic energy transition. CRE provides, as it will become clear through the progression of this thesis, wide ranging opportunities for addressing social justice issues along the full value chain of the energy system and beyond. The embeddedness of social and technical relations in CRE makes it transformative and communitarian

that may broaden participation in the energy system. In addition, CRE helps generate pressure for changes in the way energy is generated, supplied, and consumed that could have far-reaching consequences for the future of our energy systems. This approach, however, is in contravention to the mainstream energy transition approaches that prioritise and privilege elite actors - large scale corporate owned, centralised renewable energy infrastructures (Jenkins et al., 2016) at the cost of obliterating real actions by community main stakeholder on the ground, the contested locations where power and injustice are visible, experienced, resisted and negotiated for better social outcomes (Schlosberg, 2004).

The energy systems comprise some of the largest and the most capitalised forms of technological enterprises around which modern economies are organised. These large-scale energy transitions are a clear case of government policies, business plan, and technology designs that discourage the development of distributed installations in favour of industrialised, large-scale plants that may have much greater ecosystem and land-use impacts. The transformation in these complex energy systems involve changes not only to energy technologies and prices but also to the broader social and economic systems which are built around energy production and consumption. However, the planning and policy seldom reflect on the broader dimensions of energy systems transformation (Miller, Iles and Jones, 2013). Scholars like (Abramsky, 2010) have emphasised that the current energy debates are restricted to energy engineers, bureaucrats, and economists and therefore there is a need for enlarging their scope and nature to include the meaning and consequences of energy systems and their changes for diverse groups of people. There is an interdependence between energy systems and the people as agents of change, whether these agents are government-controlled policy makers, business managers, innovators, and engineers, or simply consumers.

The energy transition is fraught with many a challenge. The challenge, however, is not one of choosing between different fuels but between different forms of social, economic, and political configurations that result from adoption of new energy technologies. The present electricity systems are self-serving

large scale, giant power plants connected to consumers through a system of interconnected transmission and distribution networks. These changes for the reasons of their impact are much more than changes in fuels and technologies (Bijker et al., 2012).

An energy system transition to a decentralised renewable energy can in turn create not only an environmentally benign, but a more democratic and egalitarian society (Laird, 2003). This has several implications for societies as a new debate to determine whether utility-scale, community-scale, or household-scale renewables installations will form the heart of future solar energy developments has started to gain momentum in several parts of the world, especially in Europe (Miller, Iles and Jones, 2013). What should constitute the future energy systems depends on whose interests gain prominence in policy formulations.

It is important to consider that the utilities level installations enjoy a clear advantage of economies of scale and easier integration into electricity grids, whereas electricity consumers using small-scale, distributed installations have the advantage of accessing cheaper energy because they do not pay for the costs of building and maintaining the electricity grids. In addition, this type of energy offers individuals and households a more personal, hands-on relationship with the production of energy (Miller, Iles and Jones, 2013). An impending danger that lurks in not too distant a future is the prospect of utilities losing increasing numbers of households and businesses as portion of their electricity demand start to decrease.

The predominantly important role energy plays in the economic and social life implies that energy systems owe their existence, especially their ownership, control, and governance to a broad set of social acceptance. For energy to be socially responsive, secure, and affordable ownership models associated with energy production include public, private, and community-owned systems. The growth of community energy as a decentralised form of renewable energy in recent times has challenged the continuance of status quo of conventional electricity which is based on separation of generation and distribution systems. This transition, however, is not merely a transition from fossil fuels-based energy

to clean energy but an experimentation with alternative models of ownership more responsive to the needs of energy consumers, and able to accommodate a desire for greater inclusion and participation in decision-making about energy futures.

The term community has a heterogenous character and takes on different meanings across contexts, interests, and spatial settings. Community in this thesis is therefore used in the sense (Walker, 2011) uses it as a place specific actor with agency, scale, and process. Whereas, for (Bristow, Cowell and Munday, 2012) community refer to a place or interest. Community renewable energy is an energy Community energy, mostly a European concept, is a highly complex and contested subject and there is no one singular explanation of community renewable energy that can encompass the true variability existing therein. There are numerous challenges involved in understanding, depicting, analysing, and conceptualising community renewable energy in literature.

Scholars have referred to CRE by different names, but in most cases, they are discussing the same or almost the same subject matter with a changed nomenclature. For example, community renewable energy has been referred to as community energy, politically motivated energy projects, community energy projects, renewable energy source co-operatives (Walker and Devine-Wright, 2008; Becker and Kunze, 2014; Haf et al., 2019; Hoppe, Coenen and Bekendam, 2019). The most common notion of community renewable energy involves activities that are scalar in character with meso-level developments (Devine-Wright and Wiersma, 2013), local and participatory in generation, and equitable in benefits (Walker and Devine-Wright, 2008). CRE in this sense represents a development model rooted in local context with high level of acceptance by the host community (Walker et al., 2007; Hielscher, Seyfang and Smith, 2011).

5.4 Unpacking the energy dilemma: decentralised vs. centralised transition

While the role of energy in sustainability and economic development is universally accepted, how its transition is differently impacting different actors with multiple priorities and vested interests is not. How these actors respond to these challenges in a democratic way is still an understudied area which

warrants scrutiny. The analysis involved brings into focus the politics of vested interests both in the government and the industry which together determine how issues are framed, positions asserted, a narrative built, and goals set. While this safeguards the commercial-political interests of alliances forged for change or against change, it undermines the democratic rights of community to contest and oppose the commercial interests in the face of absence of community consultation. The concept of transition is intertwined with the ideals of democracy and the centrality of government's pursuit of policy objectives without public participation. It implies replacement of one energy system with another. The policy makers, while implementing transition, are concerned mainly with fuels and their related technologies. The devastating climate change impacts of conventional energy systems motivate transition to renewables the world over. The current energy systems are no longer environmentally sustainable and are increasingly becoming financially unviable too due to steep decrease in renewable energy enabling technologies worldwide.

Renewable energy transition understood simply as a process of converting the conventional modern energy systems based primarily on fossil fuels to those based predominantly or entirely on renewable energy sources is tantamount to energy regime rendered captive of euphoric technological visions with little to no consideration to society-energy relations. Looked at from the perspective of establishing a more democratic energy option with better society-energy outcome, the exponents of this vision present human scale development based on local aspirations and local determinations to achieve universal social ideals of a balance between human, energy, and ecological conflict. This vision implies a potentially transformative relationship involving society, energy, and the environment (Vaitheeswaran, 2005). Enabling individuals who have been relegated to the periphery of industrial energy systems to access power sources is a remarkable byproduct of energy transition (Mumford, 1971). This proposal implies a potentially transformative relationship involving society, energy, and the environment, by facilitating access to power sources for individuals who have long suffered marginalization from industrial energy systems.

5.4.1 Centralised energy systems

The centralised energy systems are just the opposite counterparts of decentralised energy systems and have the attributes of rigidity, centralised control and management, and harmful impacts on people and environment in proximity of the project (Boamah, 2020), including deterioration of local environmental resources, displacement, relocation, and loss of livelihoods. These facilities are implemented and operated from a distance while adhering to cross-scale interactions with the central leadership that controls planning, development, financing, ownership, and management issues. Also, there is no guarantee or legal requirement that these large, centralised plants will even connect hitherto unserved local communities in peripheral areas to the expensive national grids (Alstone, Gershenson and Kammen, 2015).

Besides variances in technology, space, and governance, centralised and decentralised energy systems differ significantly in their ownership and financing. Whereas the top-down scheme of transition draws upon and sustains itself on a neoliberal economic, veiled, and obscured agenda, advancing a narrative of progress, eco-friendly growth, and modernisation (Kumi, Arhin and Yeboah, 2014; Curran, 2015; Gupta and Vegelin, 2016) the status-quo of the modern social order coevolving with the use of fossil fuels remains intact (Norgaard, 1994).

The social analysis of contemporary energy-society relations, therefore, becomes important. Kumi, Arhin and Yeboah (2014) draw attention to contradictions in the neoliberal economic agenda, i.e., on the one hand, it pontificates market-based mechanisms, privatisation, trade liberalisation, and withdrawal of government from most economic activities, on the other, it firms up its grip on resources by enabling greater concentrations of power (Kumi, Arhin and Yeboah, 2014). Admittedly, to boost development of wind and solar energy projects in India, they are currently excluded from environmental and social clearance as well as from socio-environmental impact evaluations. Mandatory evaluations are crucial as preventative measures to mitigate any potential effects of the project on both human and animal lives. In the absence of proper regulatory frameworks, it is difficult

to achieve a fair, equitable, and sustainable energy transition (Sohail, 2020). While this narrative has gained ground in public acceptance, politico-economic logic, and a growing interest within scholarly community, there is an alternative vision of people-centric transition advanced by civil society and activist communities which remains outside the conventional discourse on 'renewable energy transition', and largely outside the radar of academic scholarship.

5.4.2 Decentralised energy systems

A decentralised energy system is better and more beneficial not only from the perspectives of local development and sustainability, but also because of there is a good bonding and close relationship between power generation establishment and consumers (Bouffard and Kirschen, 2008; Boliko and Ialnazov, 2019) and they are found to be supporting local development. In addition, the decentralised systems have a strong element of major structural transformation from centralised, dispatchable, carbon intensive systems to variable, renewable energy-based systems manifested by local governance and actions at different levels of society.

Restructuring is not a combination of human capital and technological swapping alone, but a broad transformative process for development of local jurisdictions, capacities, and expertise by unlocking and tapping into local human capital (Boselli and Leidreiter, 2017). This approach embodies the broad spirit and contours of decentralised and democratic model of renewable energy transition (Becker and Kunze, 2014; Angel, 2016; Becker and Naumann, 2017; Moroni, Antoniucci and Bisello, 2019). This is also true to some extent of the Global South where community controlled, civil society, activists, and municipalities led decentralised democratised energy initiatives are addressing energy needs of society (Wu, Schiffer and Burns, 2016; Becker and Naumann, 2017; Ockwell and Byrne, 2017).

Attempts to mainstream the existing centralised renewable energy governance model as distinct and superior pathway for an exclusive development trajectory undermines not only a possible substitution of non-renewables with renewables, but also a competition among other diverse and innumerable alternatives for renewable energy futures (Papachristos, 2017). In the light of these emerging

alternative models of energy governance, scholars have proposed a new set of political tools that promotes the need for a decentralised renewable energy system shaped and adapted by local actors to suit their design to their specific local need, context, and identity. While transition to 100% renewables is rooted in the belief that each place is unique with its unique needs; actors as well as civil society groups aiming to harness local potential therefore must build on the distinctive characteristics and potential specific to each place (Boselli and Leidreiter, 2017).

5.5 Land as conflicting territory between renewable project developers and the landowners

The land acquisition for renewable energy projects is a controversial issue which creates conflicts and tensions between project developers and landowners in India. There are competing demands for the use of land for renewable energy projects on the one hand and for agricultural, forestry, and many other economic activities on the other. Land acquisition is a complex process and some of these complexities are primarily due to issues related to multiple government agencies being involved in the process, which can lead to delays and conflicts. The Panchayats, local governments, state governments, and central government agencies, each with their own rules and regulations related to land use and acquisition present major challenges.

The transition to renewable energies has started to intensify the competition for land and the potential impacts driven by solar energy is an area of concern and needs analysis. As India starts to implement its commitment to carbon emissions, Indian power system is due to undergo a profound transformation. The largest challenge facing Indian developers of solar and wind energy projects is land acquisition. In the system of governance of the Indian state, there are three main categories under which there are division of duties and responsibilities allocated between the central government and the states. In India, land is a state issue, hence obtaining or leasing it requires consent from multiple agencies of the state government, including the revenue department and state nodal agencies, among others. The entire process is painstakingly arduous and very time-consuming because there are layers after layers of agencies involved.

The government of India has identified 19 sites spanning seven rich-in-renewable energy states for the development of wind and wind-solar hybrid parks that together have a potential of about 54 Gigawatts of capacity. This is in line with India's 2022 target of 175 Gigawatts. This is the world's largest transition plan in renewable energy (Manohar, 2022). These projects are the zones for potential land conflict relating to environmental and community related issues. Many believe that India in pursuit of energy transition has overlooked land conflicts and its irresponsible energy development may not be anything better than shifting conflict from coal-bearing areas to the renewable energy projects sites (Aggarwal, 2020).

Land conflicts have further increased in some states using outdated laws to acquire land. It is mandatory for states to acquire land in compliance with the federal law – 'Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013' (also Land Acquisition Act, 2013 or LARR Act 2013) (Government of India, 2013) which actually replaced the colonial era Land Acquisition Act of 1894. The new law increases compensation for landowners, landowners' consent mandatory prior to land acquisition, and requires projects to first carry out the social impact assessment of land acquisition. However, with the land acquisition law (LARR Act 2013) coming into force, there is a shift in the farmers and land owners' perception of land from something that needs reclaiming from commodification to something that can be used as a transactional asset in the market for a better deal within a market-driven framework (Nair, 2019).

The issue of inadequate compensation in cases of compulsory land acquisition is a common subject of debate. However, aside from the discussion of the level of compensation provided, there exist significant apprehensions regarding the procedural mechanism that governs the final compensation outcome, which can exacerbate the emotional distress of affected landowners. This deserves careful attention and further investigation in order to address the complexities of compulsory land acquisition outcomes regarding big infrastructure projects, including renewable energy (Shukla, 2021).

In Maharashtra, Karnataka, and Tamil Nadu, land acquisition for large projects is being carried out using outdated 1894 Land Acquisition laws even after implementation of the LARA Act, 2013 that guarantees fair compensation. These laws allow the state to acquire land without the landowner's consent on below the market rate compensation (Gokhale, 2019). The Madras High Court ruled the violation of LARA Act, 2013 by the Tamil Nadu government unlawful. Apart from these three states, Gujarat, Jharkhand, Telangana, and Andhra Pradesh enacted altered versions of this law to circumvent the restrictions imposed by the 2013 Act. Unfortunately, most states have diluted this Act to suit their development needs.

The idea of land acquisition in India falls within the broad sphere of constitutional property regime governing 'eminent domain' which the government employs to acquire land (Gupta, 2012). Prior to 1979, right to property was a fundamental right, which after the 44th amendment coming into effect was reduced to a constitutional or legal right and the state became empowered to acquire any private property for the public use (Hamaad, 2021). The 44th amendment that states "no person shall be deprived of his/her property save by the authority of law". However, this does not mean that such laws cannot be challenged, as the Indian Constitution provides citizens with the right to challenge the constitutional validity of any law. The 44th amendment removed the right to property from the list of fundamental rights but retained it as a legal right. The amendment also included the provision that any deprivation of property must be authorized by law. This provision was likely included to limit the government's ability to acquire land and to provide citizens with a safeguard against arbitrary state action. For these large-scale renewable energy projects, land conflict is a real problem that can't be delayed just like energy transition cannot be delayed.

Those closely following the renewable sector and land issues conflict stress that while there is overall support for deployment of renewable power, it should be implemented in a way that avoids conflict and ensures justice for communities and the environment. The project developers also need to consider the farmers' emotional attachment to their land. The use of land as an transactional asset among

farmers is influenced by their moral economy, wherein their pride, perception of state injustices, and fear of identity loss play crucial roles (Nair, 2019). The projected land requirement for these projects is quite staggering. For example, the government has identified 10,800 square kilometres of land spread across 19 sites in seven states for the proposed policy of developing 54 GW of renewable energy from wind parks and/or wind-solar hybrid parks to meet 175 GW by 2022.

If India were to meet energy production targets of 175 gigawatts (GW) by 2022, then the land footprint required to achieve this ranges from 55,000 to 125,000 km2 or roughly the size of Himachal Pradesh and Chhattisgarh, respectively (Kiesecker *et al.*, 2020).

Table showing installed and targeted capacity for 2022 and 2030.

Renewable Sources	**Installed Capacity (GW) 2022**	**Target (GW) 2022**	**Target (GW) 2030**
(a). Wind	40.08	60	No source specific target
(b). Solar	56.61	60 Utility Scale 40 Rooftop 100 Total	No source specific target
(c). Biopower	10.61	10	No source specific target
(d). Small Hydro	4.83	05	No source specific target
(e). Large Hydro	51.352	Not available	No source specific target
(f). Total-1=(a+b+c+d)	112.12 a/o 31 March 2022	175	500
(g). Total-2=(a+b+c+d+e)	159.95 a/o 31 March 2022	Not available	Not available

Figure (5f). Table showing installed and targeted capacity for 2022 and 2030.
Source: My own construction using references from (Ranjan, 2020; Manohar, 2022; Perninchery, 2022; Press Trust of India, 2022).

- The total capacity for wind, solar, small hydro (exclusive of large hydro is 112.12 GW at the end of 31 March 2022 and inclusive of large hydro is 165.472) as in the table.
- The total capacity for wind, solar, small hydro (exclusive of large hydro is 114.07 GW at the end of 30 June 2022 (Press Trust of India, 2022).

Conclusion

This chapter succeeded in establishing India's position as a global leader in energy transition despite having a beleaguered history of heavy dependence on fossil fuels mainly because of its policies of

undertaking large, centralised energy projects. This, however, will have long lasting irreversible impacts on both natural resources and society.

The rationale compelling India's pursuit of transition in the face of the challenges presented by climate change originates from the mounting energy needs prompted by the country's economic growth. The industry is in total control of the private sector. The very essence of renewable energy, i.e., decentralisation and distributed character of transition has been lost in India. The chapter concludes that decentralised distributed renewable energy system is the more suited for India's development. It further goes on to prove that the current Indian energy transition overlooks the social justice implications embedded in transition.

Access to energy and energy poverty are real issues, especially in the Global South, and they need immediate solutions in our world that is plagued by climate change. The transition that is taking place in India's energy sector is being driven by a diverse set of forces. Renewable energy has been institutionalised in India thanks to the government's drive to become a clean energy powerhouse. India is making significant efforts to combat climate change and satisfy the energy demands of the people, all without compromising its development goals. Despite the passage of the bill that paved the way for the government's systematic and organised effort to institutionalise decentralised energy in India and bring about major changes in the electrical industry, not much has changed on the ground, and renewable energy continues to be generated through large, centralised plants.

6 Justice Lost - I: India, the Mute Spectator of Forced Labour in its Solar Supply Chain Linked to Xinjiang in China

Introduction

This chapter analyses the links between the production of solar-grade polysilicon, the compound that is the main component of solar cells and modules and the forced labour in the Xinjiang Uyghur Region of China and the moral and ethical implications to India's solar systems. While the forced labour, camouflaged as poverty eradication programme of the Communist Party of China, in the Uyghur Region has pervaded an entire supply chain and reaches deep into international markets, India being a major importer of these modules has maintained absolute silence. The renewable sector must take into consideration labour and human rights violations, particularly in regions where extraction/mining of raw materials manufacturing occurs.

6.1.1 India's solar energy industry and forced labour: the China connections

The Business and Human Rights Resource Centre (BHRRC), a London based prominent organisation that works to advance human rights in business and eradicate abuse by "amplifying the voices of the vulnerable, and human rights advocates in civil society, media, companies, and governments" received between 2010 and 2021 over 200 allegations of human rights violations linked to the renewable energy sector (Beemt, 2022). There are significant human rights and forced labour related violations connected particularly to the solar industry. Close to 50% of the world's supply of polysilicon that goes into the making of solar panels is sourced from the Xinjiang Uyghur Autonomous Region in China or Xinjiang. Research by the Sheffield Hallam University has traced major solar supply chains from raw materials to panel production, found alarmingly significant forced labour concerns linked to the region for 90 Chinese and international companies (Murphy, Laura and Elima, 2021). This necessitates backward linkages to be integrated in our renewable energy system.

The energy systems as opposed to a common understanding are international systems, both in character and composition. They are characterised by a complex network of "source-to-sink" actors and activities spanning political boundaries and geographical spaces. However, the energy policies are grounded at the national level, ill-equipped to tackle transboundary issues (Goldthau and Sovacool, 2012) and in most instances oblivious of issues, such as the use of forced labour in the manufacturing of components used in our new energy, i.e., solar energy system. This has resulted in obliviating our sense of concern for human plight and suffering within the domain of solar energy value chain.

The energy policy domain, as a result, largely remains detached, indifferent, and prejudiced to the larger issues of ethics and justice (Jenkins, Sovacool and McCauley, 2018). What follows from this is the need to move away from conceptualisation to operationalisation and integrate the human dimensions of ethics and justice in the complex and geographically expansive solar value chain of the new energy system. The use of forced labour in the manufacturing of solar cells and modules, and many other products in the global value chain worth billions traded every day across the nations has become a serious issue of concern for industries, governments, international conscience keepers, such as the United Nations to focus on where and when injustice is felt and experienced. To understand the justice dynamics at play, it is important to consider who, where and whose rights have been violated and their recognition within official processes.

The intersection of energy and poverty encompasses social and environmental factors in pursuit of fairness and impartiality for those affected by the extremes of energy production and consumption. This necessitates untapped and timely potential for seeking answers to the nature of violations and regulatory safeguards along the supply chain. In India, unfortunately, there is no specific legal framework for recognition of justice related issues in energy supply chain. While energy justice has become an important research concept in justice studies in about the last 10 years (since 2013 to be precise), the omission of interest of affected communities along the energy continuum is missing. It is incumbent upon us to direct our focus towards the vulnerable communities that are adversely

impacted by conditions resembling those found in 'energy sacrifice zones', and require urgent attention (Morrone et al., 2011). The interplay between supply-side and demand-side forces in the energy landscape has caused vulnerabilities for various communities, workers, and stakeholder groups across the entire supply chain, spanning from production to consumption. From the perspective of justice, there is disproportionate burden borne by vulnerable communities along the energy continuum (Hernandez, 2015). The incongruity and disproportionality in sharing of burdens borne by vulnerable people participating either as producers or consumers are nevertheless stakeholders along the energy continuum need to be examined.

Poverty alleviation, more particularly “war on poverty” or literally “fight for poverty-alleviation” has become a predominantly urgent, important, and increasingly decisive goal under President Xi Jinping’s pet project of complete eradication of poverty by the year 2019 to coincide with the 70th anniversary of the founding of the People’s Republic of China, especially in southern Xinjiang (Zenz, 2019). Nonetheless, a divergence can be observed in the execution of poverty alleviation initiatives between Xinjiang and other regions in China. The focus of President Xi’s targeted poverty alleviation strategy, a five-pronged policy based on industrial development, relocation, eco-compensation, education, and social security in Xinjiang, has shifted its focus to industry-based, labor-intensive low-skilled factory work.

As part of its broader objective of diluting and destroying the cultural distinctness and social identity of Xinjiang's Muslim and other ethnic minority groups, the Chinese government has implemented a "mutual pairing assistance" program, which supports companies from other regions of the country in establishing satellite factories in Xinjiang, potentially extending the practices of the internment camps into these new locations. The US government reports have established there exists in the eastern part of China “mutual pairing assistance” programme in at least 19 cities and developed provinces to help establish factories in Xinjiang (US Government, 2021).

In this context, both factory and educational settings are integrated into a state-controlled environment to facilitate ongoing political indoctrination, social re-engineering, and creation of low-cost manufacturing hub by artificially keeping labour costs low and creating unfair competition for the global supply chain (Zenz, 2019). The implementation of the pairing scheme is mainly reliant on low-skilled labour industries whose workers need very rudimentary job training. The programme's intended agenda is best served when the Chinese companies can open factories close to the internment camps. The local governments receive funds for every individual they transfer from these camps to work as forced labour who are paid a fraction of minimum wage or without any compensation. In addition, both the local governments and the companies receive funds from the PRC government to build production facilities near the internment camps and for training inmates they employ respectively.

Creating a better future for humanity and every other plant or animal species that inhabit our planet through production of clean forms of energy is critical, but it holds little value if governments, companies, and individuals are complicit in human rights abuses across the supply chain. The solar industry, one of the latest and the most high-tech entrants in the global economy, is associated with a controversial supply chain like many other industries mired in human rights violation and forced labour from the point of extraction of raw materials to the point of consumption and waste disposal.

As per the International Labour Organisations (ILO) the forced labour in the context of this chapter follows the legal definition used in conventions and covenants as "a work exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily" (ILO, 1930) and that this labour is forcefully exacted by the state on a temporary basis (Lillich, 1995). In common parlance as well as in contemporary labour law discourse labour is frequently referred to as a commodity as it captures recent trends in deregulation, flexibility and dismantling of worker protection (Evju, 2013a). Commodification of labour as an integral part of the 'labour theory of value' has played an important role starting with Adam Smith and continuing through the better part of the

19th century in liberal economic theories. Although the International Labour Organization's constitution affirms the importance of dignified labor, the views espoused by Adam Smith in his seminal work, "The Wealth of Nations" (1776), offer a contrasting perspective. Smith regarded labor as a commodity, subject to the same laws of supply and demand as any other commodity, leading to the assertion that the value of labor can rise or fall accordingly (Smith, 1999).

Explaining the origin of the word proletariat, Friedrich Engels makes no difference between labour and any other commodity because the price of labour like that of any other commodity is determined by the same laws that apply to other commodities. In other words, on an average the price of a commodity is always equal to its cost of production, and same is the case with labour whose cost of production is its real price (Evju, 2013b). The treatment of labour as a commodity is a nullification of the cardinal values and foundational principles of non-commodification of labour as enshrined in the preamble of the International Labour Organization.

6.1.2 Forced labour in Xinjiang: an overview of labour abuse of Uyghur Muslims

The Chinese government has implemented programmes that facilitate (i) mass transfer of Uyghur numbering at least 80,000 and other ethnic minority citizens between 2017 and 2019 alone from the far west region of Xinjiang to factories across the country (Xu et al., 2020), and (ii) incarcerating detention camps. The Uyghur's labour constitutes the bulk of forced labour in the supply chains of at least 82 well-known global brands in the technology, clothing, and automotive sectors, including Apple, BMW, Gap, Huawei, Nike, Samsung, Sony and Volkswagen (Xu et al., 2020). Sources including government documents have confirmed that these workers suffering in extrajudicial 're-education camps' have been denied basic human rights, including freedom of movement (Noack, 2019).

What has been happening in XUAR is violation of human rights and is best attested by the Preamble of ILO Protocol to 2014 to the Forced Labour Convention 1930 which recognises that the "prohibition of forced or compulsory labour forms part of the body of fundamental rights, and that forced or

compulsory labour violates the human rights and dignity of millions of women and men, girls and boys, contributes to the perpetuation of poverty" (ILO, 2014). The Protocol is a reaffirmation of ILO's Forced Labour Convention 1930. The ILO has a list of 11 indicators describing an act or a situation that can be termed as forced labour. In the context of Uyghur workers there are at least 6 such indicators (ILO, 2012; Xu et al., 2020) of their being subjected to human rights violation:

"• Being subjected to intimidation and threats, such as the threat of arbitrary detention, and beingmonitored by security personnel and digital surveillance tools.
• Being placed in a position of dependency and vulnerability, such as by threats to family members back in Xinjiang.
• Having freedom of movement restricted, such as by fenced-in factories and high-tech surveillance.
• Isolation, such as living in segregated dormitories and being transported in dedicated trains.
• Abusive working conditions, such as political indoctrination, police guard posts in factories, 'Military-style' management, and a ban on religious practices.
• Excessive hours, such as after-work Mandarin language classes and political indoctrination sessions that are part of job assignments".

There are about 12 million Uyghurs, mostly Muslims living in Xinjiang, officially known as the Xinjiang Uyghur Autonomous Region (XUAR) who speak their own language, very similar to Turkish and are culturally and ethnically close to Central Asian nations. More than one million out of the total 12 million Uyghurs (Roth, 2022) and other minority groups form the vast network of 're-education camps' in the far west region of Xinjiang described by experts as a government organised programme of cultural genocide (Asia News Monitor, 2018; The Conversation, 2019; Xu et al., 2020). Living life in these detention camps is far from free as detainees are subjected to political indoctrination, torture and forced to renounce their religion and culture to remould the Muslim minorities in the image of China's dominant majority Han.

Xinjiang is the largest province-level administrative region in northwest China, covering 1/6th of the country's land. It is also the Chinese province with the longest land border of more than 5,600 kilometres, a quarter of the country's entire land border. Xinjiang is rich in resources, has the largest reserves of oil, natural gas, and coal in China, accounting for 30%, 34%, and 40% of the country's total respectively. Xinjiang is also home to China's largest polysilicon producing facilities, as well as the largest base of cotton with a production of 87.3% of the whole of China in 2020. With a large

pastureland, Xinjiang is also one of China's major sheep farming areas and fine-wool production base. For this reason, energy and related industries like petroleum extraction and purification are pillars of industries in Xinjiang (Zhou and Zhang, 2021).

The Uyghurs in recent decades have been subjected to physical and psychological torture, including forced sterilisation, abortion, and population transfer to reduce birth rates and population density, and of targeting religious leaders to break religious and cultural traditions (Gunter, 2021). The term Uyghurs here collectively refers to Turkic speaking Muslim minorities such as the Kazakhs, Uzbeks, Tartars, Tajiks, Kyrgyz, and Hui. Experts generally agree that China in its crackdown in Xinjiang since 2017, there are as many as a million Uyghurs and hundreds of thousands of other Muslims in detention and/or prison camps. China has been accused of carrying out forced sterilisation, abortion, and population transfer to reduce birth rates and dilute the population density in a move to break religious and cultural traditions.

Human rights violation is rife in these camps and the inmates there have been forced to work in slave labour across various industries, mainly the polysilicon and cotton industry. In a leaked classified document meant for internal distribution among the local officials in Xinjiang which the New York Times had access to provides an unprecedented inside view of the continuing clampdown in Xinjiang, in which the authorities have corralled as many as a million ethnic Uighurs, Kazakhs and others into internment camps and prisons between 2017 and 2019 alone (Ramzy and Buckley, 2019).

The Communist Party of China (CCP) has refuted all criticisms of its detention facilities, purportedly designed to offer vocational training, but covertly intended to address Islamic extremist activities, according to CCP officials. Ramzy and Buckley (2019) have claimed the documents unequivocally confirm extreme form of coercion used in crackdown in the orders of the officials who conceived and executed this plan (Ramzy and Buckley, 2019). While the government spared no effort in projecting its efforts in Xinjiang to the public as benevolent and excessively caring, it discussed, organised, and

carried out a ruthless campaign in these internal communications at the behest of senior leadership which ordered drastic and urgent action, including mass detentions.

The Australian Strategic Policy Institute has analysed over a period between 2017 and 2020 an unprecedented growth in the number of detention buildings in 380+ facilities (Ruser, 2020b) in Xinjiang (Ruser, 2020a). This is nearly 100% increase (more precisely 97.67%) from 2321 in 2017 to 4588 (Ruser, 2020a) as in the graph 6a below. detention facilities in 2020.

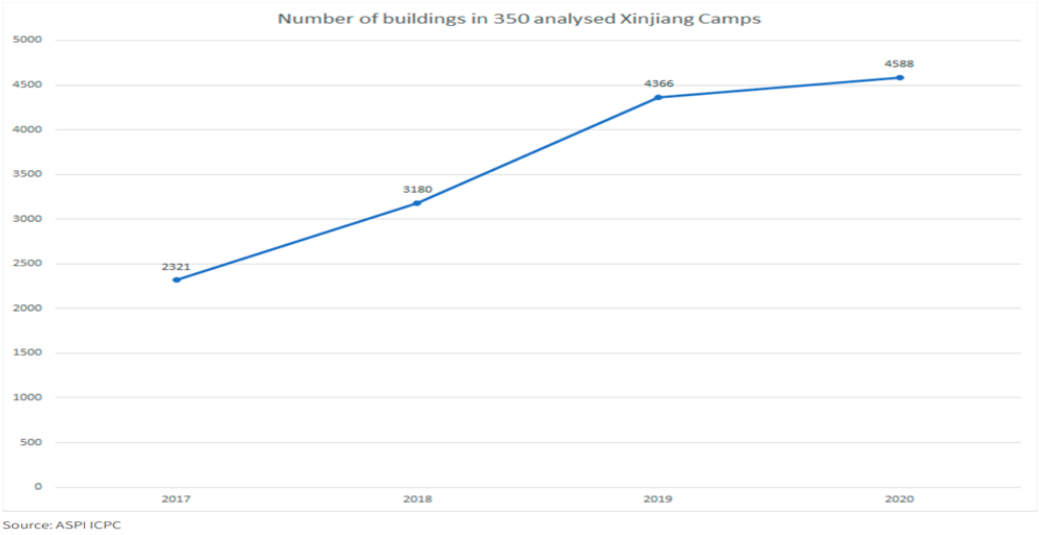

Figure (6a). Number of buildings in 350 Xinjiang camps where Uyghur Muslims are detained showing increase in their numbers between 2017 and 2020. Source: (Ruser, 2020a).

Various departments of the US government, viz., the Department of State, the Department of Treasury, the Department of Commerce, the Department of Homeland Security, the Department of Labour, Office of the United States Trade Representative have determined that there exists severe violation of human rights in Xinjiang, since at least March 2017, and the Chinese government has unjustly imprisoned more than one million Uyghurs, ethnic Kazakhs, ethnic Kyrgyz, and members of other ethnic and Muslim minority groups for indefinite periods in internment camps (US Government, 2021). This determination comes with the government's resolute commitment to make the businesses and individuals aware of the atrocities against these minorities and state sponsored forced labour practices employed by the government in Xinjiang, as well as situations of forced labour involving members of these groups outside Xinjiang (The US Department of State, 2021). There are credible

reports from government and academic sources that indicate state-sponsored coercive relocation of ethnic minorities in Xinjiang to other regions and provinces of China. A US Department of State report, *Trafficking in Persons Report 2021* has claimed that the People's Republic of China (PRC) has committed "genocide and "crimes against humanity" (Amnesty International, 2021) against Uyghurs and members of other ethnic and religious minority groups in Xinjiang" (The US Department of State, 2021).

The global demand for renewable energy is soaring beyond doubt, but the industry needs to scrutinise its supply chains to stay away from contributing to the human rights violation integral to it. As far as the use of forced labour is concerned, the solar industry must disentangle itself from the oppression of the Uyghur people. A report by Sheffield Hallam University 2021 has investigated the links between the production of solar-grade polysilicon and forced labour in the Xinjiang Uyghur Region of China. The report's conclusions indicate that an overwhelming majority of companies engaged in the solar panel sector have been implicated in exploiting forced labour among Uyghur and other Turkic Muslim communities. The report is an outcome of an in-depth inquiry that examined all aspects of the solar panel supply chain, seeking to gain a deeper understanding of the global value chains' pervasive use of forced Uyghur labour.

The report investigated over 30 Chinese manufacturers who may be contributing to the international solar energy supply chain by way of their potential participation in the Chinese government's compulsory labour programmes in the Uyghur Region (Murphy, Laura and Elima, 2021). The People's Republic of China (PRC) has forced millions of indigenous Uyghur and Kazakh citizens from the Xinjiang Uyghur Autonomous Region (XUAR), commonly known as Uyghur Region into what the government calls "surplus labour" and "labour transfer" programmes (Murphy and Elimä, 2021; Timperley, 2022). The report reveals how forced labour in the Uyghur Region has pervaded an entire supply chain and reaches deep into international markets. The report (Murphy, Laura and Elima, 2021)

has put in the public domain some very important findings to help understand the extent, pervasiveness, and the intertwined complexity of forced labour and polysilicon production in Xinjiang.

• The four largest solar panel suppliers in the world, i.e., JinkoSolar, JASolar, TrinaSolar and LONGi source from companies using forced labour in Uyghur Region.
• 95% of solar panels rely on one primary material – solar-grade polysilicon.
• 45% of the world's polysilicon comes from Uyghur Region (XUAR) known for atrocious human rights violations.
• There are 90 Chinese and international companies whose supply chains are affected by Uyghur forced labour.
• All four of the Uyghur Region's polysilicon manufacturers are implicated in Uyghur forced labour either through direct participation in forced labour schemes, and/or through their raw material sourcing.

6.1.3 Forced labour in prisons in Xinjiang

The supply chain along the journey traverses countries, oceans, and continents for sourcing raw materials from certain regions, manufacturing products in others, and supplying solar products to businesses globally. The solar industry has a serious human rights crisis to contend with across all stages of supply chain. This chapter endeavours to establish that the solar industry is exposed to forced labour in the Uyghur Region. Almost half of the global supply chain of polysilicon, the most important material necessary in solar panel construction comes from Xinjiang region of Western China, the epicentre of the Chinese communist party's (CCP) vast network of concentration camps housing more than one million ethnic minorities, mostly the Uyghurs Muslims. Polysilicon and other materials that go into making of the solar panels use Uyghur slave labour.

Although persecution is rife across the whole of China in some form or the other, it is very severe in Xinjiang, where Beijing has arbitrarily detained more than a million Uyghur or Uighur and other Turkic Muslims, subjecting them to torture, repression, forced labour and various other forms of abuse, including forced indoctrination, compelling them to abandon their religion, culture, and language (Roth, 2022). However, PRC has mounted a narrative that counters all allegations of state's indulgence in penetrating social control, pervasive surveillance, unprecedented extrajudicial internment campaign, and deep social re-engineering intention that effectively amounts to targeted cultural genocide Despite evidence to the contrary, the People's Republic of China has put forth a counter-narrative that refutes

all accusations regarding the government's involvement in pervasive social monitoring, far-reaching surveillance, an extensive extrajudicial detention initiative, and a focused endeavour to effect significant social re-engineering that may constitute targeted cultural genocide (Zenz, 2019). These coupled with penetrating social control, a pervasive surveillance state, an unprecedented extrajudicial internment campaign, and a deeper social re-engineering intention on the side of the state that effectively amounts to targeted cultural genocide. Authorities threaten, detain, and mistreat anyone who lifts the lid on these crimes.

Uyghurs have been either detained in camps or given long prison sentences or transferred to situations of forced or coerced labour (Amnesty International, 2021a). In Amnesty International's report 'Like We Were Enemies in a War': China's Mass Internment, Torture, and Persecution of Muslims in Xinjiang' (Amnesty International, 2021a), based on interviews with 55 former detainees is an expose of the Chinese state's crimes against humanity, i.e., "imprisonment or other severe deprivation of physical liberty in violation of fundamental rules of international law; torture; and persecution". Agnès Callamard, Amnesty International's Secretary General has described the situation in Xinjiang "a dystopian hellscape on a staggering scale in Xinjiang. Uyghurs, Kazakhs and other Muslim minorities face crimes against humanity and other serious human rights violations that threaten to erase their religious and cultural identities" (Amnesty International, 2021b).

In a quest to mitigate climate change by transiting to cleaner sources of energy, the governments and companies must not only limit themselves to the benefits of finished product but adopt a criterion to determine what really constitutes "clean energy". As the world makes tremendous strides towards towards a clean energy fuelled brighter future, governments, companies, policymakers, and the consumers must ensure that this transformation has not come on the back of a genocide. While the governments, international organisations, and citizens around the world envision a carbon-free future and reduced global carbon footprint, governments, regulators, and companies operating across the

value chain will need to confront the fact that the world's polysilicon supply chain is heavily reliant on forced labour in China.

There are reports of alleged human rights violations of very serious nature involving forced labour in Xinjiang region of China, whose provenance has been decidedly ascertained from credible sources, including the BBC, New York Times, Washington Times, The Guardian, Amnesty International, Human Rights Watch, Sheffield Hallam University, US State Department, Australian Strategic Policy Institute (ASPI) and solar industry associations etc. (Ramzy and Buckley, 2019; Ruser, 2020a; Xu et al., 2020; Murphy and Elimä, 2021; SEIA, 2021; Wang, 2022). This situation in the global supply chain necessitates businesses and the governments around the world the need to be cognizant of where and how solar equipment is sourced.

There are violations of human rights across the energy lifecycle, ranging right from the site of extraction to the final consumers, mostly linked to land and water grabs. This chapter sheds light on how deep human rights violation is in this industry. As violation of human rights increases so does focus on ethical sourcing and suppliers of renewable energy equipment are coming under increased scrutiny from the international observers. The supply chain violation of human rights does not always have to be scrutinised by international ethical business organisations, but the local communities where sourcing happens can come forward and exert pressure from the bottom up. A good example is Tesla in 2021 found itself in the eye of a storm of a community led boycott for sourcing nickel from Russian company Nornickel due to its impacts on the environment and livelihoods (Timperley, 2022). The ground realities of human rights violation in XUAR have put China in international spotlight. The Chinese government has built a vast network of re-education camps, detention centres, and a pervasive system of surveillance to monitor, subdue millions from Muslim minorities in the Xinjiang region, which like rest of China does not disclose information about people in prison.

The Chinese government by its own admission has initiated a poverty alleviation programme that has placed millions of indigenous Uyghur and Kazakh citizens from the Xinjiang Uyghur Autonomous

Region or XUAR into what the government calls “surplus labour” and “labour transfer” programmes. A November 2020 official government report has claimed that through these state-sponsored “surplus labour” and “labour transfer” initiatives 2.6 million minority community citizens have been placed in farm and factory jobs within the Uyghur Region and across the country (Murphy, Laura and Elima, 2021).

The government claims that “surplus labour” and “labour transfer” programmes are legal and within the legitimate purview of the PRC’s law as part of a big push by the government to alleviate poverty and the workers’ participation is voluntary. However, reports from the government, international organisations, and corporate sources present evidence to the contrary that the labour transfers are deployed in an environment of unprecedented coercion under constant threat of imprisonment (Amnesty International, 2021a; Gunter, 2021; Murphy, Laura and Elima, 2021). All in all, the collective evidence suggest that the Uyghur workers are subjected to forcible transfers and enslavement as they have no freedom to walk away from these jobs.

International pressure on China to stop violating human rights of Uyghurs had forced the US chipmaker Intel to clarify its position on human rights status of its sourcing of semi-conductors by posting a letter on its website ensuring that its supply chain did not use any labour or source goods or services from the Xinjiang region following restrictions imposed by many world governments (The Guardian, 2022). Following backlash from China, Intel deleted point 10 of the 23 December 2021 letter (Intel, 2021), which now reads “…any human trafficked or involuntary labour such as forced, debt bonded, prison, indentured, or slave labour throughout your extended supply chains (The Guardian, 2022)”. Unfortunately, the currently the letter in question contains no mention of the Xinjiang region or the government of China.

Apologising to the Chinese, Intel had to explain the reasons why it had to comply with the US law and that the earlier letter to the suppliers was not a statement of its position on the issue. It is no secret that the Multinational Corporations (MNCs) are violating human rights code of conduct as stipulated in the

Guiding Principles of United Nations Human Rights Commissioner (UNHRC, 2011), Responsible Business Code of Conduct of the Responsible Business Alliance, 2021 (Responsible Business Alliance, 2021) and various other obligations.

6.1.4 Crimes against humanity euphemistically packaged as "vocational training centres" for "pairing assistance" and "poverty alleviation"!

One of the earliest revelations of widespread use of forced labour as part of the government's targeted campaign of repression, mass internment, and indoctrination of ethnic minorities in Xinjiang was made by the New York Times in November 2019 (Ramzy and Buckley, 2019). The newspaper had access to more than 400 pages of internal Chinese documents that provided incriminating evidence about crackdown on ethnic minorities in the Xinjiang region. According to a US Department of State report the PRC's mass detention and political indoctrination drive has expanded far beyond Xinjiang region to include transfer of more than 80,000 detainees into forced labour in as many as 19 other provinces between April 2019 and March 2020 (The US Department of State, 2021).

There are large number of labour camps scattered around in Xinjiang region. Urumqi, the capital of Xinjiang Uygur Autonomous Region in Northwest China, and the largest city of Xinjiang province alone has ten or more detention camps or prisons. A satellite imagery of one such camp near Dabancheng, one of the seven urban districts of Urumqi in Xinjiang between 2015 and 2020 published by the British Broadcasting Corporation (BBC) is testimony of the Chinese government's construction activities in Xinjiang. This detention centre spread over 220 acres and the largest in the country and possibly the world, making it twice as large as Vatican City, is said to have detained up to 10,000 inmates, reports Australian Broadcasting Corporation ABC (ABC, 2021). Imagery 1 below is worth a thousand words as it is clear demonstrates beyond doubt the PRC's secret mission of subjecting its citizens to forced labour in detention camps.

Figure (6b). Satellite images showing rapid construction of camps in Xinjiang. This camp is near Dabancheng. Source: (BBC, 2021).

The Australian Strategic Policy Institute (ASPI), the largest database of Xinjiang's detention facilities in existence, published a report "Documenting Xinjiang's Detention System" (Ruser, 2020a) has mapped 380 facilities in the Xinjiang Uyghur Autonomous Region (XUAR) government is using for (i) re-education camps, (ii) detention centres, (iii) and prisons purposes since 2017. However, the Chinese authorities have denied these allegations, and have claimed that the inmates were "trainees" receiving vocational training before graduating by late 2019. However, the evidence available presents an entirely different picture with a vast network of extrajudicial detainees who are now being formally charged and locked up in higher security facilities, including newly built or expanded prisons, or sent to walled factories for forced labour assignments in Xinjiang's vast "re-education" network (Buckley, 2019). Satellite imagery has been used and corroborated by various other sources to ascertain the ground reality of human rights violations in Xinjiang.

Using satellite imagery analysis, the ASPI researchers have reconstructed, identified, and mapped over 380 sites in the detention network consisting of re-education camps, detention centres and prisons across Xinjiang built or expanded since 2017 (Ruser, 2020b). The ASPI report, for the purpose of analysis, categorises these detention facilities in the order of level of securitisation into four tiers,

where tier 1 is the lowest and the tier 4 is the highest security level. Whether these administrative tiers are a genuine reflection of the Chinese government's actual incarceration practice is not clear. It is quite possible that due to the opaqueness in Xinjiang's carceral system it is difficult to ensure that the different tiers correspond to any official designated. The ASPI report has prepared a four-tier 3D representation of securitisation for Uyghur detention camps in Xinjiang (Ruser, 2020a) as under:

Tier 1: Suspected low security re-education camps – 108 sites (Ruser, 2020b)

Tier 1 camps are the pre-existing lowest security facilities, mostly schools but also residential and hospital complexes, that have been converted into detention camps and fitted with significant internal fencing and external walls for security purposes. In some of these cases, this fencing has been removed and recreational facilities added to suggest to the international community that the 're-education' detainees have 'graduated' (Ruser, 2020a). Documented evidence suggest that the detainees freed from these camps have gone into either forced labour or strictly controlled residential surveillance (HRW, 2018).

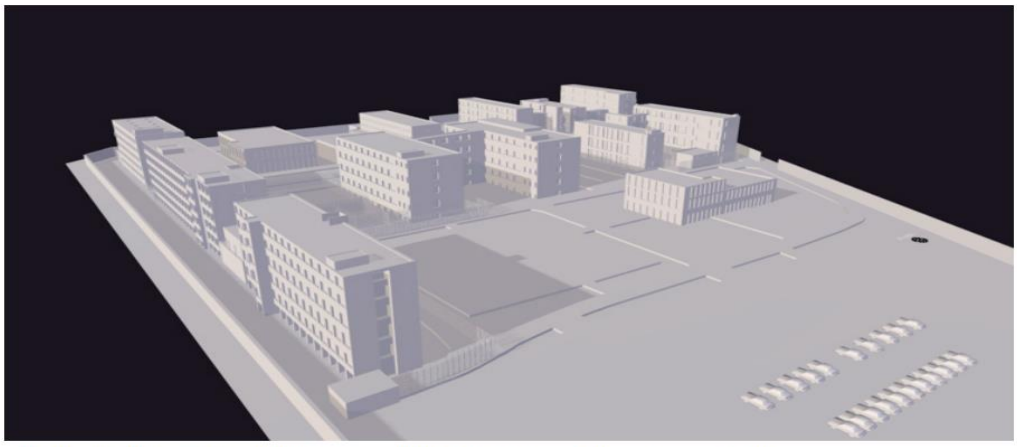

Figure (6c). Suspected low security re-education camps – site number 108.
Source: (Ruser, 2020a).

Tier 2: Suspected High Security Re-education Camps – 94 Sites (Ruser, 2020b)

Tier 2 facilities are large identical residential buildings for the detention of Uyghurs and other non-Han minorities. These facilities, though slightly desecuritised in 2019 and 2020 retain a large perimeter wall and watchtowers, clearly indicate that the detainees in these facilities are watched over and their

movements restricted. There are reports that these camps may have also been used for the rehabilitation of individuals declared a threat to society by government authorities in Xinjiang (Ruser, 2020a).

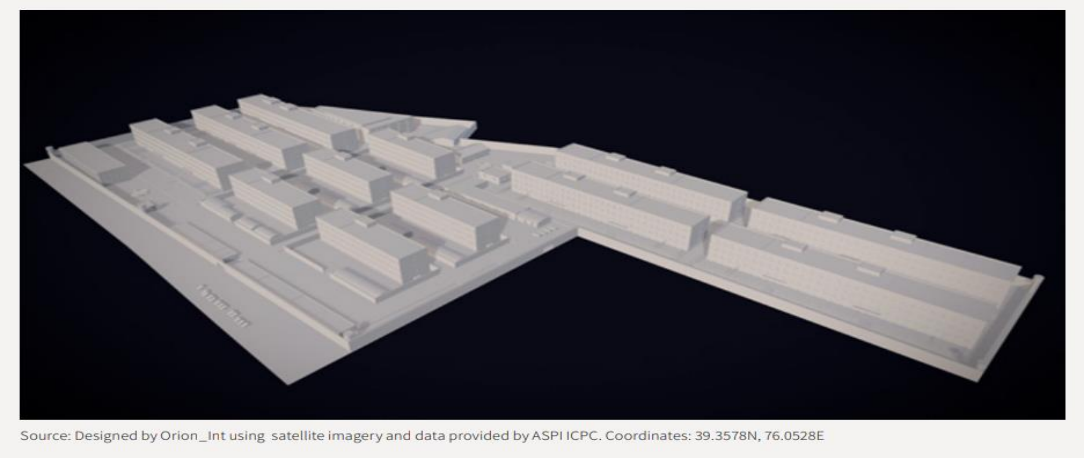

Figure (6d). Suspected High Security Detention Centres – 72 Sites
Source:(Ruser, 2020a).

Tier 3: Suspected high security detention centres – 72 sites (Ruser, 2020b)

These facilities have concrete fortification, regular watchtowers, several layers of barbed-wire fencing and an aerial walkway for guards to access the perimeter wall without entering the facility. The way they have been constructed and managed, makes it amply clear that the motive behind these facilities appears to be intended to remove people from society, with little intention for serious rehabilitation. The absence of factory warehouses or vocational amenities in these facilities implies that they could not nominally be used to train detainees for a future in factory work (Ruser, 2020a).

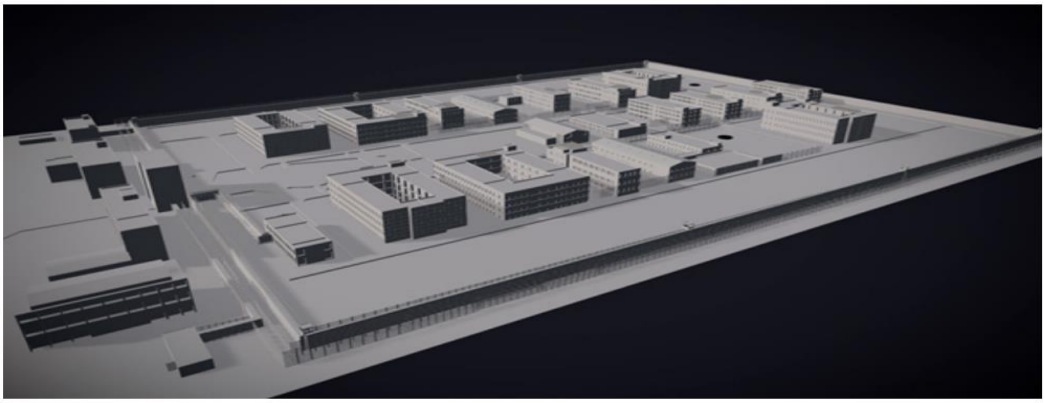

Figure 6e: Suspected High Security Detention Centres – 72 Sites
Source: (Ruser, 2020a).

Tier 4: Suspected maximum security prisons/detention centres – 107 sites (Ruser, 2020b)

Tier 4 compounds are the formal prison system which houses detainees following a formal sentencing process in the judicial system. Most Xinjiang counties had small single cell prisons in the centre of the city before the 2017 crackdown, whereas, the new facilities are considerably larger, often with dozens of cell blocks as in the figure below. Typically, they are constructed on previously empty land away from any settlement. In most cases, the older prisons have been demolished and their detainees presumably have been transferred to the newly constructed larger prisons.

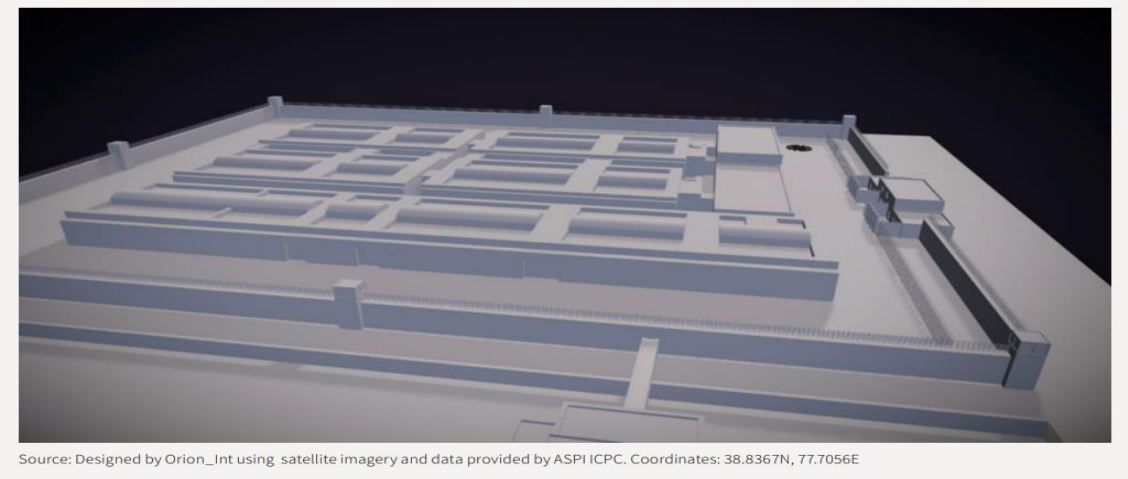

Figure 6f: Suspected Maximum-Security Prisons/Detention Centres – 107 Sites
Source: (Ruser, 2020a).

China rounded up so many Muslims in Xinjiang that there weren't enough built-up facilities to hold them. The government went in an overdrive to build a vast network of infrastructure for long-term detention and incarceration of the Uyghurs. The detention facility in the county of Shufu can house as many as 10,000 people and there are many such facilities across Xinjiang. The speed with which these facilities were built can be gauged through the example of Shufu detention centre which was built in a mere 10 month period, between March 2019 and January 2020(Rajagopalan and Killing, Alison; Buschek, 2020).

Below is a series of satellite images from 26 March 2019 to 29 January 2020 that captures speed, determination, and the scale of the Chinese government's incarceration project in Xinjiang.

Figure 6g: Shufu county, Xinjiang detention facility showing the site location for housing 10,000 forced workers. Satellite image date: March 26, 2019. Source: (Rajagopalan and Killing, Alison; Buschek, 2020).

Figure 6h: above Shufu county, Xinjiang detention facility showing considerable progress in construction development over a period of less than 7 months. The facility is meant to house 10,000 forced workers. Satellite image date: October 7, 2019.
Source: (Rajagopalan and Killing, Alison; Buschek, 2020).

Figure 6i: Shufu county, Xinjiang detention facility showing full completion over a period of 10 months. The facility is ready to house the intended 10,000 forced workers. Satellite image date: January 29, 2020.
Source: (Rajagopalan and Killing, Alison; Buschek, 2020).

The image below shows the prisons/internment camps found, identified, investigated, and corroborated by different sources (Rajagopalan and Killing, Alison; Buschek, 2020). It must also be noted that individual representation of the detention centres below is not possible for all 268 newly built compounds identified by (Rajagopalan and Killing, Alison; Buschek, 2020).

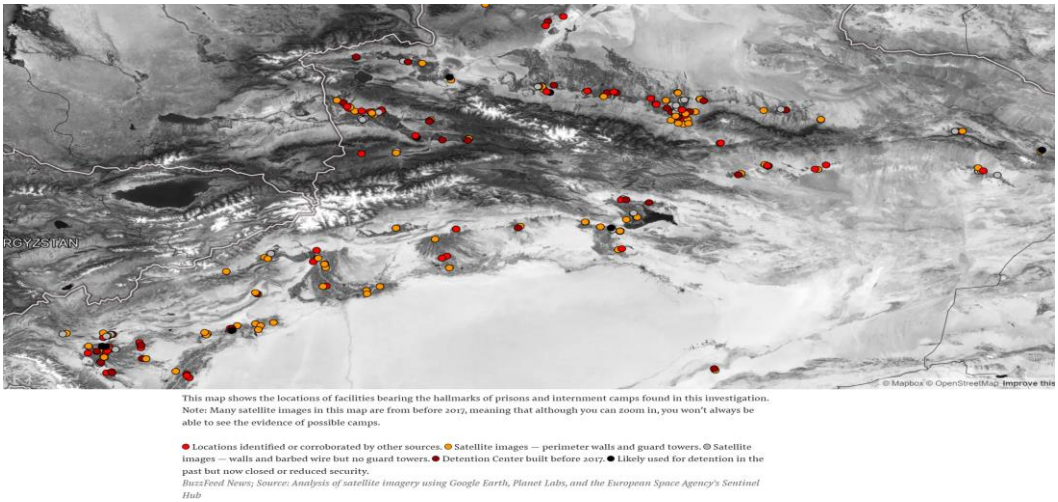

Figure 6j: Satellite image for forced labour camps in Xinjiang province.
Source: (Rajagopalan and Killing, Alison; Buschek, 2020).

6.2 Supply chain challenges: Xinjiang as the brewing ground for forced labour in global solar supply chain

The Chinese government has launched poverty eradication programmes across the country. China's meteoric rise from a poor country to the present status of an economic powerhouse spans decades of anti-poverty programmes under its political leadership. China's poverty alleviation efforts as a policy priority have enjoyed the highest levels of government support from Deng Xiaoping to Xi Jinping, under whose leadership a long-term strategy of targeted poverty alleviation has been launched since 2013. These long-term poverty alleviation programmes, a result of President Xi Jinping's idea of "helping the poor with precision" (Sun et al., 2021) have been bearing fruit, some of which, however, have infringed on the basic human rights of the targeted beneficiaries. There are aspects to these programmes whose real purpose has been shrouded in the propaganda projected as government's benign interventions to alleviate poverty. However, certain programmes decidedly undertook discriminatory social control, pervasive surveillance, and a large-scale detention targeting predominantly Muslim minority groups (US Government, 2021).

The Chinese government has unleashed the worst form of repression since the ruthless suppression of the pro-democracy movement that ended in the Tiananmen Square massacre in 1989. The Chinese Communist Party (CCP) and President Xi Jinping have implemented extensive measures aimed at preventing Chinese citizens from engaging in unsanctioned political activities or mobilizing resistance against the established ruling authority. President Xi Jinping has crushed civil society and all institutional channels to silence, censor, and stifle attempt to enforce human rights, rule of law, and free speech. The industry is stained with human rights abuses of Xinjiang's Uyghur Muslims and need to step up and hold Chinese suppliers to internationally upheld human rights and labour standards of the highest order (Murphy and Elimä, 2021).

The economy of the Xinjiang Uyghur Autonomous Region (XUAR) is inextricably entwined with forced labour and oppression which in turn reinforce a chain of human rights violation across the value chain of goods produced in the region. The linkages between government abuse and the economy are not limited to Xinjiang but go far beyond and spreads across the global market. This implies that the world shares a responsibility in forced labour and repression perpetrated by the People's Republic of China (Bhukarin, 2022) and every business involved in supply chain using materials and products from Xinjiang is involved in supporting oppression. There is ample evidence that the CCP or PRC under the guise of "vocational training" has indulged in forced labour, detention, debt bondage, and other abusive practices in the internment camps, large industrial parks, Chinese companies outside Xinjiang, and among the non-detained Uyghur Muslims of rural Southern Xinjiang (US Government, 2021).

Xinjiang's location

Source: DW

Figure 6k: Map of Xinjiang with reference to mainland China. Source: (Shah, 2021).

While going solar is a good idea for homes and businesses, but it's not a good idea when it comes to the production processes and the spaces of unfair processes along the supply chain. The emerging solar energy system is a complex network of activities and processes spread across countries and continents and what are the human rights implications on people involved in the solar energy supply chain merits in depth evaluation. Forced labour in communist China has a role to play in making solar power cheap and easily accessible.

Research using satellite mapping, first-person testimony of ex-detainees, corporate disclosures, secret filming, and state supervised access to detention facilities have been used to reveal the extent to which the entire solar module supply chain from quartz to panel has been tainted with forced labour of the Chinese Uyghur Muslims and that it affects international value chain the world needs to be aware of to take needful action to prevent forced labour. It also serves to provide stakeholders with the evidence of vulnerable communities' exposure to forced labour in the solar supply chain. The solar industry's complicity in human rights abuses is evidenced by a lack of systemic response to the challenge and letting it pass by while the Chinese government has launched a massive surveillance campaign to silence the Uyghur people and block information to the outside world.

6.2.1 Lack of visibility in global supply chain: a major threat to human rights and ethical consumption

Lack of visibility, complexity in the production, processing, and manufacturing of goods is a major challenge in tracing that may lead to prevention of goods produced with state-sponsored forced labour in the PRC from entering foreign markets. These challenges are further compounded by the limited means of reliably tracing product sourcing and lack of tracing technologies.

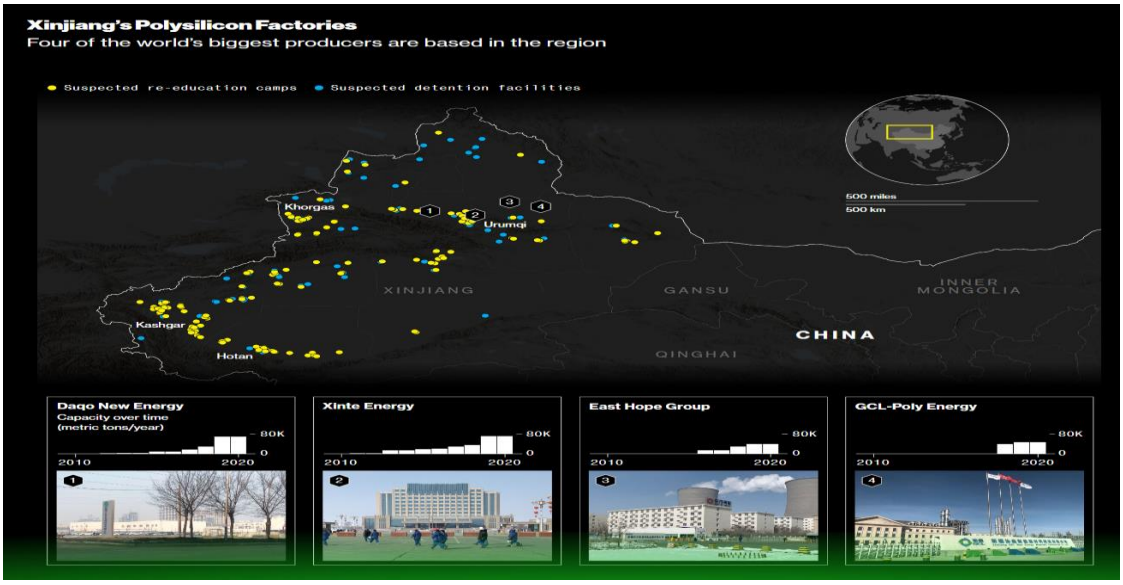

Figure 6l: Suspected re-education camps and detention facilities identified by ASPI.
Sources: Australian Strategic Policy Institute (ASPI) by (Ruser, 2020b), Bloomberg reporting in (List Solar, 2021).

Multinational companies are facing double-edged sword when it comes to doing business in China. On the one hand, they are under heavy pressure for complying with Xinjiang-related trade sanctions, and on the other, they are under criticism by international community for operating in China, their biggest market. Multinational companies are obligated to comply with several codes of conduct, but there is no global governance and transparency protocol applicable in every country. One such code of conduct is the Responsible Business Code of Conduct, prepared by the Responsible Business Alliance, "the world's largest industry coalition dedicated to corporate social responsibility in global supply chains" which stipulates that "under labour standards, alliance, forced, bonded (including debt bondage) or indentured labour, involuntary or exploitative prison labour, slavery or trafficking of persons is not permitted. This includes transporting, harbouring, recruiting, transferring, or receiving persons by means of threat, force, coercion, abduction or fraud for labour or services" (Responsible Business Alliance, 2021). Another internationally accepted set of principles is the United Nations Human Rights Commissioner's (UNHCR) Guiding Principles, which recognise "(a) states' existing obligations to respect, protect and fulfil human rights and fundamental freedoms; (b) the role of business enterprises as specialised organs of society performing specialised functions, required to

comply with all applicable laws and to respect human rights; (c) the need for rights and obligations to be matched to appropriate and effective remedies when breached" (UNHRC, 2011).

6.2.2 Shrouded in secrecy: solar industry thrives and dominates the value chain at the cost of freedom of Xinjiang Uyghurs

China has come to dominate world solar cell production. Global solar power capacity has increased multi-fold owing to several factors, but mainly due to efficiency gains, scale of production and increasingly lower costs of solar module components produced with Uyghur forced labour as some would allege. Solar panels, whether residential, commercial, or utility use photovoltaic (PV) cells which are made with polysilicon components. Polysilicon is produced through an industrial process that requires silicon, a non-metallic chemical element in the carbon family (Troszak, 2019; Encyclopaedia Britannica, 2022) to pass through extremely high temperatures. Why only China can produce polysilicon at costs cheaper than any other country in the world when silicon, the second most abundant element in the Earth's crust being surpassed only by oxygen from which polysilicon is produced, makes up 27.7% of the Earth's crust (Encyclopaedia Britannica, 2022)? The answer lies in Xinjiang's access to cheap and abundant local coal and cheap coal-based electricity, which is some of the cheapest in China. Uyghur Region's coal reserves account for a whopping 40% of China's reserves and is one of the largest untapped reserves in the world (Zhou and Zhang, 2021).

Cheap electricity has a big role to play in Xinjiang's emergence as the global hub for polysilicon production. The production and subsequent purification of polysilicon is the first step in the manufacturing process to produce conventional silicon solar cells that involves heating of silicon dioxide (SiO2) to approximately 2000 °C, causing it to reduce to molten silicon (PV-Manufacturing.org, 2022). Xinjiang in a short time, i.e., from 2010-2020, has become home to four of the five largest polysilicon factories in the world, while China's share of the global polysilicon production has increased from 26% to 82%, while the U.S. share decreased from 35% to 5% in the same period (Reinsch, 2021).

Domestic solar module production in India has not yet reached a critical mass, the quantity needed for production to start. India is one of the top 10 solar module manufacturers in the globe, with a photovoltaic (PV) module production capacity of approximately 15 gigawatts (GW). India trails behind its largest competitor, China. The capacity utilisation of domestic production facilities is only 40-45%, and their operational capacity is estimated to be 7GW, indicating that the current production capacity can only meet 35% of the annual domestic demand. Even though domestic suppliers only account for 30-35% of utility-scale solar installations (Jyoti and Garg, 2020). Although the growth of domestic solar modules sales is anticipated to increase in the coming years by significant expansion plans by some of the largest domestic players, including Waaree and Adani, it is not clear where the supplies of materials which go into manufacturing of the solar panels will come from? The answer is China. India's continued reliance on Chinese imports to meet this demand carry the risk of these panels being stained by China's human rights abuse.

While development of a solar modules manufacturing base in India will help create a critical industry for a booming solar renewables infrastructure, it will not help abate human rights violations in the Chinese polysilicon industry which India is inseparably a part of through its imports. The business, however, is mostly dependent on imported modules from China. India has relied primarily on modules imported from China throughout the years due to a lack of native manufacturing capacity and quality. The 10GW yearly domestic demand for solar systems is far from being met by the domestic module manufacturing sector and this being the case, more the India imports Chinese solar modules more it lends itself to be part of human rights abuse there, albeit indirectly (Jyoti and Garg, 2020).

In the light of the extreme dependence on Chinese imports, the Indian government has introduced a Production-Linked Incentive (PLI) scheme in 10 key sectors, including the solar PV manufacturing sector, for which ₹45bn (US$$603m) is allocated for investment by the Ministry of New and Renewable Energy (MNRE) in high efficiency solar PV modules (Investment India, 2020). Till date, the government of India has refrained from issuing any official statement in regard to allegations of

human rights abuses in the Xinjiang region of China and has taken no concrete legislative action such as the introduction of a bill or resolution that would limit the import of solar equipment produced using materials sourced from the region. This reticence stands in contrast to the stances of other nations that have publicly condemned the Chinese government's policies in Xinjiang, with some calling for economic sanctions or other measures to pressure the country to change its course. However, this scheme by India is in no way linked to India's desire to delink itself from a China dominated industry that's wilfully complicit in China's persecution of Uyghurs "genocide" in Xinjiang. Several governments, including Canada, Japan, the USA, The European Parliament, and the UK have passed with overwhelming to near 100% majority resolutions in their parliaments to declare genocide in China's Xinjiang (Campaign for Uyghurs, 2019; European Parliament, 2020; BBC, 2021a; Patrick Jones, 2021; Reuters, 2021).

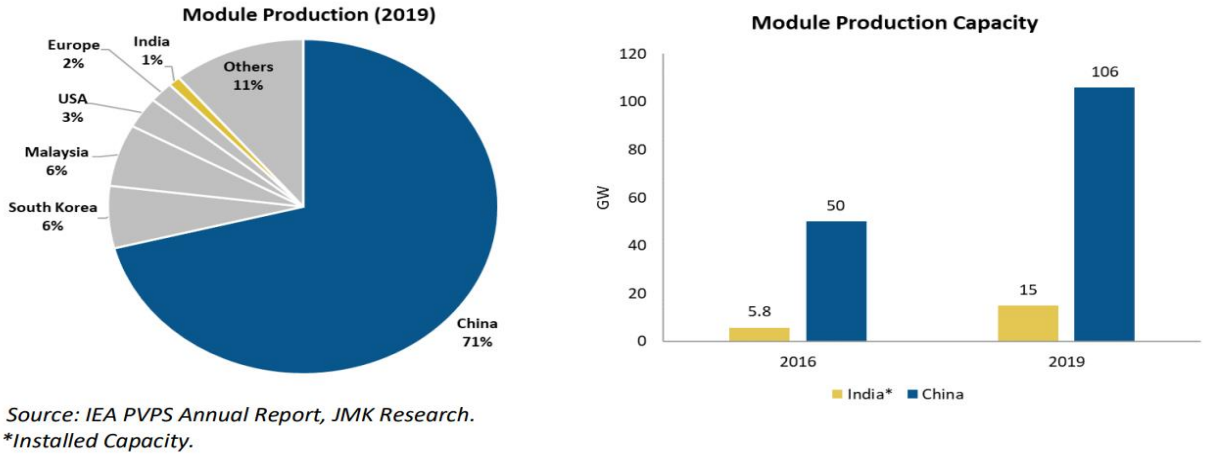

Figure 6m: Global Solar Module Production (2019).
Source: (Jyoti and Garg, 2020).

The Helena Kennedy Centre for International Justice, a leading centre for social justice and human rights research at the University of Sheffield in UK has brought in the limelight the human rights abuse the Uyghur Muslims have been subjected to since 2017 (Murphy, Laura and Elima, 2021). Chinese government's mass transfer of Uyghur and other ethnic minorities including Kazakhs, Uzbeks, Tartars, Tajiks, Kyrgyz and Hui in Xinjiang province to factories across the country strongly suggests that forced labour is involved in supply chains of at least 82 well-known global brands across industries in

the technology, apparel and automotive sectors, including Apple, BMW, Gap, Huawei, Nike, Samsung, Sony and Volkswagen (Murphy, Laura and Elima, 2021). This research, however, will focus on just one of those industries, i.e., the solar energy industry. The forced labour in the Uyghur Region has pervaded an entire supply chain and reaches deep into international markets. It is by the virtue of criticality of polysilicon, the primary metal used in solar panel manufacturing, abundance of coal as a source of cheap electricity and the availability of cheap forced labour away from the prying eye of world makes Xinjiang an attractive global hub for polysilicon import. The report concludes that Uyghur Region (XUAR) is critical because (Murphy, Laura and Elima, 2021):

"• 95% of solar modules use solar-grade polysilicon as primary material for solar panels. About 75% or more of solar-grade polysilicon comes from China.
• 45% of the world's solar-grade polysilicon supply comes from manufacturers in the Uyghur Region (XUAR), where China has its detention camps housing millions of Uyghurs.
• 35% of the world's solar-grade polysilicon supply comes from manufacturers in China excluding Uyghur Region allegedly using forced labour.
• Hoshine Silicon Industry, the metallurgical-grade silicon producer with the highest production capacity, has participated in labour transfer programmes and has significant exposure to forced labour through its quartz supplier.
• All four of XUAR's polysilicon manufacturers, Daqo, TBEA (and subsidiary Xinte), Xinjiang GCL, and East Hope, have reported their participation in labour transfer or labour placement programmes and/or have been in receipt of material supplies by companies that have participated in these programmes.
• Daqo alone has the unique distinction of supplying to the world's four largest solar module manufacturers - JinkoSolar, Trina Solar, LONGi Green Energy, and JA Solar.
• 90 Chinese and international companies have their supply chains affected by forced labour".

The figure below is a pictorial representation of Xinjiang (Uyghur Region), China (Interior), and the international share of polysilicon supply.

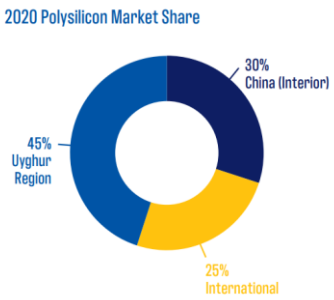

Figure 6n: China's total polysilicon market share for 2020. Source: (Murphy, Laura and Elima, 2021).

China recognised the strategic importance of dominating the solar industry way before others and focused on dominating across the entire value chain. China has come to dominate the global solar market today in all production steps, i.e., five-part value chain for solar panels (Bernreuter Research, 2020). China has achieved this supreme position through rapid implementation of government policies and state-sponsored expansion paving the way for mass production and economies of scale across the entire photovoltaic (PV) value chain.

Despite criticism of dumping from the US and European Union, Chinese central and local governments went ahead with promotion of their domestic PV sector with subsidies and incentives like cash grants, loan guarantees, free land, preferential tax rates, electricity tariff rebates and discounts on raw materials (Bernreuter Research, 2020). China's PV industry has quickly capitalised on this to reach economies of scale and acquire dominance along the entire solar supply chain. After discovering that the solar panels were being sold too cheaply to the US market the US Department of Commerce's imposed anti-dumping tariff duties of up to 165.04% on crystalline silicon photovoltaic solar imports from China and Taiwan (Fastmarkets, 2014). The graphics below illustrate Chinese dominance in all five stages of solar panel production for the year 2019.

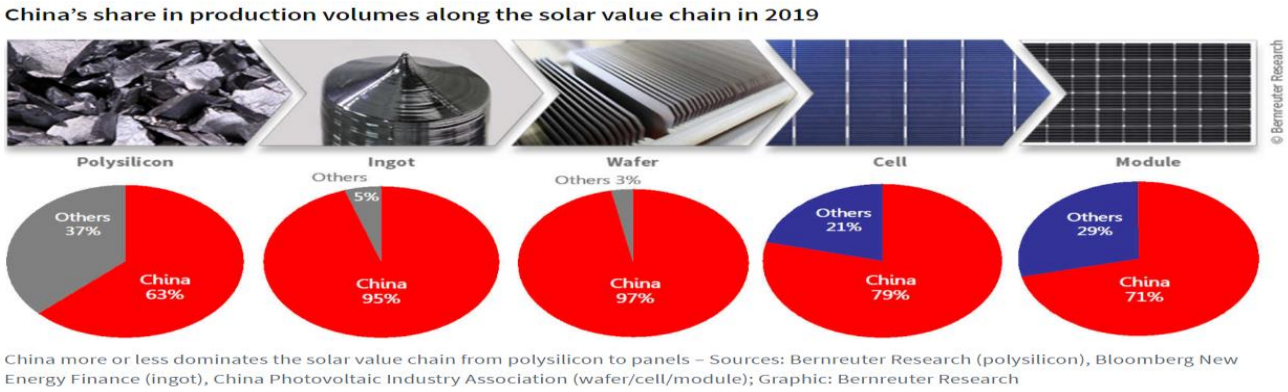

Figure 6o: China's share in production volumes along the solar value chain in 2019.
Source: (Bernreuter Research, 2020).

Reinsch (2021) states that according to Jenny Chase who heads solar analysis at Bloomberg New Energy Finance, at least 95% of the global market or nearly every silicon-based solar module is likely to have some Xinjiang silicon (Reinsch, 2021). The solar power surge is one of the great hopes in the

race against global climate change depends on the crucial supply of Xinjiang-made polysilicon. In a written response to the US Senator Marco Rubio, the CEO of Solar Energy industries Association Abigail Ross Hopper put the world's total polysilicon production from XUAR at 50% as of 2020 (SEIA, 2022). The polysilicon supply chain with its largest production facilities in Xinjiang renders it highly susceptible to the use of Uyghur forced labour. A complex supply chain that lacks visibility suffers from difficulty in traceability with production and operations spread over continents, it obscures the use of Xinjiang based forced labour in goods that enter a foreign market.

6.3 India's moral failure: import of solar cells and modules tainted with Uyghur forced labour

Companies investing in solar energy projects in India need to ensure their investments respect human rights not only in India but across the entire energy spectrum, i.e., from "source-to-sink". It is for both the government and the investors to ensure integration of human rights considerations in their renewable energy investments. Without infusing respect for human rights, whether for Indians participating on the Indian side of the supply side or on the import side, India runs the risk of compromise on universal human rights. India cannot lose sight of the need for infusing social protections and human rights into its energy transition.

The involvement of Uighur/Uyghur ethnic minority in China's Polysilicon industry is a serious human rights violation in the global supply chain of solar panels. Xinjiang is an autonomous region in the northwest of China, with a Muslim ethnic minority population of more than 12 million (Reinsch, 2021). Starting in 2017, the past 5 years have seen a lot of media coverage of extra-legal detention of hundreds of thousands of Uyghurs Muslims and other minorities in internment camps, where detainees were put on factory production lines for "job training" purposes. Researchers and news reports have claimed that these "job training" programmes were basically a coverup for a free or low-cost forced labour system. However, the Chinese Communist Party (CCP), the Chinese government, and Chinese companies operating in Xinjiang have described them as vocational training centres where legitimate

counterterrorism, and development programmes are providing education and training to the local people.

The forced labour in the Uyghur region has pervaded an entire supply chain and reach deep into international markets across all countries, all continents. The global production of solar panels rests on the inputs bloodied with forced labour of the Uyghurs Muslims in China's Xinjiang province, according to a study by the UK based Sheffield Hallam University (SHU) (Murphy and Elimä, 2021). A similar report by (Investor Alliance for Human Rights, 2020) has placed an estimated 1.8 million predominantly Turkic and Muslim-majority peoples, including Uyghurs, Kazakhs, Kyrgyz, and Hui, in detention camps, prisons, and factories in Xinjiang Uyghur Autonomous Region in China, locally known as East Turkistan (Uyghur Region), where gross violation of human rights has been going on since 2017 largely gone unnoticed by the global community until the revelations by Sheffield Hallam University. This has challenged the global community with moral and practical conundrum of developing an alternative global supply chain that's free of China like forced labour practices.

Following these shocking revelations of Uyghurs incarceration and forced labour, the human rights issue has gained traction amid the growing concern for meeting environment, social and governance (ESG) requirements. The Indian solar developers with support from global investors have started to avoid solar equipment supplies that includes polysilicon from Xinjiang, China. However, India's current import of solar cells module from China is about 80%. The Narendra Modi government must weigh the benefits and consequences of advancing clean energy priorities of his government that uses solar panels made by China's persecuted Uyghur ethnic community in Xinjiang based labour camps.

The Indian energy companies have started to raise concerns on the Chinese suppliers' alleged complicity in Uyghur forced labour and whether they comply with the Washington based Solar Industry Forced Labour Prevention Pledge (SEIA, 2022). 310 companies have signed the pledge (SEIA, 2022) that reads *"we, the undersigned companies, and organisations, state our firm opposition to the use of forced labour within the solar supply chain. We hereby commit to helping ensure that the*

solar supply chain is free of forced labour and raising awareness within the industry on this important issue. To assist in these efforts, we support the development of an industry-led solar supply chain traceability protocol as a tool for identifying the source of primary raw materials and inputs and tracking their incorporation into finished products, including solar modules".

Despite India spearheading the world's largest clean energy programme, it doesn't have its own forced labour prevention compliance protocol on the lines of the USA and the countries in the European Union. In addition, the USA companies involved in the solar supply chain business are supposed to comply with the 'Solar Supply Chain Traceability Protocol 1.0' to determine transparency of supply chains.

The protocol (SEIA, 2021) ensures that: "Companies and organisations that participate in international trade have a responsibility to ensure that social, environmental, and quality standards are not compromised by its decisions and activities. The organisation should therefore be transparent in its decisions and activities that impact the traceability of its products. The organisation should disclose in a clear, accurate, and complete manner, and to a reasonable and sufficient degree, the policies, decisions, and activities for which it is responsible, including their known and likely impacts on product traceability. This information should be readily available, directly accessible, and understandable to those who have been, or maybe, affected in significant ways by the organisation. The information should be timely, factual, clear, and objectively presented to enable stakeholders to accurately assess the impact of the organisation's decisions and activities on their respective interests".

The Indian energy companies' increasing concern for human rights violation following the ban by US department of commerce on five Chinese solar firms for using forced labour in Xinjiang and alleged human rights violations against Uyghurs and other minority groups (Bhaskar, 2021) and global outrage including in the UK.

In the UK, the solar industry has rallied behind plans to put in place a supply-chain transparency mechanism in the wake of emerging concerns regarding alleged forced labour in the production of

polysilicon, a major component in solar PV panels (Martina, Freifeld and Shepardson, 2021). These developments in addition to pressure from foreign investors are forcing energy producers in the country to assess suppliers' culpability in human rights violations for setting up projects to stay compliant with investor and stakeholder concerns.

Indian solar projects, in particular those developed with foreign funding are insisting on a letter of declaration and certification that the suppliers are not indulging in such practices violative of human rights in China or elsewhere. However, the Indian government has no official stand on Uyghur Muslim's human rights violation in Xinjiang labour camps responsible for at least 45% of global polysilicon supply and about 35% comes from rest of China which allegedly uses Xinjiang forced labour sent to factories manufacturing solar equipment across the country. India has imposed 25% and 40% basic customs duty on solar cell and solar PV modules respectively from April 2022 (Manohar, 2022) as a counter measure to check dumping by Chinese companies (Mohanty, 2021) to safeguard the interest of domestic manufacturers. How far the government of India is removed from upholding the human rights in its supply chain whose origin is either in Xinjiang or in other parts of China can be gauged by India's Minister of New and Renewable Energy R.K Singh's statement that for India disruption in "solar cells supply chain had occurred due to coronavirus in China" and not for any other reason (ETEnergyWorld, 2020).

Solar photovoltaic (PV) manufacturing in India started in mid-1990s but have not achieved the required economies of scale to compete with low priced Chinese modules on global platform and relies on China for its rapid increasing needs. As a result, the solar PV module manufacturing sector could not flourish, and solar power developers have relied heavily on importing solar PV modules from China (GRIHub, 2021). According Mercom (Bello, 2020) India's dependence on Chinese solar modules is very high, which despite high tariffs, reached 85% of all its solar modules and cells imports, with 5.5% and 4% coming from Vietnam and Thailand (Ranjan, 2020). However, However, it is possible that India's current position regarding imports of solar equipment produced using materials

sourced from the Xinjiang region of China may be modified considering the country's launch of the ‘Atmanirbhar Bharat’ or ‘Self-Reliant India’ programme, which includes the implementation of a Production-Linked Incentive (PLI) Scheme aimed at expanding India's manufacturing capabilities and promoting exports in the High Efficiency Solar PV Modules sector. Under this scheme solar PV manufacturing has been pushed hard with financial outlays of INR 24,000 crores ($3+ billion) under Atmanirbhar Bharat 3.0 and imposition of basic customs duty of 25% on solar cell and 40% on solar PV modules with effect from 1 April 2022 (Manohar, 2022).

6.4 Global response to the import of goods mined, produced with forced labour in China

There are international human rights benchmarks against which the human rights impact of business enterprises is assessed. Business enterprises operating in the region of Xinjiang have a responsibility to uphold their corporate responsibility to respect human rights, as laid out in the United Nations Guiding Principles on Business and Human Rights, which serve as both foundational and operational principles in this context (UNHRC, 2011). Businesses must adhere to the core internationally recognised human rights contained in the International Bill of Human Rights consisting of the Universal Declaration of Human Rights and the main instruments through which it has been codified viz., the International Covenant on Civil and Political Rights (UNHRC, 1976a) and the International Covenant on Economic, Social and Cultural Rights (UNHRC, 1976b), as well as the principles concerning fundamental rights in the ILO Declaration on Fundamental Principles and Rights at Work (ILO, 1998).

The United States, in its commitment to promoting respect for human rights and dignity and supporting a system of global trading free from forced labour, has enacted several acts right from the ILO inspired US Tariff Act of 1930 through to the present Uyghur Forced Labor Prevention Act 2021 (UFLPA) with the sole purpose of preventing goods made with forced labour in the Xinjiang Uyghur Autonomous Region (XUAR) of the People’s Republic of China from entering the United States market. The Uyghur Forced Labor Prevention Act (UFLPA) was enacted on December 23, 2021, “to

strengthen the existing prohibition against the importation of goods made wholly or in part with forced labour into the United States and to end the systematic use of forced labour in the Xinjiang Uyghur Autonomous Region" (Department of Homeland Security, 2022). The UFLPA enforces the development of a strategy for supporting the enforcement of amended Section 307 of the Tariff Act of 1930 as per 19 U.S.C.,1307 (Congressional Research Service USA, 2022), which "prohibits importing any product that was mined, produced, or manufactured wholly or in part by forced labour, including forced or indentured child labour" anywhere in the world. US Customs and Border Protection (CBP) is charged with enforcement of the prohibition.

The focus of the 'Unfair Imports From China's Xinjiang Uyghur Autonomous Region Prevention Act' (UFLPA) is specifically on goods sourced from the Xinjiang region of China, which has been subject to extensive documentation of labor rights abuses and mistreatment of members of the Uyghur minority group (Ingram, 2022). The purpose of the legislation is to prohibit the importation into the United States of goods that have been wholly or partially mined, produced, or manufactured using forced labor within the People's Republic of China, thereby seeking to uphold robust labor standards and prevent perpetuation of unfair labour practices (Department of Homeland Security, 2022). Section 307 of the Tariff Act defines forced labour as "all work or service which is exacted from any person under the menace of any penalty for its non-performance and for which the worker does not offer himself voluntarily" (Congressional Research Service USA, 2022) modelled on the ILO Forced Labour Convention of 1930. The United States government pursuant to its objective of mitigating and preventing the use of forced labour in Xinjiang by identifying and targeting specific entities and products found to be using forced labour in supply chains since 2019 has directed, Customs and Border Protection (CBP) to issue Withhold Release Orders (WROs) on specific goods from the Chines companies using government-sponsored forced labour (USA Department of Homeland Security, 2022).

Pursuant to the provisions of UFPLA specific guidelines (USA Department of Homeland Security, 2022) to importers are provided to ascertain that:

"(A) due diligence, effective supply chain tracing, and supply chain management measures to ensure that such importers do not import any goods mined, produced, or manufactured wholly or in part with forced labour from the People's Republic of China, especially from the Xinjiang Uyghur Autonomous Region;
(B) the type, nature, and extent of evidence that demonstrates that goods originating in the People's Republic of China were not mined, produced, or manufactured wholly or in part in the Xinjiang Uyghur Autonomous Region; and
(C) the type, nature, and extent of evidence that demonstrates that goods originating in the People's Republic of China, including goods detained or seized pursuant to section 307 of the Tariff Act of 1930 (19 U.S.C. 1307), were not mined, produced, or manufactured wholly or in part with forced labour".

The above criteria of compliance, both rich in legality and firm in applicability, demonstrate that the United States of America is serious in upholding its commitment to human rights as it resonates with the United Nations Universal Declaration of Human Rights (The United Nations, 1948) and that its own constitution defends human rights within and beyond the borders. The UFPLA 2021 is the most recent link in the long history of USA's commitment to upholding the human rights through promulgation of various national and international laws including the US Tariff Act of 1930 and the United Nations Universal Declaration of Human Rights 1948 (UN-UDHR).

The very essence of these laws strengthens society's beliefs that nations could no longer abuse their citizens without attracting global wrath and repercussions (US Department of State, 2020). However, the act meant to "end the abhorrent practice of forced labour around the globe" (Ingram, 2022), with reference to Xinjiang and its cotton, clothing, tomato, and polysilicon industries is fraught with loopholes, ambiguities, and ways to bypass through export first to neighbouring Canada and from there to the USA. Failure to address these could render the act meaningless. Weeding out the offenders and their dubious supply chains is a difficult task, especially tasks such as detecting and probing the origins of raw materials to determine the extent of outsourcing and whether goods or portion of their manufacturing is getting redirected rerouted to the US through Canada and Europe (Ingram, 2022). Canada will be a vital ally and a crucial link in ensuring success and effectiveness of the legislation.

Conclusion/reflection/recommendation

Since Xinjiang metallurgical-grade silicon and polysilicon permeate the market to such an extent, module manufacturers who wish to avoid producing goods that may be tainted with forced labour in Xinjiang will need to conduct extensive due diligence on their supply chains, all the way down to the raw quartz materials, to ascertain whether they were manufactured with forced labour. They should insist that none of the polysilicon used in making their wafers comes from firms that indulge in forced labour transfers. As a result, the number of viable Chinese options free from allegations of involvement in forced labour in the Uyghur Region has been drastically reduced.

Mapping the solar supply chain is straightforward and detecting the use of forced labour in Xinjiang is simpler than in other sectors like textiles and agriculture. Moreover, this research aims to foster an atmosphere of rigorous academic inquiry to examine and scrutinize the issue of forced labour in Xinjiang. The objective is to delve deeper into the root causes of this problem and provide a comprehensive analysis of the various factors contributing to the situation. By adopting a multi-faceted approach that incorporates a detailed examination of social, political, and economic conditions in the region, this research seeks to gain a nuanced understanding of the challenges faced by the Uyghur Muslim population in Xinjiang. Furthermore, it endeavours to identify potential strategies and solutions that could be implemented to address the issue of forced labour and ensure the protection of human rights in Xinjiang.

The aim of this chapter is to contribute to the existing academic discourse on this subject and help to generate ideas that could inform policy decisions aimed at promoting a more just and equitable society. In the context of both human rights and climate concerns, it is imperative that we prioritize a sustainable and ethical approach to the transition towards green energy. Rather than relying on coal, which not only contributes significantly to greenhouse gas emissions but also perpetuates the exploitation and oppression of marginalized communities, we must strive towards a future that prioritizes the protection of human rights and the preservation of the planet. By adopting a more

holistic and conscientious approach to our energy policies, we can mitigate the long-term costs and negative impacts associated with the continued reliance on non-renewable resources and exploitative labour practices. This requires a thorough examination of the socio-political and economic factors that perpetuate the use of such practices, as well as the identification and implementation of sustainable and equitable solutions that uphold the basic tenets of human dignity and environmental responsibility. Ultimately, academic discourse in this chapter serves to contribute to a more comprehensive and informed understanding of the complex considerations involved in the pursuit of a sustainable and just energy transition.

In conclusion, it is critical that we take a proactive approach towards addressing the interrelated issues of human rights abuses and climate change, particularly in relation to the production and consumption of energy. By prioritizing sustainability and equity, we can create a more just and harmonious future that benefits both current and future generations.

Conclusion

The findings of this research have several implications. Firstly, it highlights the use of forced labour in the production of solar-grade polysilicon, which is a primary component of solar cells and modules. This raises concerns about the human rights implications of the solar energy supply chain and the need for in-depth evaluation of the people involved in the production processes. Secondly, it reveals that India, despite being a significant importer of solar panels from Xinjiang, has maintained its silence on the matter. This raises questions about India's commitment to ethical consumption and human rights. Thirdly, it emphasizes the need for extensive due diligence on supply chains to ensure that solar module manufacturers do not produce goods tainted with forced labour in Xinjiang. Fourthly, it highlights the lack of visibility and complexity in the production, processing, and manufacturing of goods, which is a major challenge in tracing and preventing goods produced with state-sponsored forced labour in the PRC from entering foreign markets. Finally, it underscores the need for a global governance and transparency protocol applicable in every country to ensure that social, environmental,

and quality standards are not compromised by decisions and activities that impact the traceability of products.

This chapter explored and uncovered the connections between the manufacturing of solar-grade polysilicon, the compound that is the primary component of solar cells and modules, and the use of Uyghur forced labour in the Xinjiang Region of China. In addition, the chapter revealed that there are justice ramifications of these linkages for India's solar power infrastructure. The chapter brought to light that India, despite being a significant importer of these modules, has maintained its silence on the matter. This is the case while India is a major importer of Xinjiang solar panels. The country has a very limited domestic manufacturing capacity to meet or to feed burgeoning solar industry. It also became apparent that China's repression of its minority community, Uyghur Muslims has not slowed down despite pressures and condemnations from the international community notably the major European powers.

This chapter concludes that there are connections between the manufacturing of solar-grade polysilicon, the primary component of solar cells and modules, and the use of forced labour in the Xinjiang Region of China. The research highlights the need for extensive due diligence on supply chains to ensure that solar module manufacturers do not produce goods tainted with forced labour in Xinjiang. It also emphasizes the lack of visibility and complexity in the production, processing, and manufacturing of goods, which is a major challenge in tracing and preventing goods produced with state-sponsored forced labour in the PRC from entering foreign markets. The research recommends that companies, policymakers, and consumers must ensure that the transformation towards renewable energy does not come at the cost of human rights violations.

The research also suggests that the idea of justice cannot be limited to national boundaries and that there is a need for a global governance and transparency protocol applicable in every country to ensure that social, environmental, and quality standards are not compromised by decisions and activities that impact the traceability of products. The Communist Party of China maintains absolutely secrecy over

its policy of forced labour and detention camps holding more than 1 million Uyghur Muslims. These findings may open the new doors for a new stream of research that will extend the concept of justice in renewable energy sector across the entire value chain. The idea of justice transcends national boundaries and cannot stay confined within them.

7 Justice Lost - II: Land and Livelihoods at Stake in India's Misplaced Priorities for Ultramega Solar Parks

Introduction

This chapter explores the dark side of seemingly bright story of solar energy. What has generally been avoided in the discussion of solar energy growth is its impact on land, environment, and livelihoods. Land is not seen as a constraint on India's ability to benefit from the many blessings that the sun provides. Large areas of land would be needed, which India lacks, to convert a major portion of our electrical supply to solar power.

If decarbonisation must be pursued unchecked, an unprecedented re-commodification of large tracts of land for large-scale wind and solar is unavoidable and it is likely to have major distributive implications for rural people whose livelihoods is dependent on land (McCarthy, 2015). The amount of land needed for solar systems is unclear, and there is a lack of openness in the government's official data reporting. The shift to renewable energy will be significantly hampered by the enormous demand for land and potential environmental side effects such as the conversion of arable land and the disintegration of ecosystems.

A significant portion of the renewable energy production is underway in rural areas, where big swaths of sparsely populated land is available at lower price. It would therefore place intense pressures on rural lands and people, particularly in the country like India, and compete with and likely displace many existing or alternative land uses, mostly food production. As a result of this, any shift to such new geographies of energy production will unavoidably include strong new claims on, disputes over, and vast new deployments of capital and labour in rural areas. This is true of renewable energy expansion across both the North and the South (Knuth et al., 2022). Throughout the lifespan of renewable energy, there are ongoing and potential injustices, worker exposure to dangerous substances, land dispossession, persistent energy poverty, and ecosystem degradation (Healy and Barry, 2017). Political ecology analysis demonstrates that the injustices and power imbalances

associated with energy transitions are mostly a result of inadequate access to resources. Current global energy systems, bolstered by technological innovation, are constantly evolving, largely in response to countless drivers such as limiting the effects of climate change, maintaining economic competitiveness, strengthening energy security, decreasing energy poverty, and increasing social justice. India is no exception to this.

The gradual but constant push to replace fossil fuels with renewable forms of energy in India is attributed in large part to factors like climate change, energy security and access. It is important to recognise that the drivers responsible for this transition are also experiencing a shift currently, making the development of both energy systems and the drivers themselves irreversible. Up until now in India, the emphasis has been largely on identifying and acknowledging the advantages of renewable energy, i.e., the enormous contribution it makes to lowering carbon dioxide emissions as well as country's energy import bills. With the scaling up of deployment, both positive and negative effects throughout renewable energy value chain are anticipated to become more pronounced.

The widespread adoption of the technology is often seen as being intrinsically beneficial by a range of stakeholders because of its well-recognized positive impacts. Because the renewable energy companies generate clean energy, they are often included in sustainable investment portfolios. However, the value chains of the renewable energy sector are quite like those of other infrastructure sectors, and as a result, they are vulnerable to a similar set of social, financial, and environmental risks. Studies on financial practices and accumulation strategies of renewable project development firms have revealed practices that they indulge in widespread financial exclusion, such as favouritism, extraction and rentierism (Baker, 2015).

The dynamics of renewable energy, finance, and investment are becoming ingrained in the social, political, and economic context of India as well as the intricate interconnections between newly emerging national, international, public, and private organisations. This is the characteristics of India's evolving system of accumulation in the renewable energy domain (Bridge et al., 2020; Baker, 2021).

Transition in India is coming at a big price. It's become clear that renewable energies like solar and wind are the most effective weapons against global warming. The urgent need of incorporating human rights into the renewable energy system in this race to save the environment calls for a comprehensive, holistic perspective to save humankind from the disastrous consequences of climate change. Since these renewable energy methods need extensive areas of land, they displace local communities and make it difficult or impossible to grow food and raise livestock.

Land in India is very scarce yet necessary for large-scale solar and wind installations. The dependence of humans on the land might be radically altered because of the widespread adoption of land-intensive renewable energy technologies. Because of this indifference, there is escalating land dispute and intricate, interconnected issues with government and justice. However, the nature of current transformation is such that it cannot be made without violating the human rights of those who stand to lose the most from the spread of renewable energy infrastructure.

The Government of India's declared target of increasing domestic renewable energy to 175 GW by 2022, comprising 60 GW of wind and 100 GW of photovoltaic including 40 GW from rooftop installations (Kiesecker et al., 2020) is indicative of a decentralised vision of renewable energy, especially when 40% of the solar energy is to be derived from rooftop installations. And if the same vision were to continue, India's renewable story would be significantly different from what it is today, with a focus on justice at its core.

7.1 Land conflict and the renewable energy infrastructure in India

For renewable developers, acquiring land might be difficult, but the state governments manage on their behalf quick access to land, approvals, and evacuation infrastructure and a 100% payment guarantee to reduce the danger of curtailment (IANS, 2022). India's current population is 1.411 billion (Worldometer, 2022b) and in coming decades it's going to contribute to intensification of land disputes. Meeting the land needs required to install renewable energy aligned with the year 2030 and 2070 net-zero emissions commitments would intensify land disputes in India (RRI & TISS, 2016;

IANS, 2022). If renewable energy production is sited without considering current land use, it may have unintended consequences for agricultural and natural lands. However, this has not been the subject of popular research.

While India is committed to increase the generation of renewable energy, it recognises the importance of forestry sector to help mitigate climate impacts, protect biodiversity, food and water security, and the livelihood of people. To achieve this India has launched 8 missions under National Action Plan on Climate Change (NAPCC), one of which is Green India Mission (GIM). The objective of GIM is to safeguard the biological resources of India and "associated livelihoods against the peril of adverse climate change and to recognise the vital impact of forestry on ecological sustainability, biodiversity conservation and food, water, and livelihood security" (Government of India, 2014).

India's commitment to meeting renewable energy development goals through large scale solar parks will require proactive land use planning to avoid dire land use conflicts. 'Land Conflict Watch', an environmental research consultancy that tracks disputes on natural resources to facilitate better decision-making on investments and governance in India. The figures below taken from the 'Land Conflict Watch' (landconflictwatch, 2022) are aninteractive representation of ongoing land and resource conflicts in India. There are 8 million people affected by land conflicts in India. In one state alone, namely Gujarat, there are 2,754 villages, which have experienced forceful land acquisition. The land conflicts associated with the power sector are presented in colour yellow, which on zooming in the map present the actual spots of land conflicts.

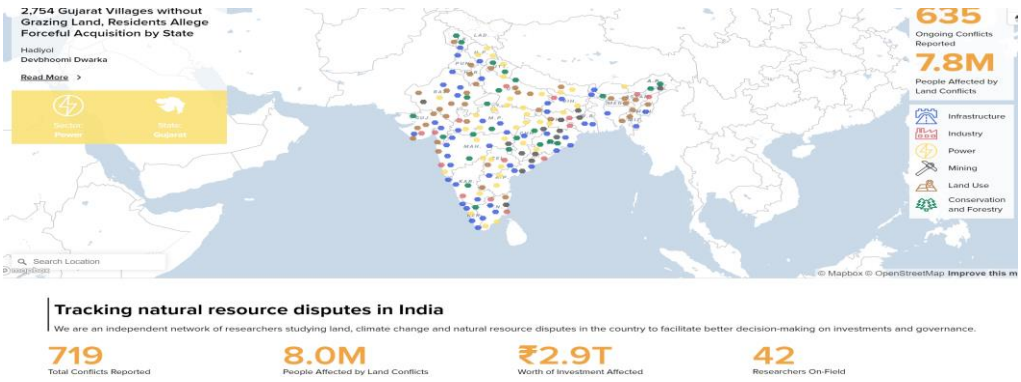

Figure 7a: Tracking natural resource disputes in India 2022. Source: (landconflictwatch, 2022).

The (mis)governance of lands is an important cause of conflicts in India, despite not receiving adequate attention to date. How dire the land conflicts in India are given in the figures below (RRI & TISS, 2016). About a third (32%) of all land disputes are exclusively concerned with private land, while another 42% involved both common and private land. However, research indicated that just 26% of conflicts included exclusively private property. In all, 74% of disputes were on common land. These findings reveal that, despite not having received sufficient attention, governance of common lands is an important cause of disputes in India. In addition, the findings track how forest commons were involved in disputes (43% of all cases). 1.8 million people are affected by forest land conflicts.

Figure7b: Sector wise distribution of land conflict, sector wise distribution of people affected by land conflicts, number of conflicts by land type, number of people affected by conflicts of land type & land-related conflicts involving forest land.
Source:(RRI & TISS, 2016).

The Indian government has played a significant role in developing and regulating the renewable energy sector and continues to do so in accordance with the federal structure of the country and the mandate of electricity sector governance it jointly shares with the state governments. In addition, several agencies at different levels of government are engaged in the administration of the renewable energy sector, with the federal government's Ministry of New and Renewable Energy (MNRE) acting as the nodal ministry. The federal government has also played a significant role in accelerating and catalysing the process of acquiring land for project sites through implementation of a wide range of policy measures to promote the growth and maturity of the industry as well as through the creation of a legislative framework to allow the integration of renewable energy into the electricity grid.

In this context its worth mentioning that the government of India, to achieve the ambitious renewable energy deployment goals, renewable governance now functions as a market-enabling agent for promotion and the adoption of renewable energy. The government's governance role as that of an enabler has created for the renewable energy players a restriction free space with little environment and social governance accountability in the renewable energy value chain's adverse socio-environmental consequences. The industry needs to fully incorporate responsibility for these impacts into its operations.

An international drive for the use of renewable energy sources has gained significant traction. Nonetheless, social justice is often disregarded, particularly in the poor countries. The Indian government's narrative, however, is that the renewables installations is mostly in places like waste lands that are thought to be safe from environmental and social hazards. As a result, in India, environmental and social impact assessment have been kept out of the picture for these kinds of projects. Cost-benefit studies, techno-economic modelling, and scientific and engineering estimates of future technologies or scenarios (Sovacool et al., 2016) are not the whole story when it comes to energy.

True, the pursuit of technological advancement and economic growth are central to India's energy systems, but the pursuit of political power and social cohesion is just as important. Ethical and moral principles, fairness, due process, and justice are also crucial qualities that cannot be disregarded in energy systems. As many people's livelihoods would be jeopardised by these big solar plants, it's important to consider fears of social justice being ignored. Land purchases for major development projects in India, however, have historically been met with these kind of social justice concerns. Developments are representative of state-developmentalism and neoliberalism in India, which draws on historical examples of land confiscation to fund industrialisation (Nilsen, 2010; Levien, 2013).

India's developmenta(al) policies in the energy sector, in general, are reflective of country's policies and regulations encouraging sector growth as well as the broader infrastructure development and economic growth. One of the controversial pieces of law India has legislated in recent times is the 'Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013 (LARR Act)' (The Parliament of India, 2013). This Act, in effect, is the core constituent of the government's renewable energy project development policy. Most infrastructural projects have repercussion on environment and climate and the case of renewable energy is no different, but there is one aspect to these projects which make them special to get environmental impact assessment waived off by the central government's special provision.

The LARR Act 2013 has some stringent provisions that can protect the landowners if forced to surrender their land. The Act, however, also requires Social Impact Assessments (SIAs) to be conducted and evaluated. There are arguments presented that implementing the SIA has challenges, viz., (i) it is time consuming and can take as much as four years, which can delay the project implementation and make it costly, (ii) and the lack of credibility of land records, which needs updating (The Energy Resource Institute, 2021).

The government of India recognises these challenges and with the help of the NITI Aayog, the policy arm of the government has prepared alternative mechanisms for acquiring private land under Special

Purpose Vehicles (SPVs) and various other extraordinary powers for renewable energy development. These alternatives have enabled the state governments to side-step certain provisions of the LARR Act. For example, Karnataka Solar Policy (Panagariya, 2015) gives absolute powers to the District Commissioner (DC) to re-classify agricultural land to suit the commercial interest of the project developers. The DC, in effect, re-classify land from the commons to 'wasteland' which has adverse impacts on local community and the pastoralists who use such a land for grazing their cattle.

The renewable energy sector's continued development is essential in the battle against the climate problem, but its expansion should not mirror that of polluting industries. In terms of land grabbing and ensuring they had free, prior, and informed consent of communities, the renewable energy sector is just as violative of human rights as the fossil fuel companies, according to the Investor Alliance for Human Rights, a reputable non-profit collective action platform for responsible investment grounded in respect for people's fundamental rights (Timperley, 2022). Research on energy justice has the difficult challenge of bringing together a wide range of interests that often conflict with one another to formulate an overall agenda. The questions of impacts on the communities employed in coal mining and climate change's inequitable impacts on low-income groups are not a part of this research; however, the energy justice agenda and the distributive and procedural justice concerns that will accompany this transition are important (Dernbach et al., 2017)

This is a critical time for the sector to address these issues head-on and avoid repeating the mistakes of oil, gas, and mining industries. The sector's inherent role in combating climate change combined with a disturbing surge in charges of human rights abuses is an increasing concern for immediate attention (Kennedy, 2019). Likewise, the acquisition of public utility lands in India often transpires without notification or consultation of those local individuals utilizing such land for agricultural, habitation, pastoral activities, and other purposes. And when they are consulted, it frequently resembles a staged hearing with public representatives and influential local leaders driving the process on behalf of the people, frequently for material gains like construction or logistics contracts in what seems to be

a quid pro quo between such leaders and the private company (Shukla and Sharma, 2021). For this very reason, the Supreme Court recently revoked the award of one such area for a solar plant in Rajasthan's Jaisalmer District.

After China, the US, and the EU, India is the fourth-largest carbon dioxide emitter in the world. However, despite its large population, India's per capita emissions are much lower than that of the developed economies. For example, it is only 1.9 tonnes compared to the USA's 15.5 tonnes and Russia's 12.5 tonnes in 2019 (McGrath, 2021). Prime Minister Narendra Modi made the pledge for India to get 50% of its energy from renewable resources and reduce total projected carbon emissions by one billion tonnes by 2030, at the Glasgow COP26 summit. The country has pledged to go net-zero by 2070. Land in this transition will be a major challenge, which the government of India pretends does not exist or if it thinks it does it is not serious to give the attention it does. In this regard, the government of India needs to consider how concentrated or distributed the energy projects are.

Can the Indian government's ultramega solar park development policy effectively address the pressing challenge of climate change mitigation and foster a common good for all, or is its primary intent geared toward advancing the interests of private entities financing the development of such parks? The veracity of the latter position appears certain, and I will explicate its rationale as this chapter evolves to a state of academic maturity. India unlike the most developed world embarked on rapid ultramega utility-scale solar installations to quickly realise scale, but not realising that this obsessive focus on these parks seems to have become an unintended impediment in the development of the rooftop segment (Down to Earth, 2019).

As of June 2021, India had an installed solar rooftop capacity of approximately 3.902 Gigawatts in the industrial sector and 3.799 Gigawatts on home generating a total capacity of 7.701 Gigawatts (Jaganmohan, 2022). This is an extreme underachievement of the set target of 40 GW of rooftop solar capacity by 2022 (Ranjan, 2020; Manohar, 2022; Perninchery, 2022; PTI, 2022). In other words, as of June 2021, the solar rooftop (SRT) progress falls short by 32.299 GW, which is only 19.25% of the

2022 target. Residential solar rooftop installations in India have been almost neglected due to the dominance of large-scale rooftop installations by commercial, industrial, and government or Public Sector Undertaking segments.

7.2 Tribal (indigenous) people's right to access to 'jal, jungle and zameen' meaning 'water, forest and land' in India impacted by renewable energy projects

'Jal, Jungle, aur Zameen' in India is the indigenous peoples' metaphor as well as literal translation of 'water, jungle, and the land'. The indigenous people of India are commonly referred to as Adivasis. Adivasi is a collective term used for the tribes of the Indian subcontinent. Water, forest, and the land together make up an essential component of the tribal culture and provide the members of the tribe the right to access these natural resources that have been part of their cultural heritage and identity since time immemorial. In addition, people whose livelihoods depend on being close to nature and its resources, such as water, forest, and land generally have unrestricted access to those resources, especially those classified as common use resources.

There is an intertwined relationship between land and resources in India and the welfare of its people, which highlights the salience of property rights regimes and the accessibility of institutional remedies for effectively mitigating conflicts over resource utilization, thereby accentuating the criticality of these dimensions in ensuring sustainable and equitable development outcomes. Findings by Rights Resources and TISS published in 2016 represents conflicts in districts with Schedule V Areas, which have special protections under the Indian constitution. The report concluded that the intensity of conflicts is higher in districts with Schedule V Areas, constituting 12% of total districts in India, but are the site of 18 percent of all land conflicts (RRI & TISS, 2016).

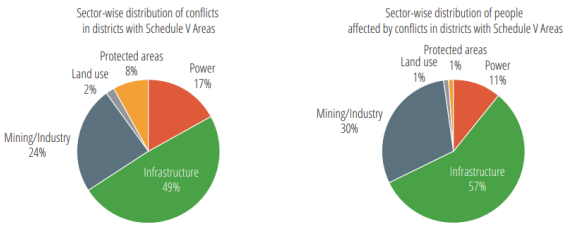

Figure 7c: Sector wise distribution of clonflicts in districts with Schedule V areas; Sector wise distribution of people affected by conflicts in district with Schedule V area. Source:(RRI & TISS, 2016).

The development of utility scale solar power parks in India has become a contentious issue due to the significant land-use changes and displacement of traditional dwellers that often accompanies these projects. Such solar energy projects frequently involve the conversion of large areas of land owned by private individuals, forest land, and land designated as "wasteland" by the government. Considering such concerns, renewable energy projects are required to comply with the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers Recognition of Forest Rights Act or simply the RFR Act 2006 (The Energy Resource Institute, 2021). Under this act, the District Collector, a top government official, is responsible for seeking approval from the relevant Gram Sabha or village council and submitting a report to the Conservator of Forests. There is a poor compliance with this law. The poor level of implementation, however, might be attributed in part to communities' unfamiliarity and lack of knowledge with their individual and communal rights under the RFR Act.

Given the scope and scale of these energy projects, it is crucial that environmental, social, and governance concerns are adequately addressed. One of the primary challenges faced by renewable energy projects is the displacement of traditional landowners and the disruption of long-standing social and cultural practices. Development planners and policymakers must take care to ensure that the rights of local communities are respected and that they are provided with adequate compensation and resettlement support.

The conversion of forest land must be subject to rigorous environmental impact assessments, and projects should be designed in a way that minimizes the potential for long-term environmental damage. Furthermore, policymakers must also consider issues related to sustainable development and energy security. While renewable energy projects offer significant advantages over fossil fuels in terms of reducing greenhouse gas emissions and promoting energy independence, they must be implemented in a way that factors in broader socio-economic and environmental considerations. This includes identifying potential constraints related to land-use, water resources, and ecosystems, and developing policies and strategies to mitigate these impacts and ensure that sustainable development is achieved.

While the development of renewable energy projects such as utility-scale solar power parks offers promising potential for improving energy access and mitigating climate change, they must be implemented with caution and in accordance with relevant laws and regulations. It is important that development planners and policymakers prioritize addressing the concerns of local communities and ensuring that these projects are sustainable and equitable in the long term.

In most instances, village councils are unaware of most laws, and even when they are, they are pressured into compliance by government officials who are in turn subject to pressure from the local political establishment. In general, village councils neither have the will, knowledge or the ability to face the consequence of non-compliance with the government. A case in point is the socio-economic and environmental impacts of large-scale renewable energy projects in India is the Bhima Shankar Wildlife sanctuary (Pratap, Pillai and Muthu, 2020), part of the Western Ghats (Sahyadri Ranges), which itself is recognised as one of the 12 biodiversity hotspots of the world (Financial Express Online, 2021). Communities are still struggling to gain control of the forest land that government of Maharashtra acquired for wind projects many years ago. The research claims that the Gram Sabha was not consulted about diverting forest land for non-forest use in violation of this Act.

The government of India’s Environment Protection Act (EPA) of 1986 is an overarching legislation enacted to provide a framework for the central government's coordination of the activities of various central and state authorities that had been established under earlier laws, such as the Water Act and the Air Act, as well as for other legislations related to the conservation of forests and biodiversity. Renewable energy projects fell within the purview of this Act. Getting the environmental clearances for projects in most industries as spelled out in the government of India’s Environmental Impact Assessment (EIA) Notification of 2006 is mandatory.

According to the EIAN 2006, energy projects were exempted from the EIA. This was a major setback to environment in the country. However, unlike other sectors, the solar PV projects, solar thermal power projects, development of solar parks (Ministry of New and Renewable Energy, 2017) and

onshore wind, small hydro (up to 25 MW), biomass, and waste to energy (up to 15 MW) projects do not need an EIA (MNRE, 2013). The renewable energy projects operating in the areas considered outside of the eco-sensitive zones are exempted from EIAs. This, however, has severely restricted civil society's ability to engage formal mechanisms to monitor and assess environmental impact.

The renewable energy projects may appear to have adequate safeguards to keep their environmental impacts contained in line with the state and central governments' guidelines. The Environmental Impact Assessment (EIA) as per the Government of India Notification 2006 (Ministry of Environment and Forests, 2006), are required across sectors under the Environment (Protection) Rules 1986. This is a prerequisite for procuring an environmental clearance (EC). In several of the developed countries like the US, UK, Ireland, Denmark, Netherlands, Germany, Spain, and even in China where renewable energy transition is underway, EIA is required for large-scale wind and solar energy projects (Pratap, Pillai and Muthu, 2020). This, however, is not required in India for solar and wind energy projects as they are presumed to have little carbon footprints and adverse environmental impacts. This may be somewhat true compared to traditional power plants. However, poor project execution and improper adherence to environmental impact assessment provisions can have significant adverse impact on the local ecology (Pratap, Pillai and Muthu, 2019) and ecosystem services land-based livelihoods of people in project areas.

Under the Air Prevention and Control of Pollution Act 1981(Government of India, 1981) and the Water Prevention and Control of Pollution Act 1974 (Government of India, 1974), renewable energy projects involving wind and solar power are required to obtain a No Objection Certificate (NoC) and a Consent to Establish (CtE) from the State Pollution Control Board (SPCB) of their respective states. Pavagada's solar Park in Karnataka exemplifies the absence of clarity regarding whether solar power plants meet the requirements for implementing water conservation practices such as rainwater harvesting and developing social infrastructure. The Pavagada Solar Park is built on 13,000 acres of semi-arid, drought-prone land in a region where the state government declared drought 54 times in the past 60

years (World Resources Institute, 2021). It is nevertheless a point of concern in the light of very high-water intensity of panel operation and maintenance of solar parks. When it comes to operations and maintenance, washing solar panels may be a very water-intensive process. It is estimated that each wash will consume between 7,000 and 20,000 litres of water per MW of capacity (Pratap, Pillai and Muthu, 2020). Such washes are usually needed once in a month. By this estimate a solar power project of 1 GW (1000 times that of 1 MW) requires between 7 to 20 million litres of water per wash per month.

Even considering the average of the lower and the upper estimates, the water consumption is 13.5 million litres. The estimated water use by the Pavagada Solar Park plant in Karnataka is 1,110 kilolitres per day (KLPD) or 1.11 million litres KLPD (The Energy Resource Institute, 2021). A report by a consultancy, 'Bridge To India' highlighted that more than half, i.e., 56% of India's installed solar capacity is located in arid and high water-stress zones, where excessive use of water for the purpose of washing solar panels is creating a significant amount of water risk. To live up to its reputation as being environmentally friendly, the sector must replace labour-intensive manual cleaning with technology that provide water-saving alternatives. The findings while shading light on projects located in areas with good availability of water, suggests that wasteful use of water is a common problem.

The distributed generation capabilities of renewable energy sources enable the reduction of transmission and distribution losses, thus highlighting their potential in contributing to a more sustainable and efficient energy infrastructure. While the benefit of SRT on individual homes is clearly apparent, as the generated power is consumed locally, achieving significant capacity addition in rooftop solar would require close engagement with key stakeholders, i.e., numerous small consumers (Down to Earth, 2019). This strengthens the case for the abandonment of centralised approaches and developing solar power plants as close as possible to the ultimate consumption sites. It is therefore important to make sure that the area occupied by these facilities does not, either directly or indirectly, harm to the environment.

India since the signing of Paris Agreement and its ratification on 22 April 2015 and 2nd October 2016 respectively (The United Nations, 2015) it has been making great strides in renewable energy. Renewable energy, particularly solar energy has taken a centre-stage in India's march to achieve its economic goals through significant development of energy infrastructure. The Indian government set a lofty goal in 2016 to replace polluting fossil fuel-based power industry with a low-cost, low-emission system based on renewable energy, with 175 gigawatts (GW) by 2022, 275 GW by 2027, revised in 2019 to 450, as per India's Central Electricity Authority, by 2030 (Shah, 2020) and the current formidable target now stands at 500 GW (Jaiswal and Bhagavatula, 2017).

India has developed the concept of the ultramega power plant (UMPP) under the Ministry of New and Renewable Energy (MNRE) and has been at the forefront since 2016. An "ultra-mega solar park" is a solar power project greater than 500 MW. According to the UMPP concept, a state or local distribution company or 'discom' would facilitate a single central grid connection and assume the risks associated with land acquisition and shields developers from procurement and time-delay risks. Over the past 5 years, the government's strategy has been crucial in successfully fostering economies of scale and attracting foreign investment into the country's solar energy sector (Shah, 2020).

In the matters of execution of mega renewable projects there are three major risks, viz., (i) project execution risk, (ii) off-taker risk and (iii) operation and maintenance risk, which India has managed to successfully overcome. However, admittedly one of the most challenging obstacles to such infrastructure projects is the process of land acquisition. The difficulties associated with acquiring land for infrastructure projects can be attributed, in part, to India's complex and fragmented system of land ownership, which involves various layers of government, private individuals, and community land-use rights. To overcome these obstacles, state government renewable development energy agencies have taken on the role of acquiring large-scale government and privately-owned land for the development of mega solar parks. This approach has relieved the burden on project developers and helped streamline the land acquisition process. However, this approach also raises concerns about the displacement of

local communities and traditional landowners, as well as questions about the ownership and use of the acquired land. For example, in Andhra Pradesh, the Andhra Pradesh Solar Power Corporation (APSPCL) was the lead government agency that took upon itself land acquisition for the project and then construct roads, training facilities in surrounding villages and other infrastructure development for operational functionality of the park (Jaiswal and Bhagavatula, 2017).

7.3 Socio-environmental aspects of renewable energy related land footprint

The role of the renewable energy in the 1970s was envisioned to be a unifying overarching system of unconventional energy sources that could displace centralised energy systems that ran on fossil fuels and nuclear power and tended to concentrate political power. Unconventional energy initiatives do, nonetheless, hold out the possibility of replacing centralised energy systems; what they fail to do, however, is figure out how to limit their environmental impact. The way these energy projects are being implemented has made it obvious how much land the decentralised energy projects would need, as is evident from the massive tracts of land that India's ultra-mega size solar projects are displacing. Admittedly, it was also realised that the problems with industrial power systems were not just technological; they were also political (Mittlefehldt, 2018) and could be best used to redistribute political power and serve as an effective tool for decentralising society (Bookchin, 1978) to help empower communities in decisions about energy. Ivan Illich, an Austrian philosopher, Roman Catholic priest, and critic of the institutions of contemporary Western culture and their effects of the provenance and practice of education, energy use, and economic development stressed on the negative side of the large-scale fossil fuel-based energy systems as they tended to centralize energy production and concentrated both political and physical power.

The adoption of renewable fuels technologies was seen as a means of aligning more closely with the natural world, as these technologies utilized natural resources rather than relying on non-renewable energy sources. Furthermore, there was a belief that nature could serve as an equalizing force in power production, promoting a more balanced and sustainable approach to energy generation. However, there

is a risk that the excessive growth of these technologies could create negative outcomes that conflict with their intended purpose. Specifically, the large-scale implementation of renewable fuels technologies may threaten the well-being of society itself, thereby working against the very ideas that drove their creation. In other words, while the use of renewable fuels technologies was seen as a path towards greater environmental sustainability, their rapid expansion could ultimately generate unintended consequences that undermine their original goals (Illich, 1973). Land is one aspect that is largely ignored. Land is not considered a barrier to our capacity to take advantage of the sun's endless bounty from heaven. Switching a sizable amount of our electrical supply to solar power would require vast tracts of land, which India does not have.

The deficiency in the transparency of the government's official statistical reporting and the absence of clarity regarding the acreage necessary for implementing solar installations are visible lacunae that underscore the need for greater scrutiny and discernment in the domain of sustainable resource allocation and management. The huge demand for land will be a major impediment to the renewable transition as the potential environmental side effects including the conversion of arable land and the fragmentation of ecosystems (Diab, 2021). Dirk-Jan Van de Ven of the Basque Centre for Climate Change (BC3), while upholding the importance of decarbonisation of the energy systems pressed for the importance of solar energy to be integrated into agricultural systems instead of clearing them prior to the construction phase. Such integrated practices are not common in contemporary solar energy systems anywhere, but they are of utmost importance to avoid many of the negative impacts of solar energy land occupation (Diab, 2021).

India's ambitions for renewable energy are enormous and quite likely completely unattainable, if the push for ultramega solar parks continues to be government's principal priority. There is significant negative impact on the environment and the communities that live near such developments. Moreover, it is important to note that the substantial size of installed renewable capacity may not necessarily reflect the actual energy output of such projects. Rather, the efficiency of renewable energy projects

should be regarded as the key factor, as opposed to solely focusing on their installed capacity. Therefore, there is a need to consider the efficiency of renewable energy projects to accurately gauge their potential impact, rather than relying solely on installed capacity as a metric.

India has made a formal pledge to achieve net-zero emissions by 2070 (McGrath, 2021) and it will continue to expand its extremely sizable solar and wind power capacity during the coming decades. India's ambitious goal of making the switch to clean energy is consistent with that strategy, but what is likely lacking is a thorough evaluation of the energy transition programmes' effects on the environment and society. For instance, one of the main criticisms of the rapid transition to renewable energy is that it is displacing fertile agricultural areas and having a significant negative impact on avifauna (Aggarwal, 2020). This continued capacity expansion will be needed to accommodate population growth and economic expansion, as well as for replacing thermal generation.

India’s unfolding rapid energy transition implies extraordinary amount of future land requirements (Worringham, 2021). Before Prime Minister Modi announced net-zero commitments for India by 2070, a lot of studies were carried out that outlined likely future land requirements based on the mid-century, i.e., 2050 scenarios; some of those by Council on Energy, Environment and Water (CEEW), The Energy and Resources Institute (TERI), the International Energy Agency (IEA), and others (Chaturvedi, 2021; International Energy Agency, 2021b). For example, the study by (Shell and TERI, 2021) land use estimate for net zero in 2050 is between 50,000 and 75,000 km² for solar, and 15,000-20,000 km² for wind.

The acreage of land required for different energy types is important, but what is more important is the impact this will have on society, environment, and the ecology of the area where these projects will be located. The question of renewable energy, especially solar energy’s high requirement for land has raised concern over competition with agriculture in the developed and developing countries, including Netherlands (Bellini, 2019) and Indonesia. In this context, India’s case of land-use requirements is quite unique. Some of these unique characteristics include extremely high population densities, areas

with inadequate electrification, low levels of power usage, variations in the climate in the face of growing demand from economic and population growth. According to the well-known New Delhi-based thintank, Council on Energy, Environment and Water (CEEW), India would need to augment its production of renewable electricity by a multiplicative factor of 55 to attain a net-zero emissions target by 2050, highlights the magnitude of the challenge posed by climate change and the exigency for concerted efforts towards sustainable energy transitions (CEEW, 2021).

The larger issue at play is the competition between electricity generation and possible alternative uses for land. There is an opportunity cost associated with electricity generation for possible alternative uses for land, such as food production, ecological conservation, and human habitation. The standard principle for selection of land for energy projects is that the chosen site is on a barren, unused and/or unusable wasteland. This is, however, subject to what constitutes a "barren" or "wasteland" implying that such areas have no value that cannot be used for agricultural or any other productive activities. The first preferred site for renewable energy projects is expected to be mainly placed in "zero impact areas", such as rooftops, landfills, contaminated industrial and mining sites (Gulagi et al., 2017).

7.4 Is big really beautiful? land remains a critical concern for India's utility-scale solar parks

The renewable energy from very humble beginnings to its current state has seen a remarkable progress traversing the hard and "soft energy path", which relied on centralised, fossil fuel-based energy systems and energy efficiency and technologies fueled by flexible, diverse, and renewable fuel sources respectively (Lovins, 1976). One of the earliest and most prominent advocates of renewable power Amory Lovins emphasised that apart from the technical and economic aspects, it is the sociopolitical implications of energy paths that are paramount both in moral importance and in political acceptance. The moral imperative of these transitions as stressed by Lovins is neglected in the Indian context.

The current energy transition in India is marked by large scale land hungry centralised projects. Although, humans have harnessed the sun's power for their energy needs from time immemorial, it is the second half of twentieth century that brought in its wake a new wave of interest (Perlin, 2013) for

solar energy, that could provide alternatives to dominant energy systems and better suited to fit the needs of local people and places, idealized as a product of new technology called by various names by various scholars, such as Lewis Mumford (Mumford, 1971) called them “democratic technologies”, while for Schumacher (Schumacher, 1973) they were “alternative technologies” (Mittlefehldt, 2018). The new decentralised renewable technologies christened as “alternative technologies” or “democratic technologies” were democratic in the sense that they became tools for economic development, particularly in developing nations (Kaplinsky, 1990). These technologies still retain their fundamental attributes of a decentralised energy system that involves smaller-scale technological “assemblages” fueled by renewable forms of energy that can serve the development needs of the communities in a democratic way.

India's complicated land ownership laws, which the government authorities often take advantage of date back to its colonial history. Developing ultramega solar parks on huge tracts of land demonstrates the magnitude and complexity of the obstacles the nation of 1.4 billion people (World Population Prospects, 2022) has in achieving its targets for renewable energy. Development of electricity storage for times when the sun isn't shining, or the wind isn't blowing are the global challenges, but issues more India-specific, such as the ownership of land in underprivileged areas or by underprivileged people that contribute the least to the climate disaster have not been given the due consideration they deserve.

There isn't yet a clear roadmap for India's transition to renewable energy, meeting 50% (500GW) (The Economic Times, 2021) of the country’s energy needs by non-fossil sources may prove disastrous for the country’s small land holders and pastoralists (Dolton-Zborowski, 2022). While goal 7 of the United Nations Sustainable Development Goals (UNSDG) being widely regarded as the bedrock of the global effort to achieve greenhouse gas emissions targets and expand access to affordable energy, it is important to have a closer inspection of the approaches that governments have taken towards realizing this objective. Child labour in transitional mineral extraction, forced labour in the production of

polysilicon in China, public health effects from the disposal of solar and wind energy equipment and displacement of vulnerable people during the deployment of wind and solar projects, including project's design, building, and continuous operation have been highlighted as human rights consequences in the wind and solar value chains (Dolton-Zborowski, 2022).

In February 2019, the Indian cabinet approved central financial support of Rs.11,814 crore (US$1.48 billion) to implement Phase-II of Grid Connected Rooftop Solar Programme for achieving cumulative capacity of 40,000 MW from Rooftop Solar (RTS) Projects by the year 2022 (Government of India, 2019), which appears to show government's commitment to roll out RTS energy but has fallen short by 32.4 GW as of March 2022 (PTI, 2022). The reality is the government is not serious about implementing RTS and has chosen the easier way out. One of the biggest obstacles to the development of this industry is that Discoms are reluctant to promote solar rooftop in their licence area since they see it as a direct threat to their earnings. They anticipate significant income loss because of declining energy sales and the cost they will incur for any excess energy produced and pumped into the grid (NowSolar, 2021). The total installed capacity of 7.6 GW of rooftop solar (PTI, 2022) is way too short of the 2022 target, which India has been trying to compensate through development of utility-scale solar parks. However, India's neglect of rooftop solar is the neglect of distributed renewable energy, which is more democratic and more equitable.

7.5 Land-renewable energy project nexus vs. adverse impacts on vulnerable communities

According to a report by the International Energy Agency (IEA) on renewables energy forecast to 2026 (IEA, 2021), renewable energy installed capacity is expected to increase by 60% by 2026, with wind and solar leading the way. The report paints a grim reality of human rights consequences of renewables infrastructure. The land-intensive nature of wind and solar installations, portends a troubling parallel trajectory of negative human rights repercussions on communities living on and/or close to the plant locations. China, India, Brazil, Turkey, and Mexico are 5 of the 7 countries expected to attract the biggest wind energy projects rank 'high' or 'severe' on risk indices relating to violation of

people's land rights (IEA, 2021; Dolton-Zborowski, 2022). Unless something changes, the community implications of rapid expansion, land intensification, country risk profiles, and mounting human rights claims will be the most serious concerns to be addressed.

Centralised energy systems are the opposite of decentralised ones; they are inflexible, difficult to administer, and have negative effects on the local community and environment (Boamah, 2020), such as the destruction of natural habitats and the loss of income for local residents. Despite having a centralised leadership team oversee the planning, construction, funding, ownership, and management challenges, these facilities are implemented and administered remotely. Furthermore, there is no mandate or law requiring these massive, centralised facilities to provide service to previously unserved small towns on the periphery via the pricey national networks (Alstone, Gershenson and Kammen, 2015). Apart from technical, spatial and governance differences there is a major distinction between centralised and decentralised energy systems in the way they differ in their ownership and financing.

India has demonstrated technological prowess and its commitment to climate change mitigation by jumping on the bandwagon of ultra-mega solar parks and mobilise capital at a scale and the cost that is quite an achievement. However, it has completely overlooked the unfavourable externalities such massive solar parks create. India's solar energy is a success story.

The question arises how India managed to undertake this mammoth task of creating ultra-mega solar parks in a country with a population of 1.41 billion (Worldometer, 2022b) where procuring land is difficult and has a direct implication on farmers' and pastoralist' livelihoods. To infuse confidence in project contracts, two federal public sector companies Solar Energy Corporation of India (SECI) and National Thermal Power Corporation (NTPC) Ltd, have been tasked to underwrite Power Supply Agreements (PSA) with the new solar parks as well as take the risk on their own balance (Shah, 2020). This has boosted project developers' long term financial commitment and expected returns from project investment. With a third-party guarantee, project developers are ready to do business with financially stressed state government-owned power distribution companies (discoms), which owe

more than US$12 billion to generation companies for 2019-2020 (Shah, 2020). The figure below lists 9 of India's largest, ultra-mega solar power parks and Bhadla Industrial Solar Park in Rajasthan that spans 14,000 acres is the world's largest solar park to date, with total capacity of 2,245MW. Bhadla Solar Park is located in a dry and sandy region in Rajasthan, and spans 14,000 acres. To this project, 3 solar parks which are operational and exceed the capacity of 1,000 MW will be considered. These parks are and (1) Bhadla Industrial Solar Park, (2) Pavagada Solar Park, and (3) and combined Ananthapuramu – I Solar Park and Ananthapuramu – II Solar Park.

No	Project Name	Capacity (MW)	Status	State	Sponsors
1	Bhadla Industrial Solar Park	2,245	Operational	Rajasthan	Rajasthan Solar Park Development Company ltd, ESSEL, IL&FS, Adani RE power Ltd
2	Pavagada Solar Park	2,050	Operational	Karnataka	Karnataka Solar Power Development Corporation Pvt Ltd
3	Kurnool Ultra Mega Solar Park	1,000	Operational	Andhra Pradesh	Andhra Pradesh Solar Power Corporation Pvt Ltd
4	Rewa Solar Park	750	Operational	Madhya Pradesh	Rewa Ultra Mega Solar Ltd
5	Adani Kamuthi Solar Plant	648	Operational	Tamil Nadu	Adani Green
6	Ananthapuramu - I Solar Park	1,500	Partially operational	Andhra Pradesh	Andhra Pradesh Solar Power Corporation Pvt Ltd
7	Kadapa Solar Park	1,000	Partially operational	Andhra Pradesh	Andhra Pradesh Solar Power Corporation Pvt Ltd
8	Ananthapuramu - II Solar Park	500	Partially operational	Andhra Pradesh	Andhra Pradesh Solar Power Corporation Pvt Ltd
9	Dholera Solar Park (Gulf of Khambhat)	5,000	Under development	Gujarat	Gujarat State Government
	Total	**14,693**			

Source: MNRE, IEEFA.

Figure 7d: 9 of India's largest, ultra-mega solar power parks.
Source: (Shah, 2020).

7.6 Mid-century estimate for land use by renewable energy projects

There are several studies that have estimated land requirement for renewable projects in India. However, it's difficult to choose from a range of different estimates each study has given because of a high degree of variability in different data sources and assumptions (Worringham, 2021). There cannot be a consistent method for selecting from a variety of estimates, particularly if they are extremely variable, come from several data sources, and are predicated on various assumptions. Additionally, it is important to note that there is no governmental research that can be regarded as completely dependable in commencing pivotal renewable infrastructure which can endure for an extended period

and serve as the foundation for decision-making in the domains of project design and implementation. A much larger generation capacity is expected to be implemented in the future, this could help guide the adoption of solutions to reduce needless land-use disputes (Mahtta, Joshi and Jindal, 2014). At present, there are no available estimates that can truly represent the quantity of land required for the renewable energy projects over the coming decades. To establish how much land will be required in India for development of renewable infrastructure, I present here findings of several studies, each of which have estimated land requirement as a range with quite a big difference between the two ends of the range.

Report	2050 Generation (TWh)			2050 Capacity (GW)		2050 Land Use (km2)		2050 Land Use (km2) - Average		
	Total	Solar	Wind	Solar	Wind	Solar (range)	Wind (range)	Average of Solar	Average of Wind	Solar+Wind
CEA	5,072	1,265	726	732	329	14,054 - 18,300	757-987	16177.0	872.0	17,049
IEA STEPS	4,968	1,745	722	1,033	298	19,384-25,825	685-89	22604.5	387.0	22,991.5
IEA SDS	4,551	1,996	1,119	1,176	476	22,579-29,400	1,095-1,428	25989.5	1261.5	27,251
IEA IVC	5,467	1,895	951	1,135	393	21,792-28,375	904-1,179	25083.5	1041.5	26,125
Gulagi	7,212	4,441	501	2,220	200	42,624-55,500	460-600	49062.0	530.0	49,592
TERI/Shell	10,934	3,909	3,930	2,300	1,680	44,163-57,504	3,865-5,41	50833.5	3865.0	54,698.5
CEEW	10,602	6,336	2,464	3,728	1,053	71,580-93,204	2,423-3,160	82392.0	2791.5	85,183.5
Average	**6,972**	**3,084**	**1,488**	**1,761**	**633**			**38,877**	**1,536**	**40,412.93**

Figure 7e: Table of Estimates of Land Use for 2050.
Source: (Worringham, 2021) in black and blue is my own construct, which gives average of the range estimates worked out by the author using various studies. According to my own calculation based on land used by the two of India's largest solar parks, it is 25.65 km²/GW.

I have used these studies as well as my own calculations based on land allocated to utility-scale ultramega solar parks – Dhabol Solar Park in Rajasthan, and, and Pavagada Solar Park in Karnataka, the two over 2GW solar parks. In the table, prospective installed capacity is utilised to calculate land requirements based on electricity outlooks for 2050.

The wide range of land-use estimates in the Table is primarily due to the large variations in projected electricity generation for the year 2050, but it is also influenced by uncertainty in energy needs by then, change in the density of solar panels due to advancement in technology and the target variation allocated to each of the renewable energy source. The largest land use estimate by the Council on Energy, Environment and Water (CEEW) with 83% of renewable energy penetration has very high

outlook for electricity at 10,602 Twh (TeraWatt Hours) projects the largest land use requirement of 85,412.93 km², whereas the high expectation for overall energy generation and the relatively significant expectation for wind generation in comparison to previous reports is mostly because of widely differing assumptions about wind's future share of generation (Worringham, 2021). From the Table, the overall combined average estimate of 40,412.93 km² for 2050 appears to be credible. However, the estimates for the target year 2070 will go well above the 2050 target. In seven states, the Indian government has designated over 10,800 square kilometres of land for the construction of wind parks or wind-solar hybrid parks with a combined capacity of about 54,000 MW. However, the planned strategy for these parks primarily ignores issues pertaining to the environment, land, and communities (Aggarwal, 2020). Below, I am presenting some government of India's estimates for development of 54 GW of energy from wind and wind-solar hybrid parks to give an idea about how much land is at stake for India's 2070 net-zero target. In seven renewable energy-rich states, the Indian government has designated over 10,800 square kilometers of land for the construction of wind parks or wind-solar hybrid parks with a combined capacity of about 54,000 MW. However, the planned strategy for these parks primarily ignores issues pertaining to the environment, land, and communities.

State	Site	District	Area (km²) available	Average Wind Speed (m/s)	CUF (%) P50	Average WPD (W/Sq.m)	Installable Potential (MW) [assuming 5 MW/km²]	Land to be procured/allotted for Wind Energy Park Development (Sq. km)
Tamil Nadu	A	Tirunelveli	68	7.326	36.348	572.730	340	3.4
	B	Tuticorin	169	6.998	35.146	305.284	845	8.4
	C	Coimbatore & partially Palakkad (Kerala)	351	8.588	40.802	558.989	1755	17.6
	D	Tiruchirappalli & Perambalur	547	7.093	34.878	444.800	2735	27.3
Andhra Pradesh	E	Tumakuru & Anantapur	1055	7.307	36.309	334.628	5275	52.7
Karnataka	F	Chitradurga & Davangere	640	7.132	34.263	369.945	3200	32.0
	G	Bellary & Davangere	924	7.139	34.705	335.037	4620	46.2
	H	Chitradurga	269	7.153	34.886	309.581	1345	13.4
	I	Chitradurga & Davangere	380	7.194	35.142	335.889	1900	19.0
Gujarat	J	Junagadh & Porbandar	2900	7.017	35.315	385.530	14500	145.0
	K	Kutch	771	7.329	38.039	337.750	3855	38.6
	L	Kutch	680	7.510	39.367	371.885	3400	34.0
	M	Kutch	590	7.434	38.805	372.130	2950	29.5
	N	Kutch	308	7.297	37.513	358.508	1540	15.4
Rajasthan	O	Barmer	265	6.50	30.375	289.84	1325	13.25
	P	Barmer	109	6.52	30.470	286.69	545	5.45
Madhya Pradesh	Q	West Nimar	220	6.91	31.647	400.90	1100	11.00
Telangana	R	Ranga Reddy	346	7.14	31.273	299.65	1730	17.30
	S	Ranga Reddy	197	6.61	32.190	268.43	985	9.85
			10,789				53,945	

Figure 7f: Government of India's estimates for development of 54 GW of energy from wind and wind solar hybrid parks. Source: (MNRE Government of India, 2020).

The energy needs of India by 2070 will be many times more than currently being generated. According to an analysis by an influential independent think tank, Council on Energy, Environment and Water (CEEW), India's total installed (i) solar-based power capacity will need to expand to 1,689 GW by 2050 and to 5,630 GW by 2070, (ii) wind-based electricity generation capacity to increase to 557 GW by 2050 and 1,792 GW by 2070, while (iii) nuclear-based electricity generation capacity must increase to 68 GW by 2050 and to 225 GW by 2070 (Chaturvedi and Malyan, 2022). I am going to use energy generation estimates for solar and wind by 2050 and 2070 worked out by CEEW (Chaturvedi and Malyan, 2022) and land acquired to generate 54GW of energy from wind and/or wind-solar hybrid projects in 7 states to calculate the quantity of land required to meet India's renewable energy targets.

Energy type	Energy (GW) by 2050	Energy (GW) by 2070	Land required (km²) by 2050	Land required (km²) by 2070
Solar	1689	5,630		
Wind	557	1,792		
	2,246	7,422	449,200 (solar + wind)	1,484,400 (solar + wind)

Figure 7g: 2070 net-zero emissions commitment (MNRE Government of India, 2020).
Source: (my own construction using data from (MNRE Government of India, 2020; Chaturvedi and Malyan, 2022).

Based on the above table, I am going to present two land required scenarios for hybrid wind and/or wind-solar for 2050 and 2070 respectively by projecting those land masses on India's map using Google Earth's GPS coordinates.

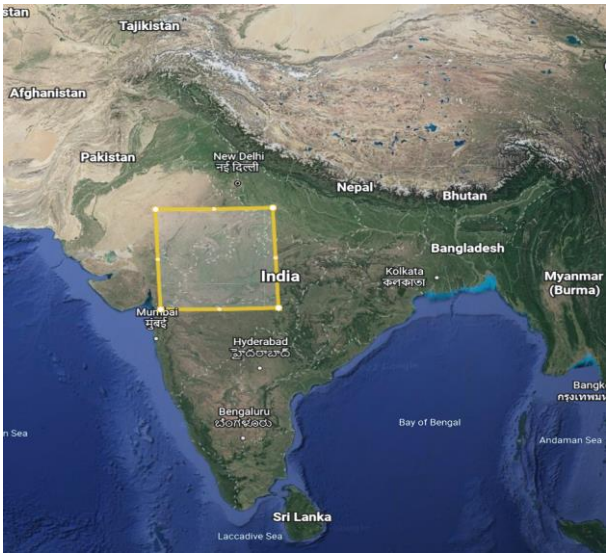

Figure 7h: 2050 Scenario: land required for 2,246 GW power generation by wind/wind-solar hybrid projects is 449,200 km². Source: (the area marked in the Indian map from Google Earth represents land requirement by 2050 using data from (MNRE Government of India, 2020; Chaturvedi and Malyan, 2022).

Figure 7i: 2070 Scenario: land required for 2,246 GW power generation by wind/wind-solar hybrid projects is 1,484,400 km².
Source: (the area marked in the Indian map from Google Earth represents land requirement by 2070 using data from (Ministry of New & Renewable Energy, 2020; Chaturvedi and Malyan, 2022).

India has a total land area of 3,287,263 km² (World Population Prospects, 2022) and the population of 1.4083 billion (WorldAtlas, 2022). Add to these figures 1,484,400 km², the land required to generate 7,422 GW to meet 2070 net-zero emissions. In other words, country's 45% land will be covered in solar and wind or hybrid projects, while assuming that there is no technological improvement in the solar and wind technology that may reduce substantially the land requirement.

It is noteworthy to mention that by 2070 India with 45% of its land used up by wind and solar energy projects will have a 1.63 billion (Population Pyramid, 2022) people who will have to be fed, sheltered, and clothed. This brings the truth home that the scale and immensity of challenges – population, resource scarcity, energy needs are of such an extraordinary proportion that the country just cannot afford to sacrifice 45% of its land to electricity generation. The list of challenges associated with India's net-zero transition doesn't stop there as issues of windmill and solar panels related waste management need to be factored into the current renewable infrastructure development planning.

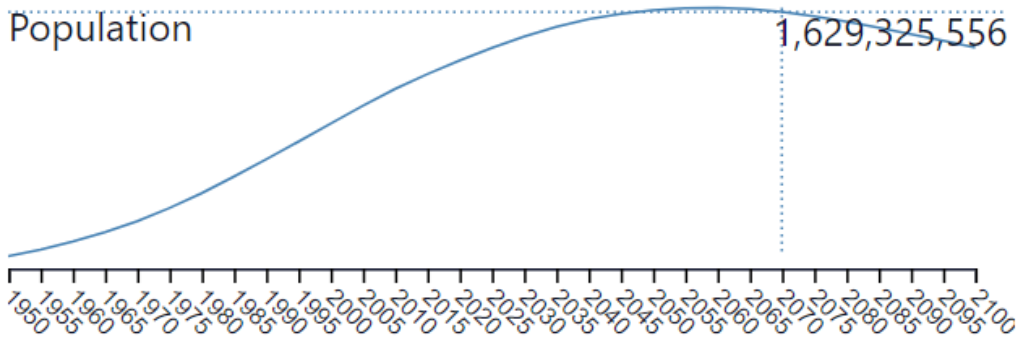

Figure 7j: (Population Pyramid, 2022).
Source: India's population projection 1950-2100 (Population Pyramid, 2022).

7.5 Ultramega solar power parks and land conflicts

Figure 7k: Bhadla Solar Power Plant, Rajasthan (2245 MW).
Source: (Prateek, 2018).

The Bhadla Solar Power Plant is vital to India's commitment to reducing its carbon footprint and combating climate change. It is very clearly visible that the land where this portion of the solar park is constructed is lush green and suitable for crops. The image depicted above portrays the fields situated in the northern vicinity as thriving, lush green, and the robust standing crops accentuate the notion that contradicts the governmental propaganda regarding the usage of barren land for the solar park's establishment that cannot sustain any crops. The research will use several such photos, including

satellite imageries to prove that transiting to solar energy is sacrificing fertile land which supports livelihoods of the people tilling such land. The presented satellite image highlighting the fertile farmland areas within Bhadla Solar Park is a critical piece of evidence challenging the government's claim that the park primarily spans barren land. This necessitates an academic assessment and evaluation of the government's decision-making that led to this misrepresentation, including the potential repercussions and implications of constructing the mega solar park on fertile lands. Such an analysis should also involve examining the stakeholder perspectives, incorporating the ecological and socio-economic considerations, and assessing the implications of the development on the local ecology and communities. Ultimately, the government should be held accountable for its claims and actions, and any misrepresentation of facts and its consequences must be subject to transparent investigations to uphold the tenets of sustainable development.

The potential for state governments to undertake assessments of drought-prone areas for the installation of solar parks is a topic of academic dispute. However, the inadequacy in stakeholder participation presents a critical challenge that could undermine the interests of key stakeholders, such as farmers. This issue is common in land acquisitions for government-led development works and begs for a more critical analysis of the processes involved. Accordingly, it is imperative to conduct an in-depth, interdisciplinary evaluation of the potential impacts of government-led solar park projects on rural communities to ensure that development initiatives consider the unique needs and interests of all stakeholders involved.

Figure 7l: Bhadla Solar Power Plant, Rajasthan.
Source: Google Earth at (GPS coordinates: 27°27’38” N, 71°58’22” E).

According to Mercom, a market intelligence and advisory for India’s energy markets in India Solar PV Tracker reported that solar projects were facing major land challenges in Rajasthan’s Bhadla Park. There are conflicting claims regarding the ownership of the land allocated to the project as farmers claim the project land as their own whereas the government claims it belongs to the state government (Prateek, 2018). Despite a lack of clearly defined rules or penalties governing land quality, fertile cultivable land is often obtained for the purpose of constructing solar power plants.

In practical terms, the land acquired by solar power plant developers is not consistently barren. Daanish Varma, the Vice-President of Sustainable Investment Banking at Yes Bank, has explained that while it is ideal to use non-fertile land, various influencing factors - such as land availability, distance to the substation, and acquisition challenges - often complicate the bidding process (Sreenivasan, 2019).

Land accounts for only 2-3% of the overall project cost, and given the tight deadlines for project completion, developers pay 50% more for fertile land that meets additional project requirements to ensure its completion on time. Frequently, challenges arise from community members, especially farmers, surrounding land allocation for development projects. For instance, during the SB Energy (an affiliate of Softbank) bid for the project, the company was met with significant opposition from farmers who asserted conflicting claims of ownership over the land in question. During phase III of its development efforts, SB Energy was granted a contract to construct and operate a 200 MW utility-scale solar energy project as part of a larger 750 MW portfolio, and it faced significant public opposition during its execution.

Since solar parks require large tracts of land and for a country like India, they are a cause of land conflicts with farmers and pastoralists who eke out living from land-based resources. India is a land scarce country and its policy of ultramega solar parks will need tens of thousands of hectares of land in the coming decades. The per capita availability of agriculture land in India is 0.12 hectare, whereas world per capita agriculture land is 0.29 hectare (Press Information Bureau, 2019).

There is already an unprecedented pressure on the land beyond its carrying capacity which is resulting into degradation. The states with wastelands are undergoing positive change. For example, in Rajasthan alone, 0.48-million-hectare land has changed into categories of ‘croplands’, forest-dense, forest plantation etc (Press Information Bureau Government of India, 2019). Where then then is the question of available wasteland that can be used for ultramega solar parks? As of June 30, 2022, a total of 114.07GW of renewable energy capacity (excluding large hydro) has been installed in India, against the target of 175GW of renewable energy (excluding large hydro) installed capacity by 2022, according to the government’s response on the floor of Indian parliament (Press Trust of India, 2022). To attain its objective of reaching 175 GW of sustainable energy by 2022, India would need roughly 845,000 hectares of land. This was determined using my own calculation as presented in Figure 7g by

performing calculations that employed data on land assignment sourced from the Bhadla and Pavagada solar parks located in the Rajasthan and Karnataka regions, respectively.

It is imperative for the government to adopt a critical approach and consider the potential negative externalities of the ultramega solar park development before proceeding full throttle. This requires taking a comprehensive evaluation of the risks associated with large-scale implementation, encompassing both the ecological and socio-economic dimensions, to ensure that the initiative strikes a balance between sustainability and progress. The need for a more comprehensive, focused policy initiative to promote decentralized and rooftop solar energy cannot be overstated. Critical aspects of such an initiative involve educating consumers and developing appropriate business models. The current approach of the government, which prioritises supporting large-scale solar projects, may be a more facile option, but it fails to fully address the challenges associated with achieving these goals. Considering this, it is crucial to critique and reassess the government's current energy policy framework to ensure that a more sustainable and effective approach is adopted.

Implications of the findings of this research

The findings of this research have several implications related to the development of solar energy in India. Firstly, there is a lack of available land in India to switch over to solar power, and the amount of land needed for solar systems is unclear. This could lead to significant opposition from people affected by the negative environmental repercussions, such as the loss of arable land and the devastation of ecosystems. The transition to a more sustainable energy source will have direct and negative implications on India's food security. However, the lack of available land in India is not seen as a barrier to the construction of ultra-mega solar parks in the country, even though most farmers in India only have access to small plots of land.

Secondly, the rapid transition to renewable energy is displacing fertile agricultural areas and having a significant negative impact on avifauna. The transition to a new energy source in India will have a major and detrimental impact not only on the natural environment but also on the ecosystems that are

critical to the very existence of wildlife. This will have an adverse effect on both the natural world and the ecosystems.

Thirdly, the neglect of rooftop solar is the neglect of distributed renewable energy, which is more democratic and more equitable. The total installed capacity of 7.6 GW of rooftop solar is way too short of the 2022 target, which India has been trying to compensate through the development of utility-scale solar parks. However, India’s neglect of rooftop solar is the neglect of distributed renewable energy, which is more democratic and more equitable.

Fourthly, the enormous amount of installed renewable capacity doesn't translate into the energy produced by those renewable power projects, so what matters is the efficiency of such projects rather than the installed capacity. India has made a formal pledge to achieve net-zero emissions by 2070 and will continue to expand its extremely sizable solar and wind power capacity during the coming decades. India's ambitious goal of making the switch to clean energy is consistent with that strategy, but what is likely lacking is a thorough evaluation of the energy transition programs' effects on the environment and society.

Finally, the research suggests that the development of solar energy in India needs to be approached with caution and consideration for its potential negative impacts on the environment, society, and economy. Overall, the findings of this research highlight the need for a more comprehensive evaluation of the energy transition programs' effects on the environment and society, and the importance of integrating solar energy into agricultural systems instead of clearing them prior to the construction phase.

Conclusion

This chapter explored the darker side of something that seems to be quite bright: solar energy. Unfortunately, India does not have enough available land to switch over to solar power. The amount of land needed for solar systems is unclear, and there is a lack of openness in official data reporting by the government. Because of the high demand for land and the possible negative environmental

repercussions, such as the loss of arable land and the devastation of ecosystems, the transition to renewable energy sources will face tremendous opposition from people affected.

Even though most farmers in India only have access to small plots of land, the lack of available land in India is not seen as a barrier to the construction of ultra-mega solar parks in the country. This is because India is home to many people who work in agriculture. This is because the majority of farmers in India have little more than a few acres of land at their disposal. The transition to a more sustainable energy source will have direct and negative implications on India's food security. These results in times to come will become apparent. Contrary to what some individuals may assume, most projects using renewable energy are not located in deserted places such as waste lands, which are supposed to be free from environmental and social issues. The narrative that renewable energy projects are mostly located in areas such as waste lands, which are supposed to be safe from environmental and social concerns, is incorrect. This is a narrative that is being aggressively promoted by the Indian government.

The transition to a new energy source in India will have a major and detrimental impact not only on the natural environment, but also on the ecosystems that are critical to the very existence of wildlife. This will have an adverse effect on both the natural world and the ecosystems. Even though most farmers in India only have access to small plots of land, the lack of available land in India is not seen as a barrier to the construction of ultra-mega solar parks in the country.

8 Conclusion and Recommendations

This chapter revisits the research question of energy transition to advance a new understanding of injustices involved in the renewable energy systems during and post-transition phases in India. The chapter will then summarise the findings of this thesis by highlighting its initial objectives and demonstrating that energy systems are not national, but rather global in nature and comprise a complex network of "source-to-sink" actors, activities, and consequences that transcend national boundaries and geographic locations.

Findings of this thesis suggest that the process of implementing India's top-down energy transitions, particularly in the realm of solar energy, have significant justice implications throughout the whole supply chain. Additionally, this research offers an academic foundation and reasoning for a prompt investigation into the commonly overlooked topic of detrimental externalities emanating from utility-scale ultramega solar power parks. These externalities have substantial impacts on socio-environmental aspects, as well as contributing to the rise in land conflicts and associated livelihood disruptions.

The thesis posits energy as a socially and environmentally integrated justice issue and advances our current understanding of the links between energy and vulnerability, particularly along the solar energy value spectrum. In essence, it enlarges the ethical evaluations of energy technology development and the surrounding policy during energy transition. It then highlights that the Indian transition does not pay the required attention to how the socio-environmental costs of developing renewable energy infrastructure should be distributed throughout the community, rather than falling disproportionately on vulnerable groups like farmers and pastoralists.

There is a dark side to India’s seemingly successful and bright energy transition, which has not been recognized let alone addressed. Land is an important subject that has not been an issue of serious concern as a practical constraint for the government’s ongoing renewable energy installations or as a

subject of popular academic enquiry. This calls for a much-needed change to prioritise land in India's energy transition, because India, unfortunately, does not have enough available land for large-scale renewable energy infrastructure projects. Overall, it provides a distinctive analysis of the transformative potential of renewable energy infrastructure for delivering justice.

The objectives set out at the outset of this research have been achieved by analysing the detrimental effects of India's energy transition on land usage and people's livelihoods. The findings established (i) a clear link between the social, economic, and environmental implications of India's growing energy infrastructure and the energy transition underway, and (ii) a clear link between India's solar supply chain and the human rights violation of workers engaged in solar module production across the border at the other end of the supply chain.

8.1 Contributions to the body of knowledge

This study advances the justice implications in energy transition by assessing the entire supply chain of an energy system, rather than limiting its scope to the national geographical boundaries. This has been established by embedding the concepts of justice, equality, fairness, and human rights across the whole energy supply chain, particularly in situations where justice has been violated at the extraction of resources. Contrary to popular belief, the renewable energy systems violate the fundamental principle of equity by denying access to the commons.

This thesis begins with a general review of energy justice and injustices before focusing on the basics of energy justice, such as distributive, procedural, and recognitional justice, throughout the energy spectrum in a source-to-sink way. Justice for those working in the solar module manufacturing industry in China is an integral part of the research in renewable energy justice. This contribution clearly stands out as not many studies have broached this topic in the past. In the field of renewable energy research, the idea of justice has often been confined to national borders, and its extension throughout the whole supply chain, from point of origin to destination, has been noticeably lacking.

This thesis makes a significant contribution by establishing a link between the use of forced labour in the Chinese region of Xinjiang Uyghur and the manufacture of solar-grade polysilicon, which constitutes 90% of India’s solar energy industry. This in effect, links nearly the whole of India’s solar industry to human rights violations associated with abusive labour practices in China, the origin of India’s solar supply chain. Additionally, it highlighted how these links may affect India's solar energy infrastructure in terms of justice. It also revealed that even though forced labour in the Uyghur Region has permeated an entire supply chain and reaches deep into international markets, despite India being a major importer of these modules, it has maintained absolute silence on the matter. This paves the way for further research in the area.

Long-term changes in the energy system cause irreversible changes in many aspects of human existence as well as in natural and manmade surroundings. Concern for land conflicts and the loss of livelihoods centre around land that has been largely neglected in the previous energy justice research and focuses on the importance of the notion of justice that was limited to the geographical confines of a country. This research, regardless of geographic expanse, re-envisions energy justice to identify injustices across the supply chain and develops a new framework for preventing their recurrence (Bhukarin, 2022).

The treatment of the concept of energy justice in this study is a radical departure from the conventional understanding of energy as merely a collection of technological components, ignoring the human activities that may have serious negative effects on human rights, such as the use of forced labour in the manufacture of solar cells and modules in China's Xinjiang province. The findings of this study help expand boundaries of renewable energy justice across whole of the supply chain as a source-to-sink concept.

It also explored the dark, seemingly bright side of solar energy. One topic that has always been ignored in academic and policy discussions is land. India's access to the various advantages that the sun offers is not considered as being limited by land. India lacks the vast tracts of land necessary to convert a

significant amount of our electricity supply to solar power. Uncertainty surrounds the quantity of land required for solar systems, and the government's official data reporting lacks transparency. The massive demand for land and potential environmental side effects like the conversion of arable land and the breakdown of ecosystems would considerably hinder the transition to renewable energy.

Even though most farmers in India only have access to small plots of land, the lack of available land in India is not seen as a barrier to the construction of ultra-mega solar parks in the country. This transition in energy will have direct and negative consequences on India's ability to provide for its food security. The narrative that renewable energy projects are mostly located in areas such as waste lands, which are supposed to be safe from environmental and social concerns, is incorrect. This narrative is being promoted by the Indian government. India's energy transition will have a profoundly negative impact both on the natural world and on the ecosystems that support wildlife.

8.2 General recommendations and suggestions for future research

The current energy transition in India is a mirror image of the large scale centralised conventional fossil fuel energy systems and such systems are incompatible with the intrinsic socio-economic transformative potential of energy transition. The study recommends that within the realm of energy transition research, it is essential to consider an all-encompassing approach for the study of lost justice. This study has established a forward-looking and an overarching system of studying justice implications across the entire value chain of an energy system.

In the Indian context, the energy spectrum from “source-to-sink” needs to be explored because there are serious issues of justice violation of labour engaged in solar cell/panel production in China. More than 85-90% of India’s solar panels come from China. For this reason, it is essential that the operational field of justice be expanded to cover the prospective areas in which violations of justice may occur. In other words, energy justice investigates the complete spectrum of injustices by actively engaging with energy systems from the beginning to the end of the supply chain.

8.3 Limitations of the study

Owing to the complexity of the global solar energy supply chain it is difficult to ascertain the exact location and the number of people engaged in forced labour in Xinjiang and in greater China. It is well known that information is deliberately withheld in that part of the world. As a result, this study has depended on reports in world media. Similarly, this study suffers from the inability to have physically amassed data and research material from China and India, especially over the past two and a half years, owing to the global pandemic.

The pandemic-induced lockdown effectively impeded in-person interactions among subjects, peers and academics at social settings, within and outside the university.

8.4 Recommendation

The violation of human rights such as forced labour in detention camps and inhuman working conditions, at one end of the supply chain, should be integrated into the supply chain analysis. It is recommended that the energy justice studies need to look beyond state boundaries to capture the entirety of justice implications.

An important area of enquiry into energy justice has overlooked the land requirement for massive centralised renewable energy systems. This is so true of India, a heavily populated country that is land scarce on one hand, and battles food security on the other. In the contemporary era of increasing capitalist production of nature, small land holdings face the imminent risk of displacement and marginalisation. Consequently, there exists a strong justification for advocating a bottom-up approach to transition, that involves the participation and incorporation of local interests and stakeholders in the decision-making process.

In the realm of energy justice, it is imperative to duly consider the distinctive characteristics of poor rural communities and indigenous groups, encompassing their culture, traditional knowledge, preferences, and capacities. Additionally, active promotion of their participatory engagement is vital to ensure the absence of energy-related injustices. To uphold the benefits of renewable energy

technologies for everyone, it is necessary to account for the associated environmental and societal impacts. As such, it is incumbent upon public, private, and community-driven renewable energy projects to undergo rigorous environmental and social impact assessments (ESIAs), which should be mandated by law. In certain cases, such as in India, wind and solar projects are not subjected to such assessments due to their purported environmentally good energies. Moreover, to ensure that the various biophysical and social impacts of renewable energy projects are suitably assessed prior to, during, and in the aftermath of their implementation, the methods and tools used throughout the ESIA processes ought to be consistent with accepted international standards.

To attain sustainable and favourable energy outcomes, it is crucial for renewable energy to be community-centric with a particular focus on smaller-scale operations. Notably, such projects have the potential to proffer secure, dependable, cost-effective, and lasting energy solutions to local communities, all while maintaining a measure of local eco-friendliness. Additionally, these community-based projects are advantageous in that they encourage utilisation of customary institutions and customs in participation processes, while simultaneously distributing the associated burdens and benefits among the local populace in a more equitable manner. For sustainable and equitable energy systems to take full effect, the involvement of various stakeholders, particularly those who are disenfranchised or marginalised, is paramount. This includes their active participation in all phases of renewable projects, ranging from planning to implementation. Moreover, it is incumbent on both governments and developers to respect the rights of tribal peoples (Aadivasis) by providing them with full and effective participation, consultation, and free, prior, and informed consent. Such measures contribute to the recognition of cultural identity and ensure community support by addressing diverse needs, perspectives, values, and concerns. Failure to do so may result in disproportionate risk distribution and lack of confidence in the process.

Conclusion

The government and private sector exercise a considerable influence on India’s renewable energy sector. The decentralised distributed renewable energy systems are better suited for India's

development and carries with it significant implications for energy policy, climate change mitigation, and social justice issues. A decentralised system offers an opportunity to address structural problems in India's energy infrastructure, such as the issue of inadequate transmission lines, and energy access for marginalised communities. These issues have often been overlooked by the Indian government's energy transition policy, indicating a disregard for social, economic, and political issues. Past energy transitions have resulted in significant social and economic shifts, highlighting the need for a thorough examination of the social implications of the current transition.

While there are noted efforts to track the social and environmental impact of the Indian energy sector, it is still limited in scope and has yet to systematically address the social justice implications that may arise from the energy transformation. Examining the energy lifecycle, from extraction to production, supply to consumption and waste management is essential when analysing the impacts of the energy sector, as different groups are affected at each stage in the value chain. Policymakers, industry leaders, and academics must prioritize social justice and equity concerns by engaging diverse stakeholders in the transition's design, implementation, and evaluation. Such an approach will alleviate some of the social impacts and inequalities of the current transition, mitigating any adverse effects of the energy transition.

It is necessary to address the larger social and economic issues present in India's energy transition holistically within the country while considering the global context of climate change adaptation and mitigation. By addressing and bringing to fruition people’s concerns for justice, it is expected that the energy sector would result in decrease of longstanding environmental, social, and governance deficits which the industry has long struggled to address without success.

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