LUND UNIVERSITY

CIRCLE

CENTRE FOR INNOVATION RESEARCH

# A human-centric approach to energy justice: Embedding agency and capabilities in transitions discourse

Stuti Haldar, Markus Grillitsch, Amir Bazaz

Papers in Innovation Studies no. 2024/07

# A human-centric approach to energy justice: Embedding agency and capabilities in transitions discourse

Stuti Haldar[a,c] (Corresponding author, stuti.haldar@circle.lu.se), Markus Grillitsch[a,b] (markus.grillitsch@keg.lu.se) and Amir Bazaz[c] (amir.bazaz@iihs.ac.in)

[a] Department of Design Sciences, and CIRCLE (Centre for Innovation Research), Lund University, Sölvegatan 16, 223 62 Lund, Sweden.

[b] Department of Human Geography, Lund University, Sölvegatan 10, 223 62 Lund, Sweden.

[c] Indian Institute for Human Settlements, 16th Cross Rd, Sadashiva Nagar, Bengaluru, Karnataka 560080, India

**Abstract**

This paper addresses the critical gap in understanding the justice implications of renewable energy transitions, particularly concerning the agency of different actor groups, including marginalised and local communities. Given urgency of transitioning to renewables to mitigate climate risks, it highlights the need for more human centric approaches to ensure equitable outcomes. To bridge this gap, the study proposes a theoretical framework centered on the capability approach, human agency, and energy justice. This framework demonstrates how capability sets shape human agency and influence the trajectory of transitions. Through a case study of the Pavagada Solar Power Park in India, the study exemplifies the practical application of this framework, exploring how policy interventions can enhance capability sets and empower communities throughout transition processes. By surfacing the mechanisms through which capability enhancement can foster more just outcomes, this research seeks to inform policymakers, practitioners, and scholars navigating the complexities of just energy transitions. Overall, this study contributes to advancing the discourse on energy justice and offers actionable insights for achieving more equitable and resilient energy transition pathways.

Keywords: energy justice; energy transitions; institutional work; human agency; capability approach

**JEL classification: O44; O20**

## 1. Introduction

The recent climate change discourse highlights the urgency for climate action given that global anthropogenic greenhouse gas (GHG) emissions have continued to rise between 2010 and 2019, with average annual GHG emissions being the highest as compared to any previous decade [1]. The energy sector contributes to approximately three/quarters of the global GHG emissions [2]. Hence, transitioning to Renewable Energy (RE) is key to averting the worst impacts of climate change and limiting average global temperatures to 1.5 degrees Celsius. 90 percent of the global decarbonisation goals needed to align with the Paris Agreement boundaries can be met through accelerated deployment of RE and energy efficiency [3]While there is increasing political

consensus globally towards reaching net zero emissions by 2050, there are also growing concerns regarding the justice implications of large scale RE technology deployment, especially on local marginalized communities who do not possess adequate agency to negotiate their rights in transition processes [4–6].

Energy transition (ET) is a massive sociotechnical reordering that has profound transformational impacts on sociocultural, economic, and political systems [7]. On one end of the spectrum, ET may improve social equity and wellbeing of people [8], while on the other, it can potentially reinforce asymmetrical power relations of the fossil fuel regime [9] In this context, literature on energy justice has emerged mainly pointing to ethical debates regarding energy policy and projects [10–12]. It raises questions on the role of energy policy and embedded institutions in addressing the challenges of widening poverty gaps, unemployment, energy security, access and affordability and social wellbeing [13–15]. Whilst the three-tenet framework (distributional, procedural and recognition justice) adopted from environmental justice scholarship, is the most widely used approach to analyze and identify the spatial manifestation of injustices [16,17], it insufficiently engages with the political economy paradigm, which tends to reproduce these injustices [18]. Energy poverty has emerged generally as the boundary for debates around energy justice [19], which tends to oversimplify the complex energy transition and justice interface.

The sociotechnical transition literature explains how ET unfolds as an interplay between actors, resources, infrastructures, and institutions at multiple levels. However, it has been critiqued for being relatively technocentric in approach, hence, paying less attention to cause-effect relationships between sociotechnical structures and human agency [20,21]. This is problematic because, ultimately ET is a human endeavor. Starting from the vantage point of non-neutrality of technology and infrastructures [22], understanding agency-structure interplay becomes increasingly important to ensure that the transition towards renewables do not reinforce the inequities and power asymmetries of the fossil fuel regime [23,24]. Moreover, how society, policy, and institutions interface with the material component of such transitions has long lasting reciprocal effects on human agency and the capabilities of individuals or social groups to shape their lives. Against this backdrop, an emerging strand of literature on institutional work and agency views ETs as an outcome of contestations of individual or collective agency to transform institutional and technological structures, hence, influencing the direction, pace, and extent of ETs.

Human agency in energy transitions is attributed to purposive actions and strategies by individuals or groups to create, maintain, or disrupt institutions in transition processes [25]. In transition research, institutional entrepreneurship has been used to explain how actors shape institutions in favor of (\against) a particular technology or practice through purposive, (long-term) strategic action (Eg. [26–29]. Thus, how the costs and benefits of RE projects are distributed depends on the agency of individuals and groups [30]. Albeit its strengths in offering inroads into the role of human agency in transforming institutions, and strategies deployed by different agents of change, this literature does not lend adequate attention to materiality [31]. In its original form, the conceptual apparatus in agency literature is majorly focused on the role of

humans in shaping institutions [32]. However, critics call for re-integrating the role of material artifacts in creating, sustaining, and mediating outcomes (justice) of these actions [33]. Secondly, extant scholarship on human agency falls short in explaining, what factors or pre-conditions enable or hinder institutional work by actors in a change process [34]

So, an important but still unexplored question concerns the foundations of institutional work and human agency: What conditions make it possible for individuals and communities to engage in institutional work to disrupt, maintain, or create institutions [34]. More broadly, this speaks to the question of *who benefits, how and why in energy transition processes*? Contributing to these key questions, this paper has two objectives: i) to develop an iterative theoretical framework pivoting around the capability approach, human agency, and just energy transitions, and ii) to illustrate this framework with a concrete case study of one of the biggest solar energy projects in India.

As regards the first objective, the capability approach (CA) has been used to explore the justice impacts of both grid-connected large scale and decentralized RE projects [35–37]. However, less attention has been paid to how and why historically shaped capability sets of individuals and communities provide the conditions for their engagement in change processes.

The proposed theoretical framework is novel in that it views capability sets as both inputs and outputs in ET processes. It situates capability sets of individuals and groups as the foundation for human agency, which make institutional work possible to influence the pattern of ETs towards more just or unjust outcomes. The framework sheds light on the tendency where capability deprivation implies reduced possibilities of individuals and communities to shape ET processes, which creates a risk of further capability deprivation and unjust outcomes. Sen's (2000)[38] CA is of interest in this framing as it deals with conversion between commodities (materiality) and capabilities. Thus, energy is not the end but a means to achieve certain ends (functionings - e.g., education, leisure, safety, mobility etc.). Which functionings are desirable differ across individuals and groups, and the possibility to engage in institutional work to promote desired functionings in ET processes depend on the individuals' and groups' capability sets. In that way, ET towards renewables have implications for human well-being and social justice, which are entangled with uneven distributions of capability sets across individuals and groups developed in the past [39–41]. We link this to recent literature on structure agency interactions in change processes, which posits the spatial and temporal nature of change agency [42–44]. This allows to uncover the foundations of human agency in energy transitions and their capability effects on a spatial and temporal scale.

We achieve this through the second objective. Here, we illustrate the theoretical framework with an in-depth case study of the Pavagada Solar Power Park (2.05 GW) in Karnataka, India. This case is interesting as it is a pilot project, facilitated by the government of Karnataka to experiment with a new model of land leasing, rather than the previous model of land acquisition. This departure was a cognizant effort to avoid potential land related conflicts that have been a major reason for delays in project development and social justice concerns, not only in the RE sector, but also in other industrial development projects in India [45–47]. Spread across 53 sq Kms, the

solar park is the second largest in India and encompasses five villages. The study shows that policy making and regulation to facilitate ETs, especially in resource constrained developing economies, need to build their approach and impact assessment matrices on the principles of enhancing capability sets of people throughout the process, which would empower them to achieve synergies with other sustainability and welfare goals.

## 2. Developing a human centric integrative framework for justice

Exploring the capability effects of ETs on individuals and groups is of importance because existing research majorly conceptualizes justice impacts in terms of economic and infrastructure benefits, which is far from a people centric and welfarist approach to defining justice outcomes. For this purpose, we rely on three key conceptions in intersection with energy justice – capabilities/functionings, opportunity spaces, and transition work/agency. In the subsequent sections we discuss each of these theoretical blocks and their relevance for a human centric framework for justice.

### 2.1 Capabilities and Human Agency

The Capability Approach (CA) constitutes a fundamental conceptual framework in numerous scholarly inquiries and policy formulations centered on paradigms of human development. Amartya Sen's articulation of the CA is rooted in his contributions to development economics, social choice theory, and welfare economics, marking a revolutionary conceptualization of how development and equality was assessed in the 1980s. The crux of this approach posits that economic growth is not an ultimate end but rather a means to development. Sen reconceptualized development as the augmentation of peoples' lives and their real opportunities to realize valued outcomes. Prominent dimensions of economic development within this framework encompass economic security, civil rights, and political liberties as key constituents [38,48,49].

In accordance with this conceptualization, the overarching criteria for assessing the efficacy of public policy can be predicated upon its capacity to augment 'human capabilities' [50]. This entails active involvement in decision-making processes and tangible opportunities to realize valued outcomes. Consequently, the judicious utilization of participatory capabilities is poised to exert a reciprocal influence on the trajectory of public policy, thereby establishing a bidirectional relationship between capabilities and the intentional direction of policy [51].

In reconceptualizing the purview of public policy, Sen introduces the distinction between *capabilities* and *functionings,* which is effectively amalgamated with the notion of freedom. While the combination of a person's functionings reflects their actual achievements, the capability set (encompassing real opportunities) signifies the autonomy to pursue various combinations of functionings, providing the individual with a spectrum of choices [52]. *Functionings* embody a spectrum of activities and states that individuals may deem valuable, ranging from fundamental needs such as adequate nutrition and freedom from preventable illnesses to intricate pursuits like active participation in community affairs or parliamentary representation. *Capabilities* pertain to the viable arrays of functionings accessible to an

individual, constituting a form of substantive freedom—specifically, the freedom to realize alternative combinations of functionings. For instance, consider the scenario where an affluent individual voluntarily abstains from eating, achieving the same functioning outcome as a destitute person compelled to endure hunger. Nonetheless, the affluent individual possesses a distinct capability set compared to the destitute person, as the former has the option to choose a well-nourished lifestyle that the latter lacks [53].

In the CA, freedom does not refer to paper freedom, rather it refers to effective freedom that goes beyond choice maximization. This conceptualization of freedom also incorporates quality of choices and people's valued functionings [49]. Thus, freedom can be evaluated on two aspects namely, the process and the real opportunity. The process aspect indicates 'agency', which is another core concept of the CA. Agency is defined as a person's ability to act on and achieve goals that she/he has reason to value. Thus, an agent is a person who can bring about change [38]. Social movements, responsibility, advocacy, democratic practice, and institutions serve as forms of agency. Agency thus relates to what can be achieved as a collective/member of a political community [54]. The notion of capability sets is attributed to the second aspect of freedom, i.e., the real opportunity to achieve valued functionings selected amongst various available alternatives.

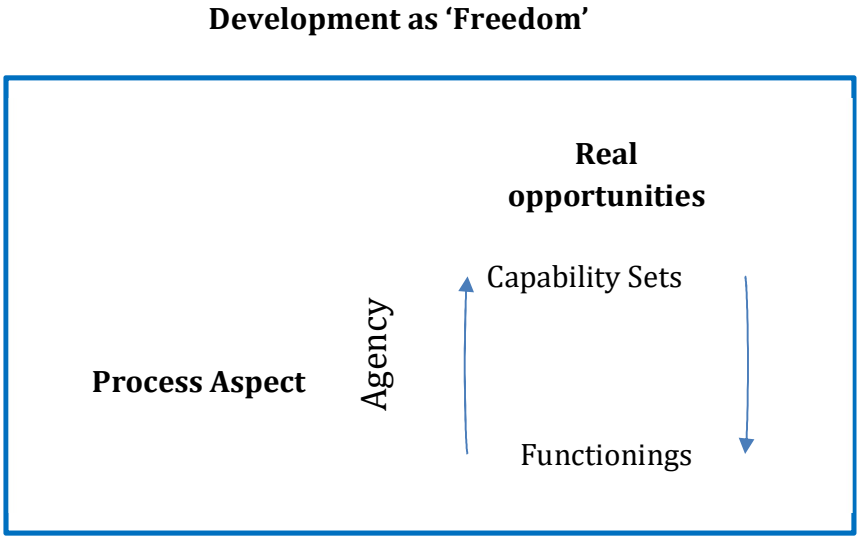


**Figure 1. Relationship between agency, capability sets, and functionings**
Source: Authors' compilation [38]

The CA is a people centered moral framework, that locates human agency at the center rather than governments and markets. The crucial role of socio-political (in this case, techno-socio-political) arrangements is to expand the realm of human agency and capabilities both as an end as well as means to further enhance individual/group's freedom to achieve desired functionings [55]. The use of 'sociopolitical (and technological)' is a useful reminder that freedoms (process and real opportunities) that an individual/group possesses cannot be understood in isolation. These are deeply entangled with other individuals, institutions, technological, political, and

cultural processes. As ETs are established as sociotechnical processes of change, we argue that CA is central to the understanding of justice implications of these transitions.

### 2.2 Situating Energy justice in the Capability Approach

The CA is recognized as the most reliable tool to conceptualize issues of social justice across varied domains of scientific enquiry. In recent years, ET and justice scholars have posited that the CA also holds significant potential to approach energy justice and social equity outcomes of ETs owing to its inherent human centric approach (focus on 'agency') [56]. Energy poverty, a central puzzle of ET, can be defined as the inability to realize essential functionings as a direct or indirect result of lack of or insufficient access to safe, reliable, and affordable energy services [57]. Alluding to this logic, it is difficult to exclude adequate access to energy services (capabilities) to realize several functionings. For instance, individuals need access to energy in some form to realize functionings such as cooking, education, lighting, enhanced mobility, get access to digital information and communicate with friends, family as well as authorities etc. [58]. Thus, a lack of access to clean, affordable, and reliable sources of energy service would clearly lead to multi-dimensional capability deprivation.

Considering energy consumption as essential to a dignified life, it intuitively raises the question of who bears the costs of energy production and distribution (socio-economic and environmental) and who reaps the benefits and how? These distributional impacts of ET can also be explained in capability terms and are directly linked to 'justice'. Justice is inherent in the CA, as Nussbaum (2002)[59] refers to it as an incomplete theory of justice. Even Sen (2008)[49] recognizes capabilities as the measuring rod for justice. Nussbaum's (2002)[59] conceptualization of justice - to ascertain realization of a certain threshold of capabilities for the society on a whole, advocates guaranteeing access to energy services while limiting the negative externalities of energy production and consumption. Thus, operationalizing energy justice using the lens of CA entails drawing attention to what functionings are being achieved and are desirable from clean energy access, rather than energy itself [60].

The burgeoning field of 'energy justice' however, tends to draw more extensively on other theories of justice [61]. One of the widely used theories for energy justice is the three-tenet approach that conceives energy justice on three interconnected dimensions namely, distributional justice, recognition justice and procedural justice [10,14,62]. The three-tenet approach has been critiqued for lack of precision on who is responsible for articulating justice concerns. Top-down imaginaries of justice often misinterpret what people value on the ground. Thus, the bottom-up nature of CA can surface the deliberative action of local communities to define what capability sets they have reason to value [63].

From our discussion above, it is evident that CA serves as an alternative to utilitarian and Rawlsian approaches to justice as it often focuses on distributional justice. However, recent scholarship on capabilities, and justice argue that it has significant potential to integrate other justice dimensions including procedural and recognition justice [60,61]. Hence, either energy justice can be determined exclusively through the capability framework, or the CA can be used as an

integrative framework to combine the triumvirate concepts of energy justice to give a holistic account of the energy transition issues.

We adopt the three-tenet approach as the analytical lens to evaluate the impacts of RE technologies in capability terms. Procedural justice pertains to the enhancement of communities' social capital and the reduction of institutional barriers for them to engage in ET processes [64]. Distributional justice from a capability approach perspective entails ensuring equality in access to clean and affordable energy and preventing the displacement of disadvantaged individuals from land use due to the installation of RE plants. Recognition justice examines how these transitions acknowledge socio-cultural and economic foundations of inequalities or injustices between different groups in society [65]. We combine the three-tenets approach with the CA, as it allows transition research to go beyond a normative top-down approach to articulate peoples' relation with infrastructure regarding what is just or unjust in a particular place [64]. This framing offers a more inclusive lens to conceptualise what justice means for different communities/individuals in different spatial and temporal contexts.

### 2.3 Opportunity spaces for institutional change - Situating the Capability Approach in time and space

The starting point of the proposed theoretical framework is that people already possess a particular set of functionings which form the basis of their capabilities to influence change processes. This transformative capability varies between individuals or groups and shapes their agency. Further, the uneven distribution of agency between actors and groups relates to the context the actors are embedded in, which also means that agency is relative [34]. The concept of opportunity space contributes with explanatory insight into what contextual and actor specific conditions constitute the degree of agency that actors possess, enable or hinder them to negotiate justice outcomes in ET projects.

Drawing on recent insights in regional development studies, opportunity spaces can be characterised in terms of three key elements – time specific conditions, region specific conditions, and actor specific capability sets [43]. *Region specific* conditions shaping the opportunity space for actors to engage in change processes include pre-existing institutional and industrial structures, entrepreneurial ecosystems, knowledge networks, local geographies and ecology, fiscal conditions etc. The region-specific opportunity space is further shaped by what local actors perceive to be possible and how they imagine their future, which in turn is influenced by historically developed social filters [66]. Region specific conditions might augment, depreciate, or remain neutral to agency of different actor groups [43]. Time specific conditions shaping the opportunity space for actors include existing knowledge, institutions, technology, and emerging market structures [43].The foundations of human agency, whether specific to a particular region or temporally bound, align with a realist perspective and the conceptualization of an 'absolute' abstract space, which could potentially be accessible to all individuals [67].

Hence, we contend that the foundation of heterogeneity of human agency *within* a specific temporal and geographical context is rooted in distinctions pertaining to achieved functionings of specific actor groups and the sets of capabilities they have acquired in the past. This argument

stems from a CA framing in development economics, wherein, a normative approach to evaluate success and failure of social development relies on the capabilities of people to achieve valued functionings and shape their own reality; and on their ability to act and decide on valued outcomes, as a member of the public and as a participant in economic, social, and political actions. So, agency is defined as the process aspect of freedom [38]. The systemic deprivation of capabilities (real opportunities), historically imposed upon certain marginalized groups, impedes their agency to actively participate in transition processes in a meaningful manner [49,68].

An agent-centered approach takes into consideration that the scope of real opportunities within energy transitions, (akin to other systemic shifts) is contingent not only upon regional and temporal prerequisites but also on the perceptions of valued justice outcomes held by individuals or groups, and their capacity to interface with both the material and non-material structures inherent in these transition initiatives [69]. Therefore, the proposed framework draws attention to the *agent specific* characteristics of opportunity spaces. This is crucial for elucidating the contextual variability in the capabilities of individuals or groups to influence justice outcomes within the domain of ET projects. The capabilities of individuals or groups are fundamentally shaped by the attainments of various functionings, such as education, social connections, financial resources, and skills, among others. The absence of certain functionings results in capability deprivation, thereby engendering disparities and diminishing the degree of agency [38,53].

### 2.4 Human agency conceptualised as transition work

ETs are nonlinear processes that occur because of a constant interplay and interdependence between actors, institutions, and material structures [26]. While there exists substantial work on (legal, environmental, and technological) impacts of energy transitions, the social and actor dynamics embedded within these processes are often fuzzy and underexplored in transition research [70,71]. Now, there is growing attention to institutional work of actors and organizations that aim to create, disrupt, and maintain institutions [72] to address this gap in transition research. Institutional work alludes to the purposeful actions of actors influencing the establishment of institutions, policies, and rules [25]. However, in ETs the 'work' of actors extends beyond policy and institutional domains. Material considerations, discursive elements, social dynamics, and organizational structures, among others, are integral components in the negotiation of justice outcomes of ETs. The imperative to comprehensively address this multi-dimensional nature of transitions necessitates an extension of the conceptualization of institutional work, encompassing the integration of material aspects, day-to-day behavioral changes, and lived experiences [73].

Transition work encompasses activities that encourage a shift towards more sustainable modes of consumption and production (Loehr et al., 2022). From this perspective, transitions can be conceptualized as processes of negotiation over such shifts [74]. Within the examination of transition work, the concepts of creation, maintenance, and disruption persist as pivotal elements within our analytical framework. Building on institutional work literature across the three domains, transition work surfaces the practices of actors at multiple stages of a transition process (eg. local communities, state actors, entrepreneurs etc.), to understand agency-structure

interplay in ET (Table 1). This typology is useful for operationalising how various actor groups engage in both institutional and non-institutional - often mundane day to day practices to articulate, negotiate and embed desired justice outcomes in transition processes.

**Table 1: A typology of transition work across creating, maintaining, and disrupting practices**

| Transition work | Definition |
|---|---|
| **Creating** | |
| Inventing & experimenting | Innovating/ experimenting with technological solutions/ recombination of existing solutions into new approaches. |
| Implementing | Implementation of a technological artefact, enabling its use. |
| Advocacy, lobbying | Mobilisation of political and regulatory support through direct and deliberate techniques of social suasion. |
| Narrative work, constructing identities, framing | Discursive activity of building visions and scenarios about the future and/or constructing shared identities amongst actors. |
| Defining rules and targets | Constructing rule systems and/or setting targets that structure interaction, define boundaries, or support/incentivise new technologies and practices |
| Creating networks, coalition building | Constructing connections between (heterogeneous) actors and/or organisations which form the relevant peer group and may be of a formal or more informal nature and of a higher or lower degree of stability. |
| Mimicry | Associating new practices with existing sets of taken-for-granted practices, technologies and rules in order to ease adoption. |
| Educating & learning | Activities concerning the transfer and adoption of the skills and knowledge necessary to support the new institution or technology |
| **Maintaining** | |
| Policing | Ensuring compliance through enforcement, auditing and monitoring activities thereby facilitating feedback into policy. |
| Valorising & demonising | Discussing in public particular positive or negative characteristics of an institution or technology. |
| Mythologising | Preserving the moral underpinnings of existing institutions, actors, technologies and/or practices by romanticising/glorifying the past. |
| Embedding & Routinizing | Stabilising and institutionalising loose practices and/or rules by further reinforcing newly established structures within socio-technical systems. |
| Deepening/ expanding networks, coalitions | Intensifying contact and exchange amongst actors within the peer group involved, increasing interdependence and/or strengthening networks, coalitions/ organizations |
| Upscaling | Bringing innovations to the market or to the next level and/or diffusing them. |

| | |
|---|---|
| Sustaining | Preserving institutions, technologies and/or practices within and/or beyond their initial scope. |
| **Disrupting** | |
| Disruptive/ defensive work | Actively working against existing assumptions or beliefs or strategically defending them in response to safeguard existing interests resisting change. |
| | Actively working against existing practices and technologies, and/or bypassing established networks and/or organisations in support of new technologies and practices – or strategically defending them in response to safeguard existing interests resisting change. |
| Discontinuing/phasing out technologies & practices | Discontinuation of a technological artefact/practice, thus disabling its use |
| Dissolving/ replacing coalitions, networks | Discontinuing established connections between formal or informal networks, coalitions, or organisations. |
| Removing/adapting support, sanctions, restricting | Removing or adapting the support and incentives for technologies and<br>practices; sanctioning or restricting technologies or practices (such as quotas, bans, etc.) |

Source: [73]

Based on our analysis of the three theoretical blocks, we propose that CA in itself is a normative theory of justice with human agency being an integral cog of the complex machinery of maximizing people's wellbeing [75]. What people are actually able to achieve (functionings) through ETs further shape their capability (real opportunities) to engage in transition work and negotiate justice concerns in terms of outcomes that they value. We use the semantics of transition work to understand how justice considerations are being articulated, legitimized, and operationalized in ET projects. It is important to note that while the transition work categories might become performative by regime level actors, these actors operate within a specific opportunity space which is constituted by certain place based preconditions/dynamics.

### 3. Visualizing our integrative framework

After an in-depth examination of the conceptual and theoretical underpinnings of the proposed integrative framework, we proceed to elucidate and articulate how the framework delineates the interrelationships among these conceptual elements. The three major elements in the framework, namely opportunity space, transition work, and justice outcomes - need to be understood through their mutual interaction on a spatio-temporal scale. Figure 1 represents this interaction visually, demonstrating how the opportunity space, constructed by time and region-specific conditions, and actor specific capability sets forms the foundation for transition work of diverse actors to negotiate outcomes in ET processes, in terms of capabilities and functionings that they value. Such processes might augment/deprive these valued capabilities and functionings (realized capabilities) for certain actor groups, hence altering the opportunity space for them to further participate in change processes.

The start of this process is marked by T1, wherein actors already have achieved or are deprived of certain functionings such as education, skills, social status, access to economic and other resources etc. This stems from the context these actor groups are embedded in, i.e. preexisting just and unjust conditions which shape their ability to engage in transition projects. As discussed above, the regional contexts such as climate, terrain, fiscal conditions, level of industrialization etc., and time specific conditions such as technologies or macro-level institutions at a certain point in time are invariant between local actors, even though these region- and time-specific conditions differently affect and are accessible to specific actors and groups of actors. Thus, the difference in agency betweenactors can be explained by the heterogeneity in the actor specific capability sets, that stem from where they are positioned in preexisting structures and throughout the transition process (i.e. through their achieved functionings). The functionings and capability sets at T1 are viewed through the three justice dimensions, which forms a baseline against which the justice effects of a particular ET process can be assessed.

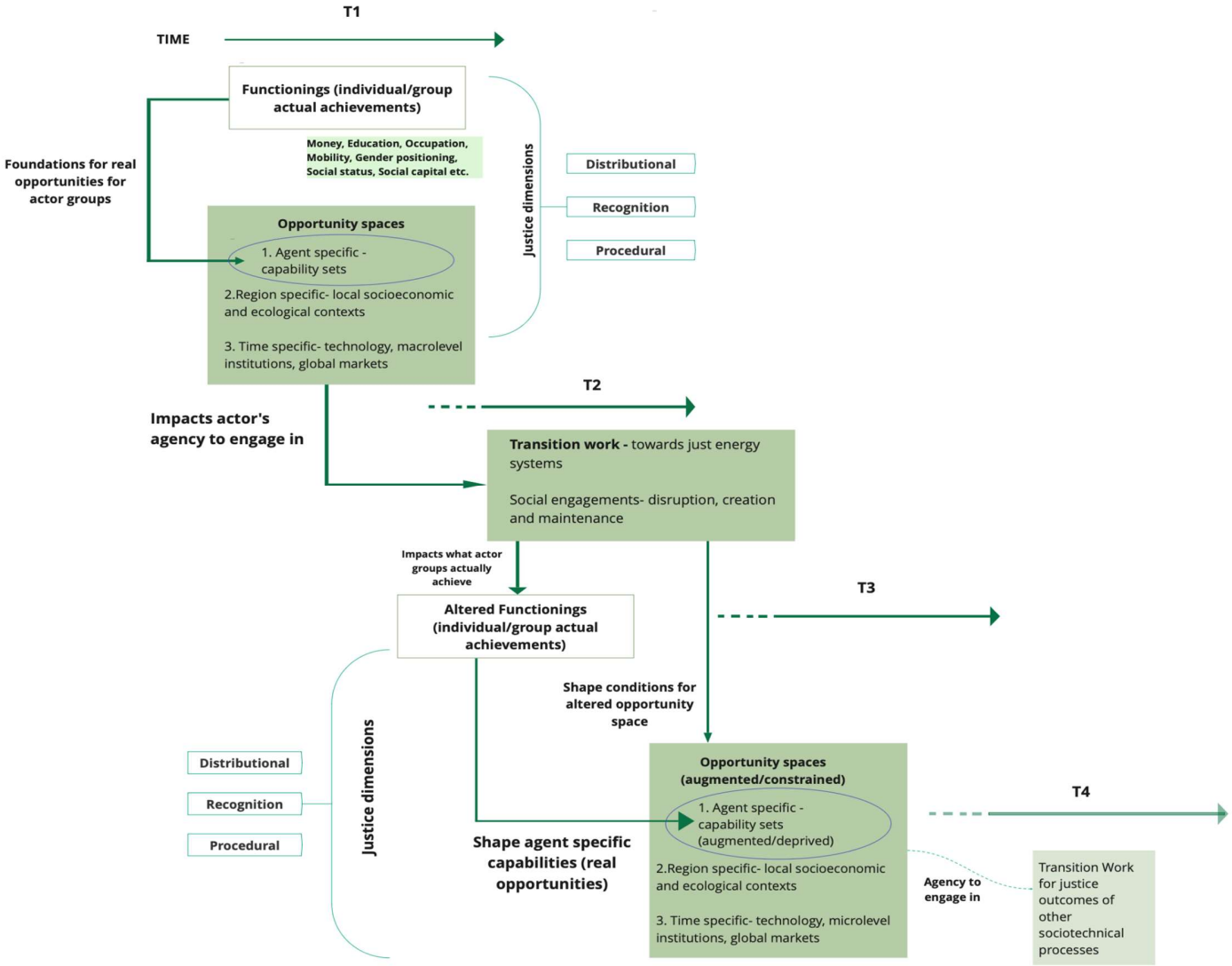


**Figure 2: Integrative framework to analyse capability effects of energy transitions across justice dimensions**
Source: Authors' composition

T2 signifies the phase in which actors engage in transition work to shape their own realities, based on their positionality (in terms of power/ agency). The concept of transition work allows us to understand creation, disruption, and maintenance practices across not only policy/institutional dimensions, but also in day-to-day practices, and their technological and material dimensions. The theoretical framework seeks to explain the transition work of specific actors and groups with their capability sets and the opportunity spaces they are embedded in. We expand the comprehension of transition work and operationalize it within the context of ETs, aimed at fostering more sustainable, socially inclusive, and equitable infrastructures and processes. This analysis encompasses both spatial and temporal dimensions. The conversion of human capabilities into transition work, resulting in augmented or diminished capability sets for diverse

actor groups, is discernible within specific socio-economic, cultural, and contextual settings. Moreover, the temporal scale is integral to this analysis, as the effects of these actions in terms of capabilities may manifest over an extended timeframe.

The way in which large scale ET projects are deployed through engagement of diverse actors has certain distributional, procedural and recognition effects, assessed at T3. These justice effects are explored using the CA, which allows for a bottom-up, actor and region specific, understanding of whether transition projects are able to augment human capabilities (real opportunities), for whom, why and how. Moreover, this framing unlike the three-tenet approach does not assume what justice means for people (often articulated by top-down imaginaries of governments, industries etc.), but it allows for assessing the success of justice delivery by ET projects based on how it alters the opportunity space for individuals/ groups along short-, medium- and long-term time dimensions.

Through this theoretical framework we establish that human capabilities form the foundation of human agency in transition work directed towards more *just* ETs. Capability sets are the inputs and the outcomes of such processes, and capability augmentation/deprivation throughout the process has distributional, procedural and recognition justice implications. This interplay between human capabilities and human agency is key, as it implies that to ensure justice outcomes are carefully articulated and operationalized in any infrastructure project, it is crucial for policy to enhance human and institutional capabilities as an important goal. This would allow for stronger agency for meaningful engagement in transition work.

## 4. Methods

### 4.1 Sampling and data collection

We rely on a qualitative research design to operationalise the proposed human centric framework of justice through a case study of the PSP which is the third largest solar park globally [76]. In accordance with this aim, we deploy process tracing to identify critical moments throughout the process of ideation to commissioning and operations and maintenance that shaped the justice outcomes of this project [77,78]. By constructing a historical timeline of such events we mapped actor groups involved in transition work of shaping the infrastructure and governance of the PSP. In doing so we referred to secondary sources - journal articles, government reports and Karnataka Solar Power Development Corporation Limited (KSPDCL) and Karnataka Renewable Energy Development Limited (KREDL) websites, and grey literature including newspaper articles and public announcements. Once we charted a timeline for the critical events we mapped stakeholder groups involved at each stage of implementation of the project. Hereafter our first step was to conduct consultations with KSPDCL and KREDL officials to cross check the validity of the sequence of events on the timeline. We also discussed their role and other key actors who were involved in the process. Once we had a clear idea of the process, we identified six actor groups - state government institutions, local government actors, local women, local landholders and Shakti Sthala farmers' association, and the private Solar Power Developers (SPDs) (refer to Annex I for details). The data collection was conducted in phases from March 2022 to December 2023. Separate sets of interview guides were created for each actor group, in consultation with academic

peers. A total of 33 respondents were selected through purposive sampling, and were interviewed for a duration of 45 to 60 minutes each. Once we transcribed the responses and drew out the first set of observations, the results were discussed with the project team and presented at academic events (external and institutional research seminars) to get reflections on the usefulness of the empirics in operationalising the proposed conceptual frame. Post this some followup interviews were also conducted to fill identified gaps in the data. All the interviews were recorded and transcribed and were sent to respondents for consent to be used pseudonymously. Table 2 provides an overview of the respondents. The analysis conducted does not focus on the impacts on academic actors, civil society actors and media actors, as they are not directly affected by the outcomes of the PSP.

**Table 2: Details of respondents across actor groups**

| S.No. | Actor group | No. of respondents |
|---|---|---|
| 1 | Academia actors/ experts | 4 (3 Male, 1 Female) |
| 2 | Civil society actors | 5 (4 Male, 1 Female) |
| 3 | Media Actors | 4 (2 Male, 2 Female) |
| 4 | Shakti Sthala Farmer's Welfare Association | 3 Male |
| 5 | Administrators/ policy makers | KSPDCL officials – 3 Male<br>Village Panchayat[1] - 3 (2 Male, 1 Female) |
| 6 | Local community members/ farmers | 5 Male |
| 7 | Local Women | 4 Female |
| 8 | Private Solar Power Developer | 2 Male |
| | **Total** | **33 (24 Male, 9 Female)** |

## 4.2 Data analysis

In accordance with our second objective, the qualitative responses were thematically coded to map initial functionings, and capability sets of each actor group at the start of the project. As we demonstrate that justice impacts have a spatial and temporal dimension, the functions and capability sets are analysed through the lens of distributional, recognition and procedural justice (T1). This along with the secondary data insights regarding the region and time specific conditions prevalent at the inception of the PSP allowed us to define the initial opportunity space that enabled each actor group to engage in certain forms of transition work (creation, maintenance and disruption). The practices of each actor group were analysed and coded as creation,

[1] Village/Gram Panchayat is the basic or lowest level of administrative institution under the constitution of India. It has jurisdiction over a group of villages, and is responsible for overseeing various civic functions within its jurisdiction, such as rural development, infrastructure, health, education and social welfare.

maintenance and disruption based on the typology defined in Table 1 (T2). Hereafter the responses are coded to map altered functionings and capability sets of each actor group at the end of the project cycle (T3). Similar to step one each capability and functioning is grouped in accordance to its justice dimension. Hence we arrive at Figure 4 where for each type of functioning and capability is indicated with a dot. Green dots indicate presence(in T1)/ augmentation (in T3) of a certain type of capability/functioning across distributional, recognition and procedural dimensions. While the red dots signify capability/functioning deprivation (in T1 and T3) across the three justice dimensions. These capability effects and the type of transition work of each actor group are first tabulated in detail (refer annexure II) and then illustrated in figure 4). For reference the analytical frame is presented in Table 3.

**Table 3: Analytical frame to determine capability effects of Pavagada Solar Park**

| Actor Groups | Initial Opportunity Space (T1) | | Transition Work (T2) | Altered Opportunity Space (T3) | |
|---|---|---|---|---|---|
| | Time-specific conditions | | | Time-specific conditions | |
| | Region-specific conditions | | | Region-specific conditions | |
| | Actor-specific conditions | | | Actor-specific conditions | |
| | Functionings (in terms of distribution, recognition and procedural justice) | Capabilities (in terms of distribution, recognition and procedural justice) | Engagement in change process (creating, maintaining, disrupting) | Functionings (in terms of distribution, recognition, and procedural justice) | Capabilities in terms of distribution, recognition, and procedural justice) |
| Actor Group 1 | | | | | |
| Actor Group 2 | | | | | |
| Actor Group 3 | | | | | |
| … | | | | | |

## 5. Empirical exploration of the conceptual framework

### 5.1 The case: Pavagada Solar Park, Karnataka

The government of India has set an ambitious target of achieving a renewable energy capacity of 500 GW by the year 2030, constituting 50% of the country's total installed generation capacity [79]. In line with this national and operationalised subnational goal, several regions/states, including Karnataka, are leveraging the RE transition to gain access to government incentives and international finance. Such efforts align with the country's 'energy transformation' vision and reflect the strategic use of RE to bolster and achieve economic development goals. The rapidly falling prices of RE technologies and supporting production-based policies to boost the manufacturing sector for indigenous production of components, have led to convergence of India's energy, climate, and industrial policies. With respect to the evolving landscape of regulatory frameworks, several states are experimenting with new financing and RE supply models [80]. Out of these, achieving economies of scale through large scale grid connected RE parks, indicating a shift from Feed in Tariffs (FiT) to a new auction regime, has emerged as the dominant form of energy transformation projects in India. This vision of energy gigantism [81], has often had negative equity and justice outcomes on local communities, owing to increasing concerns over land grabbing and dispossession [57,82], which is a matter being progressively addressed.

In this context, the 2050 MW Pavagada Solar Park (PSP) is a pilot project, facilitated by the government of Karnataka to experiment with a new model of land leasing, rather than the dominant model of land acquisition. Spread across 53 sq Kms in the Tumkur district of Karnataka, the solar park is the second largest in India and encompasses five villages – Thirumani, Balasamudra, Vallur, Kyataganacharlu and Rayacharlu. Commissioned in 2019, this park resulted from the Indian government's directive to commission 25 solar parks (each exceeding 500 MW capacity) to achieve the target of 20 GW of installed solar capacity by 2018-19. This was to be achieved through an estimated Central financial Assistance (CFA) of USD 40.5 billion[2]. In addition to the leasing mechanism, the state nodal agency for RE - Karnataka Renewable Energy Development Ltd. (KREDL) had put several codes/policy rules in place to facilitate participation of private sector developers and address the development needs of local communities in the region. We use this case study to investigate what forms the basis for human agency to engage in transition work and how the dynamics of this transition work has shaped the opportunity space, in terms of enhanced/deprived capabilities for different actor groups.

2 https://kspdcl.karnataka.gov.in/storage/pdf-files/Solar%20Polices/Solar-Park-Guidelines.pdf

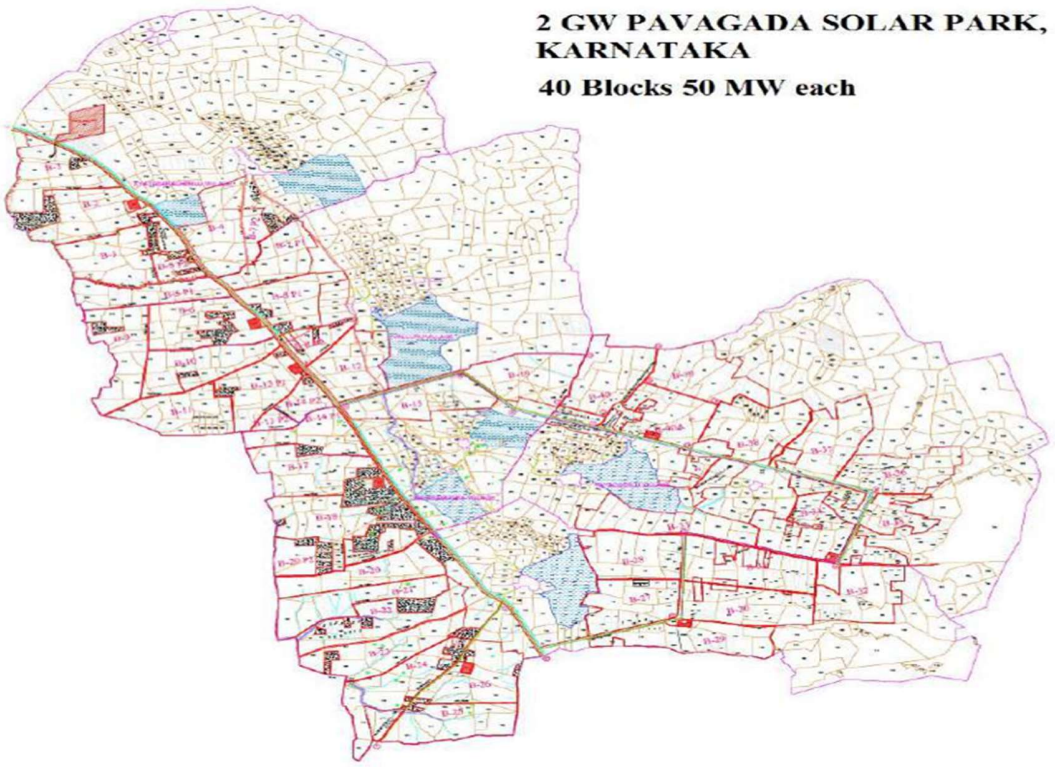


**Figure 3. Pavagada solar park (53 sq. km), Karnataka**
Source: (Rao, 2019)

### 5.2 The process

The PSP was ideated by the Karnataka Renewable Energy Development Limited (KREDL), the state nodal agency for renewable power, within the framework of the national level policy for solar energy proliferation. Solar energy was discursively being positioned by the national and state governments as a lever to link environmental sustainability with developmental outcomes . These benefits were and are intended to be realized at multiple levels - at the state level, it enhances government revenue, reduces foreign exchange expenses linked to fossil fuel procurement, achieves renewable energy targets, decreases greenhouse gas (GHG) emissions, and attracts private investment. Locally, it generates employment, provides a stable income source, facilitates infrastructure development, and creates other positive externalities [3]. The PSP was supported by the Karnataka Solar Policy 2014-21, and the Nava Karnataka Nirmana initiative of the state government. The former aimed at moving away from fossil fuels and the latter was to further development of Karnataka state, by channeling private investments through RE infrastructure projects[4].

[3]https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2022/12/2022122199-1.pdf

[4]https://www.blackridgeresearch.com/project-profiles/pavagada-second-largest-solar-photovoltaic-plant-farm-park-in-india

Historically, the land mobilisation for such large-scale infrastructure projects including solar parks and thermal power plants have been particularly challenging in India due to community resistance (eg. [83–86]) and the stringent compensation procedures under the Land Acquisition, Rehabilitation and Resettlement Act, 2013 (GoI, 2013[5]) leading to delays in project implementation.

> *"India has listed out 32 solar parks, and most of them have not been started till now because of land issues. In most of these places there is some protest going on for land.*" (R11 Media actor)

However, the mega 2.05 GW PSP was ideated and commissioned rapidly within a span of 4 years, with an investment of USD 2.2 billion (GoK, 2022)[6]. To achieve this, the KSPDCL- a parastatal body was incorporated in 2015 under the Companies Act, 2013. It was a joint venture between Solar Energy Corporation of India (SECI), GoI and KREDL, GoK. The KSPDCL is a Special Purpose Vehicle (SPV) constituted with the objective to plan, develop and operate solar parks in the state under the MNRE scheme [87]. KSPDCL identified Pavagada taluk[7] in Tumkur district of the south Indian state of Karnataka as the region receives high radiation and has ample land for setting up this park. Pavagada has faced drought in 54 out of the last 60 years [88]. Recognizing this, the establishment of the PSP in the region gained local community support. It was discursively linked to the state's effort to reduce migration to nearby urban centers, generate local employment, improve infrastructure, and stimulate the local economy through private investments.

> *"Even though Pavagada is an arid region, the farmers grow dry weather crops. However, due to bad cases of droughts for 2-3 years, farmers had suffered a lot and were quite desperate for livelihood and income. So, this opportunity actually looked good for them as they were convinced that it would benefit them. They were also told that if you don't say yes now then it will go to some other place."* (R11 Media actor).

Drawing from past experiences of similar land acquisition projects, KSPDCL consulted with multiple departments and actors including forest department, local panchayats[8], local farmers, private developers, district collector, and the revenue department.

> *"This required collaboration with several stakeholders, such as the Karnataka Power Transmission Corporation Limited (KPTCL), the state transmission utility, Bangalore Electricity Supply Company (BESCOM), the distribution utility, South Regional Load*

[5] Government of India. THE RIGHT TO FAIR COMPENSATION AND TRANSPARENCY IN LAND ACQUISITION, REHABILITATION AND RESETTLEMENT ACT, 2013 . India: https://lddashboard.legislative.gov.in/sites/default/files/A2013-30.pdf; 2013.

[6] Government of Karnataka. Tumakuru - Solar Park [Internet]. [cited 2022 Nov 11]. Available from: https://tumkur.nic.in/en/solar-park/

[7] subdivision of a district; a group of several villages organized for revenue purposes.

[8] A panchayat is a local self-government institution in rural areas of India. It consists of elected representatives who administer and govern villages or small regions.

*Dispatch Center (SRLDC), the load dispatch agency, and Power Grid Corporation of India Limited (PGCLL), the central transmission utility."* (R3 and R15 KSPDCL Official)

Through these consultations it became evident that central issues of contention and justice concerns within the land acquisition process emanate from delays in compensation disbursement, undervaluation of compensation, emotional attachment to the land, and a dearth of trust between the project developer and the local community. These injustices tend to have an amplified impact on local communities, potentially resulting in their displacement and disruption of livelihoods [89,90].

"*We adopted a unique model for this project, recognizing the immense value of land….. Consequently, instead of treating landowners as mere sellers, we incorporated them as stakeholders in the project. Under the lease model, landowners retained their rights to the land within the solar park. To assure them, we entered into a principal land lease agreement that prohibited the construction of any permanent structures on their lands. We committed to purchasing any permanent structures established. As a result, KSPDCL acquired approximately 262 acres of land within the Pavagada Solar Park"* (R3 KSPDCL Official).

In order to navigate these challenges in land mobilization, KSPDCL engaged in consultations and coalition building, as well as recoding of policy rules at the regional level. The persistent issue of drought induced livelihood loss made a compelling case for the site selection. The KSPDCL called for an expression of interest from various areas in the state of Karnataka and considering the regional climate and economic vulnerabilities, Pavagada was chosen as the site for the park. In addition to campaigns and stakeholder consultations, the revenue department was also mobilized to ensure swift land acquisition through 'leasing' rather than purchase. This ensured ownership of the land stays with the local community, hence offering them stronger agency in governance of the project and the region. Involvement of the revenue department ensured that all the documentation regarding land leasing and ownership was rectified and facilitated so that it doesn't hinder willing local farmers from leasing their land.

*"These retired officials who were tasked with getting approvals, went house to house literally and used to build on narratives such as - oh we are not convincing you, we are only suggesting, as anyway you aren't able to produce much and reaping any benefit. And if you instead give it to the solar power plant then you will earn money and the land will also be in your name."* (R1 Civil society actor)

*"Land records are a major challenge. For instance, when we visited gram panchayats like Tirumani or Vellur, we discovered that land records were not in the names of current land users but in the names of individuals who had passed away generations ago. Our primary concern was to identify the true landowners. We enlisted the help of the Revenue Inspector and local land authorities, forming a team of retired tehsildars, in-service revenue inspectors, surveyors, and village assistants".* (R4 KSPDCL Official)

Subsequent to the land acquisition process, extensive transition work occurred at both national and subnational levels. For instance, the national level exemption of solar parks and projects from mandatory Environment Impact Assessment (EIA) [91] was also endorsed by the state, which led to easing of environmental mandates for the PSP. Moreover, public hearings are typically essential in land acquisition processes, but the state circumvented this requirement by leasing the land rather than transferring land ownership to the private developers/KSPDCL. Another major policy recoding occurred with respect to conversion of the land typology in Pavagada. The Land Reforms Act, 1961 [92] does not permit leasing of agricultural land. Hence transition work of KSPDCL and Revenue Department involved conversion of the entire 53 sq. kilometers of agricultural and pastoral land to non-agricultural land.

> *"….one significant constraint was the conversion of agricultural land to non-agricultural land and the associated penalties. The state government supported us by designating the Pavagada Solar Park as a non-agricultural zone and waived the imposed penalties, providing us with approximately INR 140 million in relief. This socio-economic model benefits everyone when it's implemented.".* (R4 KSPDCL Official)

This transition work allowed the PSP to be commissioned without any delays. Post the reclassification of the land, it was leased for 28 years at USD 257/annum with an increment of 5 percent every 2 years. In addition to private farmlands, a large portion of common lands also form part of the PSP. The compensation was decided based on the estimates by a committee headed by the Deputy Commissioner of the district and 5 consultation sessions were held involving more than 2000 farmers to lease their land at the set rental rates.

> "*The pricing for land was determined by a committee headed by the Deputy Commissioner of Tumkur, set at ₹21,000 per acre per annum with 5% escalation every two years. The land lease agreement extended for 28 years, with 25 years dedicated to the project's lifespan, 1 and 1/2 years for project commissioning, and another 1 1/2 years for project dismantling".* (R3 and R4 KSPDCL Official)

> "*When it came to determining compensation, we relied on records and valuations provided by the relevant government departments. For instance, the forest department assessed the value of forest trees, and for commercial trees like coconut and mango, we only paid compensation in cases where landowners voluntarily surrendered their land due to reasons like untimely rains*". (R4 KSPDCL official)

The KSPDCL ensured that there were no delays in payment of rents, which led to lower incidence of disputes with local communities. Farmers, however, had little agency to negotiate the terms of the lease as they were in desperate need for economic and other basic resources, given that the region had been drought hit over the 6 decades (until 2015).

> *"…compensation is straightforward – it's determined by the government and directly deposited into the beneficiaries' accounts, without checks or cash involved. We used these*

*methods to ensure that the actual beneficiaries received their compensation through RTGS, with the funds transferred directly to their names".* (R15 KSPDCL Official)

"*Even at that point of time some farmer said to him (KSPDCL official) that, this rent is very less."* (R11 Media actor, R8 Local Farmer)

The leased land was then subleased to private solar power developers (SPDs) through auctions (reverse bidding) to achieve competitive prices for solar power generation. Another innovative governance measure notable here is that KSPDCL acted as a bridge between the SPDs and the local communities, as well as the Electricity supply companies (Escoms) to ensure fair treatment of leasing contracts, dispute resolution with local farmers, achieve cost efficiency, and protecting the interest of private developers and Escoms through long and mid-term Power Purchase Agreements (PPAs).

*"...one common issue that arose was related to landowners with sprinklers on their land who sought compensation. Initially, we considered not providing compensation for sprinklers because they could be dismantled and used elsewhere. However, after discussions with the Horticulture Department and others, …. We decided to provide compensation to a certain extent. Additionally, we needed to determine the compensation for trees…we had to engage with various state government departments, including the Horticulture Department, Agricultural Department, Forest Department, and the State Pollution Control Board."* (R4 KSPDCL official)

*"…we had assured buyers before entering the PSP. Our buyers were the ESCOMs, the state distribution utilities. Only 200 MW of SECI's power were supplied as interstate input; the remaining 1850 MW were consumed by Karnataka's distribution companies alone. Having buyers in place is crucial when establishing an industry, …. readiness of the state's distribution companies to purchase the power played a significant role…"* (R4 KSPDCL Official, R29 Private SPD)

In addition to the above transition work, a Local Area Development (LAD) fund was also constituted with a quantum of approximately USD 12.28 million (R3 KSPDCL official). The private SPDs are mandated to contribute to this fund in 5 installments. 80 percent of this fund is reserved for infrastructure and economic development of the 5 villages constituting the PSP, and the remaining 20 percent would be used for development expenditure at the district level. Major infrastructure categories earmarked under the LAD fund include schools, drinking water facility, hospitals and health infrastructure, improved sanitation, and afforestation. Currently USD 10.72 million worth projects are approved, while an additional USD 1.56 million are yet to be approved to further these objectives (R3, R15 KSPDCL official).

*"A LAD fund is created […] 80% of this fund will be utilized in the village where the solar power plant is situated and the remaining 20% will be utilized in the same district. Drinking water, schools, hospitals, sanitation etc. are the target areas where this money will be spent."* (R3, R4, R15 KSPDCL official; R18, R19 Village Panchayat Member)

To make the development of PSP more procedurally just, a farmers' union (Shakti Sthala Farmers' Welfare Association) was formally registered in 2018. This association comprised four members from each of the five villages hosting the PSP. As many farmers in Pavagada are educated, this resulted in enhanced agency for the local community in negotiation processes right from the inception of the project.

> *"Recently the association has started approaching local government institutions to get clearance to set up a co-operative society to invest on small local businesses and include all farmers in it, with Rs. 1000 as seed money"* (R5, Shakti Sthala Farmers' Welfare association member)

> *"There is no plan for waste management yet, but we are demanding to constitute a guideline or design a framework for the waste generated by the solar park"* (R5 and R13, Shakti Sthala Farmer's Welfare association member)

These farmers, being part of an institutionalized association, played a vital role in information dissemination, dispute resolution, mobilizing land, and monitoring the utilization of the LAD. The farmer's association is also represented in the committee chaired by the Deputy Commissioner of Tumkur that oversees the governance of the PSP and utilization of the LAD funds.

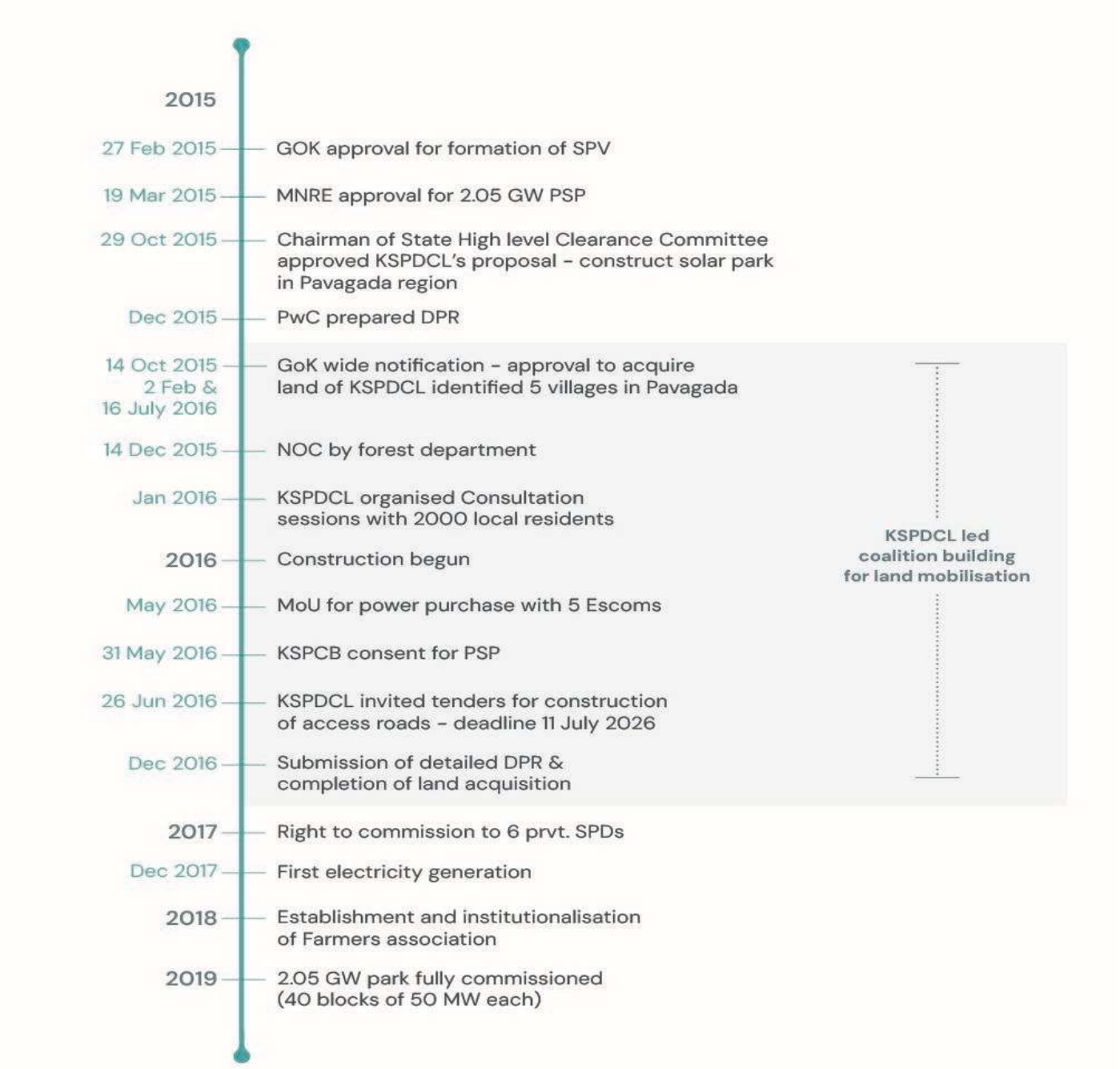


**Figure 3: Timeline of critical moments in the process of development of the Pavagada Solar Park** [9]
Source: Author's compilation (KREDL, 2018 [10], field interviews, KSPDCL reports and website)

[9] Note: GOK- Government of Karnataka, MNRE- Ministry of New and Renewable Energy, SPV - Special Purpose Vehicle, PwC-PricewaterhouseCoopers, DPR- Detailed Project Report, NOC- No Objection Certificate, MoU-Memorandum of Understanding

[10] KREDL. (2018). 2000MW Pavagada Solar Park. https://kredl.karnataka.gov.in/storage/pdf-files/1200MW%20Pavagada%20SP/14-FinalKREDLPrebidmeetingPPTdated08-02-2018.pdf.

## 5.3 Illustrating the theoretical framework

In this section, we chart out the agent specific conditions (functionings and capabilities) within the particular regional and temporal context we have described in section 5.1 and 5.2, which shape the opportunity space (with respect to justice outcomes) for actors to engage in the transition work. We then demonstrate through empirical evidence how the transition work of various actor groups impact the functionings of the different actor groups, and also in what ways their capabilities are shaped to further participate meaningfully in change processes. There is also a relationship between the altered functionings (augmentation/deprivations) and what kind of opportunities (capabilities) are now available to them in the altered opportunity space. The region-specific characteristics are also altered in the new opportunity space, which comprise certain justices and injustices for each actor group, which can be understood through the three tenets of justice lens (see Figure 4 and annexure II). Functionings are the observable outcomes while capabilities refer to the non-observable real opportunities that are created due to either the functionings that actors achieve or due to the structure of the altered opportunity space. In our analysis we discuss the capability effects on select actor groups in more detail to demonstrate how their initial capabilities underlie their agency to engage in transition work and achieve (or deprive of) desired justice outcomes of the project.

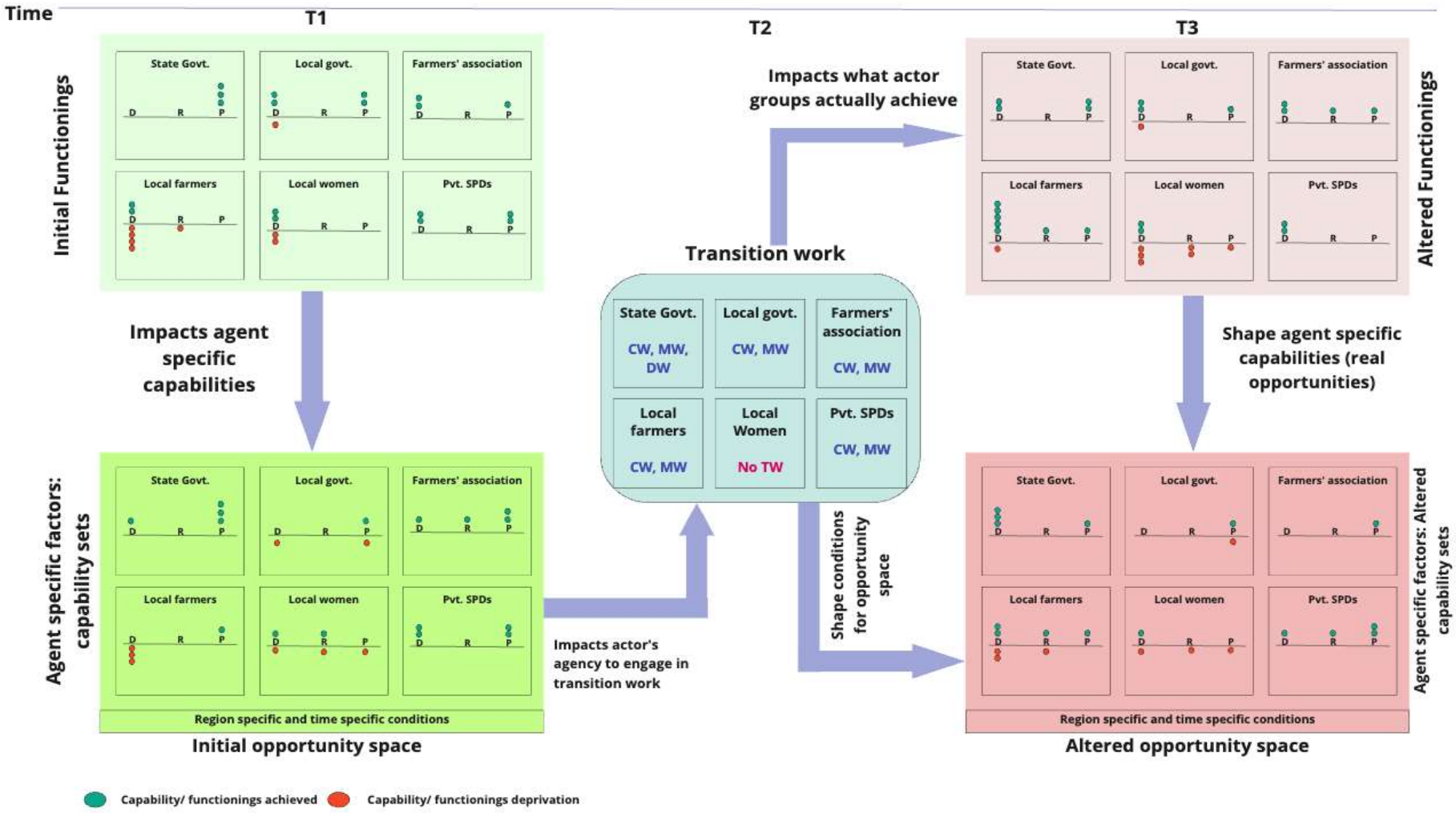


**Figure 4. Operationalization of the theoretical framework (Capability effects of the PSP in justice terms)**
Note: CW: Creation work, MW: Maintenance work, DW: Destruction work; D: Distributive justice, R: Recognition justice, P: Procedural justice

*T1: Initial opportunity space shaped by time specific, region specific and agent specific conditions*

The initial opportunity space in which the mega RE project was operationalized consisted of the Pavagada region, which is a semi-arid plateau with a mostly agrarian economy, which was drought hit over five decades. The region remained relatively unproductive over a long stretch of time, which imposed a significant public expenditure burden on the local administration, compromising key development interventions including public infrastructure such as roads, electricity, healthcare, education etc.

> "*Water used to be scarce, rains were unpredictable. No other sources of water. Uttara pinakini river is the closest river but there is no irrigation from there. The river has filled up after 30 years now and the dam is filled. Very unpredictable. We were dependent on rains only. We mainly grow groundnuts here."* (R6, Local government)

Time specific conditions included the national policy push on decarbonising the economy with ambitious RE goals (100 GW solar by 2022), accompanied by falling costs of solar photovoltaic technologies. Central and state government subsidies, performance linked incentives, tax holidays and 100 percent FDI in the non-conventional energy sector etc., led to the development of a cost competitive market for solar energy in India since 2015. Agent specific conditions, i.e. the capability sets of each actor group to engage in transition work to negotiate justice outcomes of the PSP was contingent on the functionings/real achievements of these actors. For instance, as KSPDCL was established as a parastatal agency to facilitate solar power development in Karnataka, it had access to networks with local, national and state agencies (functionings) which translated into institutional capabilities to influence policy rules and make decisions regarding the justice and local area development goals of the PSP (for details refer annexure II).

> "*… success of the PSP is not the result of a single organization but the collective efforts of various departments, including the revenue department, welfare department, panchayat engineering department, public works department, and many others. Each contributed by establishing the necessary rules and regulations that benefit the larger population."* (R3, KSPDCL official)

Similarly, local economic development linked financial resource flows were stunted owing largely to lack of buoyancy and in the wake of inadequate money flows through the regional political economy structures. This vicious cycle resulted in inadequate money flows to catalyse the local economy, leading to capability deprivation in terms of the inability of the local administrative setup to invest in need-based local infrastructure and services. This continued and has culminated in a severe lack of access to basic services and thus resulting in compromised quality of life for local residents (refer Figure 4/ details in Annexure II).

> "*In our area, the grant received by gram panchayats is quite low, and they struggle to invest in substantial development projects."* (R13, Shakti Sthala Farmer's association member, Retired government official, R19 Local government)

> "*When I initially got here, there was nothing. Now there's so much improvement. Roads are better."* (R31, Local community member)

As in the villages there was already an association (although not formally registered until 2018) which used to meet frequently to discuss justice concerns of local communities this provided local farmers with the capability to organise and deliberate around their expectations and concerns regarding the PSP. However women were deprived of the capability to participate in these negotiations. Initially women had the capability for income generation and hence some recognition in household decision making, as they used to work as agricultural labour or other local informal jobs (Refer annexure II/ Figure 4).

> "*It was better for us women before the solar park was installed. We used to make INR 300 per day, working from morning till noon. Now they don't take us at all."* (R33, Local woman)

> *"No job opportunities for women. None of us ask about it either. We are not allowed to visit the office as well. We are not aware of the sangha/whatsapp group of any kind."* (R32, R33, Local woman)

*T2: Transition work conditioned by the capability sets of actor groups*

Actors with a broader set of capabilities (and functionings) tend to engage more in transition work. While those with capability (and functionings) deprivations in the initial opportunity space are prone to lack agency to engage in transition work and hence negotiate valued functionings and capabilities through the project. For instance, one of the important reasons for the local farming community benefiting from this project was their capability to organise into unions and their functionings with respect to having formal educational qualifications and ownership of land. This positioned them as key actors when negotiating the procedures related to the PSP. As a result farmers engaged in consultation sessions with government officials, formed an association and the value they attached to land was recognised as a key element in designing the Pavagada leasing model. In this sense they engaged in creating networks, coalition building (creation), and valorising and demonising the historical practices of land grabbing and benefit sharing in other such projects (maintenance). They also expanded and deepened their social networks by engaging with local and state governments, media actors and academia actors to deliberate on the costs and benefits of leasing their agricultural land (maintenance) (refer annexure II/ Figure 4).

> "*One of the most important things which made this project possible was educated farmers. These farmers translated the entire document into local language as well as they played a very important role in convincing the farmer to lease out the land. So, this educated farmer made a big difference in bridging the gap."* (R11 Media actor)

> "*There was a distrust between the government and farmers, and they felt the need for an association hence they made the association. However, before the formation of the*

*association also these farmers were used to do meetings."* (R11 and R27 Media actor, R33 Local farmer)

In this context, as women were capability deprived in a sense that they were mostly not formally educated, did not own the land, and lacked access to social and political networks to participate and be recognised in formulating the developmental goals of the PSP, they lacked agency to engage in any form of transition work. This resulted in further capability (and functionings) deprivations for this particular actor group.

*"We should have gone and asked when things were beginning to change in the initial days. Now they wont do anything or even listen to us."* (R16, Local woman)

*"….usually the older women of the family attend the panchayat (local government). We don't feel like going…. No one listens to us. The panchayat also does not listen to us."* (R32, R33 Local woman)

Thus, the transition work that these actors engage in mediate the social equity and justice outcomes (procedural, distributive, and recognition) of the RE project, in capability and functionings terms. It is important to note that through the transition work certain valued functionings are achieved, while there are also deprivation of certain functionings for actor groups depending on the way they engage in change processes. Subsequently an altered opportunity space is created with either augmented/ deprived capabilities for different actor groups (refer figure 4).

*T3: Altered functionings and new opportunity space to engage in justice outcomes of change processes*

At the end of the cycle, the way in which actors engage in transition processes determines what they are able to achieve (functionings) and how the new opportunity space is shaped, with certain capability augmentation and deprivations. Capability and functioning augmentation can be understood as more 'just' outcomes of the transition project, in terms of distributional, procedural and recognition justice. While deprivation of capabilities (and functionings) are interpreted as injustices. Empirically the farmers' association, local women and local farmers were the groups where justice impacts of the PSP were more prominently visible. In fact the consolidated impact of transition work of farmers' association and other actors evidently had mostly positive distributional justice impacts in terms of augmented functionings for the local farmers in T3. However, certain subgroups of the local farmers (eg. cattle rearers and landless or marginal farmers) also faced capability deprivations in terms of loss of commons land for grazing and low rents from smaller land holdings (for details refer annexure II).

For the farmer's association members who initially had formal education and jobs along with land ownership and social networks, the initial opportunity space comprised of capabilities to influence local communities and articulate and negotiate local development needs with policy makers. This enabled their agency to engage in creation and maintenance work through shaping

narratives, advocacy and lobbying, coalition building, valorising, and deepening and expanding social and political networks. This kind of TW led to better distributional justice outcomes for them in the form of increased income from leasing (functionings) and recognition and procedural justice in the form of institutionalisation and representation in governance of the PSP (functionings). The altered opportunity space hence, comprised augmented capabilities for farmers' association to articulate, negotiate and achieve justice goals in transition projects (Figure 4).

> *"….we've been associated with the department (KREDL and KSPDCL), advising the government and looking out for the interests of the public and farmers in terms of their livelihood, rights, and socioeconomic status." (R28, Shakti Sthala Farmers' association member)*

> *"…history of service, combined with their expertise and social networks, gives us the ability to negotiate and advocate effectively for the development of the area. We have a good relationship with the government and local administration, which allows us to represent the farmers' concerns effectively. We also take the feedback and grievances of the farmers to the government and department through proper channels and maintain documentation of these interactions*." (R5, Shakti Sthala Farmers' association member)

Evidently, women who had inadequate capabilities initially, were unable to engage in transition work around negotiating their concerns and needs during the commissioning of the PSP. This resulted in distributional, recognitional, and procedural injustices for this actor group both in terms of concrete outcomes (functionings) and capabilities in the new opportunity space. For instance, distributional injustices that were directly observable were loss of employment opportunities within the PSP and mobility and safety constraints due to vast uninhabited areas. Women also didn't have adequate knowledge about the activities of the farmers' association and other processes through which they could voice their expectations from the PSP. Hence in the altered opportunity space, capability deprivations for women manifested as loss of income opportunities (distributional injustice) and participatory and recognition capability deprivation in governance of the PSP and its developmental goals (refer figure 4/ Annexure II).

> *"There is no source of employment and jobs for women [...] I was working as an agricultural laborer, but after the solar park came, I am not getting work there."* (R16, Local woman)

Change in regional characteristics, in the new opportunity space – eg. conversion of agricultural land to commercial land for the solar park also has gendered impacts on education and nutrition.

> *"Agriculture also coexists with animal rearing so the farmers would have some goats, some hens, one cow or buffalo and so on. All of this would supplement income at the household level and also help sustain basic nutrition at the household level. But now with no land and no access to cash to the women of the house, this money usually also goes off because men end up buying bikes or they want to set up shops and things like that, so*

*nutritional security at the household level has really gone down. This has in turn had a ripple effect wherein many girl children have been pulled out of schools."* (R1 Civil society actor, R2 media actor)

Thus, the existing functions and capabilities of actors form the basis of their agency to engage meaningfully in transition work. This in turn determines concrete justice outcomes (functionings) for these groups and shapes a new configuration of conditions in the opportunity space where actors are either enabled or deprived of opportunities to interact with structures and mediate social justice outcomes of similar transition projects. It is also important to note that the new set of capabilities and functionings achieved by each of the actor groups emerges through a compound effect of the transition work in T2 and based on prior conditions in the opportunity space at T1. So in our framework we highlight that it is important to recognise the positionality of each actor group in the transition process and also to consider their socioeconomic and cultural embeddedness to formulate a more people centric and place based approach to just transitions. Thus rather than only focusing on the more vulnerable groups, the emphasis of transition policy needs to be on developing a shared understanding of justice so as to maximise capability sets across all actor groups in the transition process. Given the temporal and spatial nature of our framework for justice, an understanding of the iterative nature of how prior capability sets influence actors' agency to meaningfully engage in transition processes becomes crucial. This iterative process can be captured with the proposed theoretical framework and has been operationalised through the Pavagada case study (refer Figure 4).

## 6. Conclusion

Through this study, we embarked on a multifaceted exploration of the CA, human agency, and just ETs, backed by empirical evidence from the PSP in Karnataka, India. Operationalising our human centric framework of justice through our case study, we sought to unravel the intricate dynamics shaping ET processes and their implications for social justice. Through this approach we uncovered significant insights into the mechanisms through which policy interventions can enhance capability sets and foster more equitable outcomes in ET projects.

Our study yielded both empirical and theoretical contributions. Firstly, we found that policy interventions aimed at enhancing capability sets within local communities, such as innovative land leasing models and targeted regulatory measures, can effectively empower stakeholders and mitigate potential conflicts in ET projects. Second, our analysis underscored the importance of considering the place-based and temporal dimensions of such projects, emphasizing the need for context-specific policy frameworks to optimize outcomes for all actors involved.

Theoretically, we provide a nuanced understanding of the interplay between capability enhancement, human agency, and ETs, shedding light on the mechanisms through which these concepts interact to shape justice outcomes. Hence, our findings contribute to the broader

discourse on energy justice by highlighting the centrality of capability-focused approaches in fostering inclusive and resilient ET pathways.

Drawing from our analysis, we offer three key propositions for theory and practice.

- First, there is a need for policymakers to prioritize capability enhancement as a central tenet of just ET policies, ensuring that interventions are tailored to the specific needs and contexts of local communities.
- Second, practitioners should embrace interdisciplinary approaches that integrate insights from development economics, sociology, and political science to inform more effective and equitable policy interventions.
- Third, scholars should engage in comparative case studies and longitudinal research to further elucidate the transferability and scalability of capability-focused approaches across diverse geographic and sectoral contexts.

Looking ahead, there is ample scope for future research in this domain. Longitudinal studies are needed to assess the long-term sustainability and equity implications of energy transition initiatives, while comparative case studies can offer valuable insights into the transferability of capability-focused approaches. Further, interdisciplinary research that bridges theoretical frameworks with practical applications can enhance our understanding of the complex socio-technical dynamics underpinning energy transitions and inform more effective policy interventions.

Thus, this study serves as a catalyst for advancing the discourse on energy justice and sustainability, providing valuable insights into the transformative potential of capability enhancement in fostering more equitable and resilient ET pathways.

**Acknowledgement**
This article is developed within the research project Reconfiguring Energy for Social Equity (ReSET). ReSET is funded by the Volkswagenstiftung under grant agreement no. 96958.

## References

[1] Revi A, Roberts D, Klaus I, Bazaz A, Krishnaswamy J, Singh C, et al. The Summary for Urban Policymakers of the IPCC's Sixth Assessment Report. Indian Institute for Human Settlements, Bangalore, India 2022:10–24943.
[2] Bouckaert S, Pales AF, McGlade C, Remme U, Wanner B, Varro L, et al. Net zero by 2050: A roadmap for the global energy sector 2021.
[3] Gielen D. Perspectives for the energy transition investment needs for a low-carbon energy system. International Renewable Energy Agency 2017.
[4] Shaw K, Hill SD, Boyd AD, Monk L, Reid J, Einsiedel EF. Conflicted or constructive? Exploring community responses to new energy developments in Canada. Energy Res Soc Sci 2015;8:41–51.
[5] Taliep N. A Community Engagement Model for an Inclusive Just Energy Transition in the South. Social and Health Sciences 2022;20:23-pages.

[6] Lennon B, Dunphy NP, Sanvicente E. Community acceptability and the energy transition: A citizens' perspective. Energy Sustain Soc 2019;9:1–18.
[7] Garcia-Casals X, Ferroukhi R, Parajuli B. Measuring the socio-economic footprint of the energy transition. Energy Transitions 2019;3:105–18.
[8] Geall S, Shen W, Gongbuzeren. Solar energy for poverty alleviation in China: State ambitions, bureaucratic interests, and local realities. Energy Res Soc Sci 2018;41:238–48. https://doi.org/10.1016/j.erss.2018.04.035.
[9] Leiren MD, Reimer I. Historical institutionalist perspective on the shift from feed-in tariffs towards auctioning in German renewable energy policy. Energy Res Soc Sci 2018;43:33–40.
[10] Jenkins K, McCauley D, Heffron R, Stephan H, Rehner R. Energy justice: A conceptual review. Energy Res Soc Sci 2016;11:174–82.
[11] Heffron RJ, McCauley D, Sovacool BK. Resolving society's energy trilemma through the Energy Justice Metric. Energy Policy 2015;87:168–76. https://doi.org/10.1016/j.enpol.2015.08.033.
[12] Heffron RJ, McCauley D. Achieving sustainable supply chains through energy justice. Appl Energy 2014;123:435–7. https://doi.org/10.1016/j.apenergy.2013.12.034.
[13] Park J, Sovacool BK. The contested politics of the Asian atom: peripheralisation and nuclear power in South Korea and Japan. Env Polit 2018;27:686–711.
[14] McCauley DA, Heffron RJ, Stephan H, Jenkins K. Advancing energy justice: the triumvirate of tenets. International Energy Law Review 2013;32:107–10.
[15] Hobson K. Bins, bulbs, and shower timers: on the 'techno-ethics' of sustainable living. Ethics Place and Environment 2006;9:317–36.
[16] Sovacool BK, Dworkin MH. Global energy justice : problems, principles, and practices. 2014.
[17] Bridge G, Barr S, Bouzarovski S, Bradshaw M, Brown E, Bulkeley H, et al. Energy and Society. Abingdon, Oxon ; New York, NY : Routledge, 2018.: Routledge; 2018. https://doi.org/10.4324/9781351019026.
[18] Lee J, Byrne J. Expanding the conceptual and analytical basis of energy justice: beyond the three-tenet framework. Front Energy Res 2019;7:99.
[19] Bouzarovski S, Simcock N. Spatializing energy justice. Energy Policy 2017;107:640–8.
[20] Upham P, Dütschke E, Schneider U, Oltra C, Sala R, Lores M, et al. Agency and structure in a sociotechnical transition: Hydrogen fuel cells, conjunctural knowledge and structuration in Europe. Energy Res Soc Sci 2018;37:163–74.
[21] Farla J, Markard J, Raven R, Coenen L. Sustainability transitions in the making: A closer look at actors, strategies and resources. Technol Forecast Soc Change 2012;79:991–8.
[22] Calver P, Simcock N. Demand response and energy justice: A critical overview of ethical risks and opportunities within digital, decentralised, and decarbonised futures. Energy Policy 2021;151:112198.
[23] Sovacool BK, Hess DJ, Amir S, Geels FW, Hirsh R, Medina LR, et al. Sociotechnical agendas: Reviewing future directions for energy and climate research. Energy Res Soc Sci 2020;70:101617.
[24] Krupnik S, Wagner A, Koretskaya O, Rudek TJ, Wade R, Mišík M, et al. Beyond technology: A research agenda for social sciences and humanities research on renewable energy in Europe. Energy Res Soc Sci 2022;89:102536.

[25] Lawrence TB, Suddaby R. 1.6 institutions and institutional work. The Sage Handbook of Organization Studies 2006:215–54.
[26] Fuenfschilling L, Truffer B. The interplay of institutions, actors and technologies in socio-technical systems—An analysis of transformations in the Australian urban water sector. Technol Forecast Soc Change 2016;103:298–312.
[27] Jolly S, Spodniak P, Raven RPJM. Institutional entrepreneurship in transforming energy systems towards sustainability: Wind energy in Finland and India. Energy Res Soc Sci 2016;17:102–18. https://doi.org/10.1016/j.erss.2016.04.002.
[28] Werbeloff L, Brown RR, Loorbach D. Pathways of system transformation: Strategic agency to support regime change. Environ Sci Policy 2016;66:119–28.
[29] Geels FW, Verhees B. Cultural legitimacy and framing struggles in innovation journeys: A cultural-performative perspective and a case study of Dutch nuclear energy (1945–1986). Technol Forecast Soc Change 2011;78:910–30.
[30] Fischer L-B, Newig J. Importance of actors and agency in sustainability transitions: A systematic exploration of the literature. Sustainability 2016;8:476.
[31] Monteiro P, Nicolini D. Recovering materiality in institutional work: Prizes as an assemblage of human and material entities. Journal of Management Inquiry 2015;24:61–81.
[32] Lawrence TB, Suddaby R. Institutions and Institutional Work. The SAGE Handbook of Organization Studies, 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom : SAGE Publications Ltd; 2006, p. 215–54. https://doi.org/10.4135/9781848608030.n7.
[33] Katila S, Laine P-M, Parkkari P. Sociomateriality and affect in institutional work: Constructing the identity of start-up entrepreneurs. Journal of Management Inquiry 2019;28:381–94.
[34] Duygan M, Stauffacher M, Meylan G. A heuristic for conceptualizing and uncovering the determinants of agency in socio-technical transitions. Environ Innov Soc Transit 2019;33:13–29. https://doi.org/10.1016/j.eist.2019.02.002.
[35] Malakar Y. Evaluating the role of rural electrification in expanding people's capabilities in India. Energy Policy 2018;114. https://doi.org/10.1016/j.enpol.2017.12.047.
[36] Hillerbrand R, Milchram C, Schippl J. Using the Capability Approach as a normative perspective on energy justice: Insights from two case studies on digitalisation in the energy sector. J Human Dev Capabil 2021;22:336–59.
[37] Rajagopalan S. Who benefits and how? A capabilities perspective on solar micro-grids in India. J Human Dev Capabil 2021;22:316–35.
[38] Sen A. Development as freedom. DEVELOPMENT IN PRACTICE-OXFORD-2000;10:258.
[39] Haldar S, Peddibhotla A, Bazaz A. Analysing intersections of justice with energy transitions in India - A systematic literature review. Energy Res Soc Sci 2023;98. https://doi.org/10.1016/j.erss.2023.103010.
[40] Levenda AM, Behrsin I, Disano F. Renewable energy for whom? A global systematic review of the environmental justice implications of renewable energy technologies. Energy Res Soc Sci 2021;71:101837.
[41] Liao C, Erbaugh JT, Kelly AC, Agrawal A. Clean energy transitions and human well-being outcomes in Lower and Middle Income Countries: A systematic review. Renewable and Sustainable Energy Reviews 2021;145:111063.

[42] Bathelt H. Geographies of production: growth regimes in spatial perspective 1-innovation, institutions and social systems. Prog Hum Geogr 2003;27:763–78.
[43] Grillitsch M, Sotarauta M. Trinity of change agency, regional development paths and opportunity spaces. Prog Hum Geogr 2020;44:704–23.
[44] Steen M. Reconsidering path creation in economic geography: Aspects of agency, temporality and methods. European Planning Studies 2016;24:1605–22.
[45] Ghosh D, Bryant G, Pillai P. Who wins and who loses from renewable energy transition? Large-scale solar, land, and livelihood in Karnataka, India. Globalizations 2022:1–16.
[46] Lakhanpal S. Contesting renewable energy in the global south: A case-study of local opposition to a wind power project in the Western Ghats of India. Environ Dev 2019;30:51–60. https://doi.org/10.1016/j.envdev.2019.02.002.
[47] Yenneti K, Day R, Golubchikov O. Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects. Geoforum 2016;76:90–9.
[48] Frediani AA. Sen's Capability Approach as a framework to the practice of development. Dev Pract 2010;20:173–87. https://doi.org/10.1080/09614520903564181.
[49] Sen A. The Idea of Justice. Journal of Human Development 2008;9:331–42. https://doi.org/10.1080/14649880802236540.
[50] Murphy C, Gardoni P. Determining Public Policy and Resource Allocation Priorities for Mitigating Natural Hazards: A Capabilities-based Approach. Sci Eng Ethics 2007;13:489–504. https://doi.org/10.1007/s11948-007-9019-4.
[51] Kim S-M, Sherraden MS. The capability approach and social justice. Routledge International Handbook of Social Justice, Routledge; 2014, p. 202–15.
[52] Saith R. Capabilities: the Concept and its Operationalisation. Queen Elizabeth House Oxford; 2001.
[53] Sen A. Inequality reexamined. Harvard University Press; 1995.
[54] Sen A. Well-Being, Agency and Freedom: The Dewey Lectures 1984. J Philos 1985;82:169. https://doi.org/10.2307/2026184.
[55] Drèze J, Sen A. Democratic Practice and Social Inequality in India. J Asian Afr Stud 2002;37:6–37. https://doi.org/10.1177/002190960203700202.
[56] Dahmen S. The capability approach and sociological conceptions of human agency: An empirical assessment on the basis of an analysis of activation policies. Soc Work Soc 2014;12.
[57] Yenneti K, Day R, Golubchikov O. Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects. Geoforum 2016;76:90–9. https://doi.org/10.1016/j.geoforum.2016.09.004.
[58] Melin A, Day R, Jenkins KEH. Energy justice and the capability approach—introduction to the special issue. J Human Dev Capabil 2021;22:185–96.
[59] Nussbaum M. Capabilities and social justice. International Studies Review 2002;4:123–35.
[60] Day R. Energy justice. Environmental Justice, Routledge; 2020, p. 161–75.
[61] Schlosberg D. Defining environmental justice: Theories, movements, and nature. OUP Oxford; 2007.
[62] Walker G, Day R. Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth. Energy Policy 2012;49:69–75.

[63] Velasco-Herrejon P, Bauwens T. Energy justice from the bottom up: A capability approach to community acceptance of wind energy in Mexico. Energy Res Soc Sci 2020;70:101711.
[64] Brisley R, Welstead J, Hindle R, Paavola J. Socially just adaptation to climate change. Joseph Roundtree Foundation, York, UK 2012.
[65] Haldar S, Peddibhotla A, Bazaz A. Analysing intersections of justice with energy transitions in India - A systematic literature review. Energy Res Soc Sci 2023;98:103010. https://doi.org/10.1016/J.ERSS.2023.103010.
[66] Kurikka H, Kolehmainen J, Sotarauta M, Nielsen H, Nilsson M. Regional opportunity spaces–observations from Nordic regions. Reg Stud 2023;57:1440–52.
[67] Grillitsch M, Martynovich M, Fitjar RD, Haus-Reve S. The black box of regional growth. J Geogr Syst 2021;23:425–64.
[68] De Haas H. A theory of migration: the aspirations-capabilities framework. Comp Migr Stud 2021;9:1–35.
[69] Laasonen V, Kolehmainen J. Capabilities in knowledge-based regional development–towards a dynamic framework. European Planning Studies 2017;25:1673–92.
[70] Chlebna C, Mattes J. The fragility of regional energy transitions. Environ Innov Soc Transit 2020;37:66–78.
[71] Geels FW. Micro-foundations of the multi-level perspective on socio-technical transitions: Developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory. Technol Forecast Soc Change 2020;152:119894.
[72] Leca B, Lawrence TB, Suddaby R, Leca B. Introduction: Theorizing and studying institutional work. TB Lawrence, R Suddaby & B Leca (Eds), Institutional Work: Actors and Agency in Institutional Studies of Organizations 2009:1–27.
[73] Loehr M, Chlebna C, Mattes J. From institutional work to transition work: Actors creating, maintaining and disrupting transition processes. Environ Innov Soc Transit 2022;42:251–67.
[74] Markard J, Raven R, Truffer B. Sustainability transitions: An emerging field of research and its prospects. Res Policy 2012;41:955–67.
[75] Claassen R. An agency-based capability theory of justice. Eur J Philos 2017;25:1279–304.
[76] Yin RK. Case study research and applications. vol. 6. Sage Thousand Oaks, CA; 2018.
[77] Sotarauta M, Grillitsch M. Studying human agency in regional development. Reg Stud 2023;57:1409–14.
[78] Beach D, Pedersen RB. Process-tracing methods: Foundations and guidelines. University of Michigan Press; 2019.
[79] Bhatti J, Das B. INDIA'S RENEWABLE ENERGY GOALS FACTS ABOUT PROGRESS MADE TILL 2022. New Delhi: 2022.
[80] Elavarasan RM, Shafiullah GM, Padmanaban S, Kumar NM, Annam A, Vetrichelvan AM, et al. A comprehensive review on renewable energy development, challenges, and policies of leading Indian states with an international perspective. Ieee Access 2020;8:74432–57.
[81] Dubash NK, Swain AK, Bhatia P. The disruptive politics of renewable energy. The India Forum, 2019, p. 1–15.

[82] Pandey P, Sharma A. Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India. Energy Res Soc Sci 2021;71. https://doi.org/10.1016/j.erss.2020.101824.
[83] Babatunde SO, Adeniyi O, Awodele OA. Investigation into the causes of delay in land acquisition for PPP projects in developing countries. Journal of Engineering, Design and Technology 2017;15:552–70.
[84] D'Costa AP, Chakraborty A. The land question in India: State, dispossession, and capitalist transition. Oxford University Press; 2017.
[85] Singh G. Problems of land acquistion: A case study of gobindpura district mansa (punjab) 2014.
[86] Stock R. Illuminant intersections: Injustice and inequality through electricity and water infrastructures at the Gujarat Solar Park in India. Energy Res Soc Sci 2021;82:102309.
[87] Rao B. A case study on one of the world's biggest solar parks - Pavagada in Karnataka - and the lessons to learn and (un) learn from the scrutiny. Investment Roadblocks and Business-driven Demands for Renewable Power Generation in India: The Way Forward for a Clean Energy/Low-Carbon Technology in India , 2019.
[88] Ghosh D, Bryant G, Pillai P. Who wins and who loses from renewable energy transition? Large-scale solar, land, and livelihood in Karnataka, India. Globalizations 2023;20:1328–43.
[89] Yenneti K, Day R. Distributional justice in solar energy implementation in India: The case of Charanka solar park. J Rural Stud 2016;46:35–46.
[90] Mueller JT, Brooks MM. Burdened by renewable energy? A multi-scalar analysis of distributional justice and wind energy in the United States. Energy Res Soc Sci 2020;63:101406.
[91] Aggarwal M. Government eases environmental clearance rules for solar power projects, parks. Livemint 2017.
[92] GoK. THE KARNATAKA LAND REFORMS ACT, 1961. 1961.