

Rural energy planning remains out-of-step with contemporary paradigms of energy access and development

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ABSTRACT

Billions of people around the world remain without access to modern energy services, the majority of whom live in rural locations. To support the deployment of these critical services, energy planners must consider complex interdisciplinary factors in the process of evaluating and deciding upon locally appropriate energy solutions. A key mechanism for navigating such complexity is to engage relevant local stakeholders in the process. In this study, we apply a systematic review to analyse process-oriented energy planning literature published over the last 35 years to explore the extent that past and present practices reflect current paradigms on energy access and development. The results indicate that the typical approach to evaluate appropriate energy solutions is siloed, disciplined in focus and non participatory. This paper highlights the need for a greater dialogue on participatory practice in the energy agenda to bring closer alignment with contemporary development thinking, and introduces an analytical framework as a way to reflect on this.

1. Introduction

The aim of this work is to determine the extent that rural energy planning in both developing and advanced economies is informed by contemporary paradigms of energy access and development. Two specific objectives are defined. First, to determine to what level human centred criteria are considered in the planning process of rural development, and second, to determine the level and type of participatory process engaged by rural energy planners.

This study is driven by an appreciation that current theory is not always reflected in common practice. Evidence to support this suggestion is presented herein. Unless significant effort is made to translate theory into practice, changing paradigms specifically regarding participation will remain largely academic with minimal real world impact. As a result, the status quo of excluding the energy impoverished from the planning process, whether intentional or otherwise, may well persist.

In 2012, 1.1 billion people remained without access to electricity, while 2.9 billion people continued to rely upon harmful fuels such as solid biomass and animal dung as their primary cooking fuel [1].¹ An overwhelming majority of the energy impoverished live in rural areas – representing 78% and 85% of the population who lack access to

electricity and clean cooking facilities, respectively [2].

Progress to address global inequality between urban and rural modern energy use continues to lag dramatically behind international ambitions [1]. This is despite recognition that energy plays an important role in the progression of human development and the alleviation of poverty [3–8]. The launch of the United Nation's Sustainable Energy for All (SE4All) initiative in 2012 aimed to focus political attention and mobilise action towards achieving universal access to modern energy services by 2030. The UN General Assembly declared 2014 the beginning of the 'Decade of Sustainable Energy for All', symbolising heightened momentum and the call for a coherent, integrated approach to energy issues and synergy across the global energy agenda [9].

However, these ambitious global targets will not be easily achieved. Projections by the International Energy Agency (IEA) in 2012 indicate that despite reducing the fraction of those without access to electricity by 20%, close to 1 billion people will remain without access in 2030 (Fig. 1) [10]. Similarly, projections also indicate that around 2.6 billion people, a little more than 30% of the global population, will still remain without access to modern cooking fuels in 2030. This represents a 25% improvement in relative terms, taking into account population growth and urban migration over the period. These projections are based on

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¹ The authors acknowledge the shortcomings of reporting energy access based on the binary definition of having access or not, and support the movement toward a multi-tier measurement framework that captures an affordable, reliable and meaningful level of energy access.

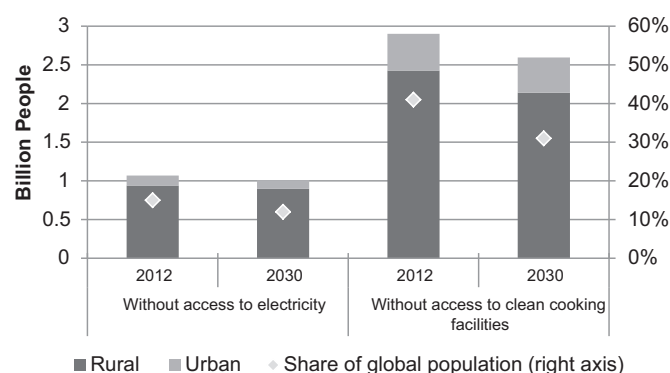


Fig. 1. Number and global proportion of people without access to electricity and clean cooking facilities in urban and rural areas, 2012 data and 2030 projections.

Source: Based on [1] and projections presented in [10].

the IEA's central 'New Policies Scenario', which accounts for existing policies in addition to the implementation of new commitments made by governments.

This global agenda to accelerate the provision of energy access has driven a desire to streamline and standardise the energy planning process [11]. However, contemporary literature suggests that to effect a sustainable change, this standardised process must account for localised conditions, uncertainty and the social and cultural complexity that this challenge demands [12–15]. For rural energy planners in particular, the complexity and uncertainty inherent in the energy supply challenge has never been greater. Rapid change in energy technologies and costs, population growth trends in low income economies coupled with mounting pressure to navigate delicate trade-offs between environmental, social and economic objectives (climate change perhaps the most obvious example here), are just some of the emerging concerns adding to the complexity of the energy planning challenge. Despite these calls for a greater emphasis on human factors dealing with localised social and political context, social science disciplines and methods that could help to inform this agenda typically remains under-represented in the broader field of energy research [16].

In part to overcome such local complexity, participatory approaches have become mainstream in development projects over the past decades for practitioners and donor organisations. The advantages (and critiques) of a participatory approach relative to a centralised, hierarchical process to decision making and planning in complex environments have been discussed extensively in the literature (see for example, [17–19] and [20]). Recognising the complex nature of the challenge and the importance of stakeholder participation are two concepts firmly embedded in the new paradigm of energy access and development. But to what extent does this contemporary thinking on energy access translate to rural energy planning practice? Here, we provide a critical analysis of the past and present state of rural energy planning practice by means of a systematic review of published literature between 1979, the earliest cited article, and 2016. We introduce an analytical framework as a tool to achieve this analysis, through a lens of participation. We also map patterns and trends of energy planning processes over time, to determine whether these trends have kept pace with changing paradigms related to energy access and development.

2. Context

2.1. Participation in development

The participatory discourse has developed on the assumption that through an inclusive process of decision making and the engagement of stakeholders, a sense of ownership and empowerment can be achieved leading to a more sustainable social impact. Development economists

have also argued that ownership and participation are key ingredients of a successful development strategy and explain why effective change cannot occur through external impositions [21]. As a result, an explosion of participatory methods, tools and frameworks have emerged in the literature since the 1980s [22]. Combined, these various methods give impetus to participatory reform of rural development practice, grounded in the recognition that local participation helps to bring closer alignment between development assistance and its intended beneficiaries [23]. From a governance perspective, the theory behind democratising the decision making process particularly in planning, emerged from recognising the limits of power and influence of governments to effect sustained change.

Considering participation in the context of development, 'participatory development' therefore is defined by the World Bank as "...a process through which stakeholders influence and share control over development initiatives, and the decisions and resources which affect them" [24]. In this article, we consider 'stakeholder' to refer to all groups, institutions or individuals who hold an interest in a project or programme, including both winners and losers, those ultimately affected (primary stakeholders) and intermediaries (secondary stakeholders).

The participatory discourse as it relates to development has not gone unchallenged, in many respects contributing to the continued refinement and expansion of methodologies. Mansuri and Rao [23], for example, argue the importance of recognising the difference between participation which is organic (endogenously driven social and ground level movements) and induced (extrinsically promoted and managed bureaucratically by governments and institutions), and how this transpires to differing outcomes. Other critiques of participatory processes relate to the concept of civil society failure as a third and often neglected dimension of common failures alongside market and government failure [23]. Civil society failure refers to the inability of society groups to self organise, hold government and business accountable and participate in activities that promote the collective benefit [23]. These criticisms remind participatory development advocates of the dangers of misaligned or poorly implemented processes and the need for critical reflection and improvement of practice and theory.

Broadly speaking, the principles underpinning participatory development and its family of methodologies reflect a paradigm shift commonplace in the development theory – away from the traditional industrial development model and towards a people centric and participatory mode of development [25].

2.2. Participation and energy access: three paradigms

In a similar fashion to distinct trends in development practice related to complexity and participation, we also observe distinct shifts in the approach toward energy access and development. One author [26] recently articulated three main paradigm shifts in energy access and development, which we adapt here in Table 1. As can be seen from the table, a distinction can be drawn between the donor-gift paradigm of the 1970s and 1980s and the market creation paradigm of the 1990s and early 2000s.

The former period of the 1970s and 1980s was characterised by policy and project instruments administered predominantly by single central agents such as governments or large multilateral donor organisations. This state-led approach typically favoured large scale energy systems with the objective of technology transfer under a donor-gift relationship. This paradigm saw little local participation in the technology driven, often centrally planned process [27].

Thailand's highly successful rural electrification program which began in the early 1970s represents an exception to the donor gift era, which is otherwise criticised for the inefficient and unsustainable provision of energy services. Much like many other energy development programmes in the era, Thailand's transition was driven by a central (often monopolistic) role of government and public utilities.

Table 1

Characteristic features of the three primary paradigms of energy access and development.
Source: adapted from [26].

	<i>Donor gift paradigm 1970s–1980s</i>	<i>Market creation paradigm 1990s–2000s</i>	<i>Sustainable development paradigm 2010s–Present</i>
Actors	Single, government or donor-led	Multiple, governments, donors and corporate institutions	Multiple agents representing public, private and community interests
Relationship	Giving (donor) and receiving (beneficiary)	Seller-customer transactional relationship	Partnership of mutual benefit across actors
Primary goal	Technology diffusion	Market and economic viability	Environmental and social sustainability
Focus	Equipment and installed capacity, often single systems and large scale	Multiple fuels (e.g. ‘electricity’ or ‘fuelwood’)	Energy services, income generation, institutional and social needs
Participation	Little need to engage local stakeholders	Input-oriented engagement of local ‘consumers’	Values-driven participation of broad stakeholders
Ownership	Given away	Sold to customers	Cost-sharing and in-kind community contributions

However, Thailand's ability to rapidly and sustainably electrify villages in both urban and rural populations, from 20% to 98%, was partly attributed to its emphasis on affordability and local participation [27].

From the beginning of the 1990s a new energy development paradigm began to emerge that saw governments and multinational donors play a less direct role in the delivery of technology transfer and instead focus on the creation of markets and removing barriers to entry. This neoliberal shift emphasised the deregulation of energy markets, encouraging greater involvement by the private sector and a softer hand played by state institutions. The motivation behind this paradigm shift from the state to the market was driven in large part on the assumption that the provision of goods and services can be more efficiently achieved through private enterprise than by state and donor funded agencies. Engaging local ‘consumers’ became instrumental to the point that energy access and development products and services relied equally upon local investment and identifying consumer demands.

Growing environmental concerns, coupled with a recognition of the scale of the energy impoverished has seen another paradigm of energy development emerge in recent times [12,26] in the global energy policy agenda [28]. This new paradigm is driven more toward a collaborative partnership between private, community and state led agencies, accepting once again the important role of governments to ensure equal opportunity and choice is afforded to the global public and their basic needs are met. The focus of this new sustainable energy development paradigm emphasises energy services and outcomes such as achieving individual and community aspirations as well as income generation, rather than the classical models of technology delivery and achieving economic efficiency. The engagement of stakeholders in this process becomes more aligned as a partnership and purposefully driven.

2.3. An analytical framework to map participatory processes in rural energy planning

As outlined above, a key motivating driver for this research is to explore how the practice-oriented energy planning literature reflects contemporary paradigms on energy access and development. To achieve this, we introduce a framework to analyse participatory processes related to decision making and rural energy planning. The framework has been adapted from other characterisations of participatory processes found in literature [29,30]. We argue that the purposes for which planners undertake participatory processes in rural energy decision making fall into one of five broad categories: to exclude, legitimise, consult, partner or empower (Table 2).

3. Methodology

A systematic review of the literature [31] was undertaken to capture relevant energy planning scholarship to date. A four step process was followed. First, the topic and research questions were identified and

explicitly articulated to ensure a clearly defined purpose for the study. Second, a database was constructed to capture relevant original, published and peer-reviewed journal works over time. Scholarly databases were searched using key terms and the results cross examined for prominent missing articles against reference lists from key recent reviews of the energy planning literature, namely [32–35], and [36]. We were only interested in practice oriented studies for this review. As such, we narrowed the pool to those studies that demonstrated or evaluated a planning process applied to a particular case study. This left a total 139 studies in our database ready for further analysis.

Third, the data was further analysed to record for each core research article when and where the article was published, the geographical focus of the study, the criteria considered in the rural energy planning process, and characteristics of the participatory process if employed. Fourth, the results were presented graphically for analysis.

The final 139 original and peer-reviewed journal articles had been published in 31 different journals between 1979 and 2016, demonstrating various approaches to rural energy planning across 53 different countries.²

This review exclusively covers published, peer-reviewed journal articles and does not include an analysis of relevant grey literature such as reports, working papers, theses, conference material or articles in languages other than English. Substantial effort has been made to capture an unbiased representation of the current and preceding literature on rural energy planning. While this goal has been aided by the use of a systematic process, the literature database is by no means exhaustive.

4. Results and discussion

The section is structured to address each of the objectives in sequence as follows: To what extent are human centred criteria considered in the planning process of rural energy development? What level and type of participatory process are engaged by rural energy planners? And finally, to what extent do rural energy planning processes reflect changes in paradigms of energy access and development?

4.1. Consideration of human centred criteria

We categorised energy planning processes in terms of their consideration of selection criteria based on five dimensions, namely: technical, economic, environmental, political and institutional, and socio-cultural. By doing so we can observe if particular criteria are featuring more frequently in energy planning processes while others have received less attention. A study that is considered to have met the

² A full citation list and coding dataset is available upon request.

Table 2

Analytical framework for characterising participatory processes in rural energy planning.

Purpose of participation	Description	Level of stakeholder engagement
Exclude	Specific stakeholder groups have been excluded from the decision process. This may include local, primary stakeholders who are significantly impacted by the decisions that are made.	Non-existent
Legitimise	A participatory strategy to engage stakeholders for the purpose of legitimising the decision to be made. An example of this strategy employed may entail a regulatory requirement or a condition placed on funding or other contractual obligations.	Shallow engagement, e.g. information sessions, briefings
Consult	Stakeholders are consulted in the decision process. This category of participatory strategy may be motivated by a need to resolve or avoid conflict, to improve stakeholders understanding or seek input to inform the planning process – typically a process of extracting information through surveys or questionnaires.	Moderate engagement, e.g. surveys, questionnaires, consultations
Partner	Stakeholders are engaged in partnership with planners. This partnership strategy may be employed by planners in order to frame issues, clarify problems, and identify potential solutions. Possible solutions are deliberated as a group and the final decision making control is shared among stakeholders.	Moderate engagement, e.g. discussion groups, public events
Empower	Empowerment as a process of encouraging and facilitating a transition toward equal opportunity and control over the final decision to be made. This strategy purposefully engages stakeholders with an interest in devolving substantial decision making power and entrusting control over the planning decisions.	Deep engagement, e.g. workshops, capacity building

technical criteria has discussed the physical energy resource availability in the provided case study location, in doing so identifying appropriate technology on that basis. For example, one such technology focused study published in the targeted journal *Biomass and Bioenergy* employed satellite imagery techniques and global information systems to assess the energy resource potential from surplus rice straw in a rural region of Assam, India [37].

In many cases, a technology focused study will be accompanied by a discussion of economic criteria, such as the economic feasibility of the proposed technical solution. In recent times, energy planning literature has observed greater use of computer-aided software packages that evaluates various energy supply options on the basis of technical and economic criteria [33]. One such favoured package is HOMER, developed by the USA National Renewable Energy Laboratory [38]. An energy planning study published in *Energy Policy* in 2013 for example employed the use of HOMER to a rural China case study, evaluating the technical and economic viability of distributed wind or solar power relative to large scale coal fired infrastructure [39]. Despite its popularity, HOMER has been criticised for finding optimal solutions based on economic and technical components alone [32], with limited consideration of socio-cultural, environmental or political and institutional concerns which are prevalent in the local context of rural energy decisions.

An energy planning study is considered to have addressed the environmental criteria if it investigates the impact of the proposed solution on the local or global environment. A recent example is a 2013 study published in the journal *Energy*, demonstrating a planning methodology that optimises an energy solution in rural Sri Lanka. This approach considered solar and wind resource estimates, initial and ongoing system costs in addition to greenhouse gas emissions as

objective functions [40]. A further recent study published in this journal describes the energy planning status in the Philippines and proposes an alternative renewable energy framework that is more in tune with local environmental characteristics and requirements [41]. Political or institutional criteria on the other hand concern governance matters such as legalities, policy or other potential institutional barriers of the proposed energy solution. The authors of one remote energy planning study recently published in *Energy for Sustainable Development*, discusses the impact of policy and subsidy instruments in Lao PDR on the attractiveness of various energy solutions [42].

Finally, studies are evaluated for their consideration of the appropriateness of the proposed energy solutions with respect to cultural or social matters such as local employment, socio-technical adequacy and willingness to adopt. One such study from our database, published in 2013 in *Energy Policy*, chose a rural village in Bangladesh to test a multi-criteria approach that considered four social dimensions alongside 20 other criterion under the headings of technical, economic, environmental and policy/regulation dimensions [43]. This particular study is one of only three from our database of 139 articles that demonstrated a consideration of all five dimensions.

Taking a closer look at Table 3, which displays the combinations of dimensions that emerged and how frequent each occurred, we note that technical and economic criteria featured in each of the popular combinations.

We find supporting evidence to suggest a bias toward a techno-economic perspective in rural energy planning (Fig. 2). This finding is consistent with recent literature suggesting that energy research more broadly remains preoccupied with conventional technological and economic thinking, and lacks focus in more human centred concerns [16,44]. One particular recent study in this journal critiqued the

Table 3

Breakdown of rural energy planning literature into the five key dimensions of technical, economic, environmental, political and institutional, and socio-cultural.

Single criteria	Number of articles	Two criteria	Number of articles	Three criteria	Number of articles	Four criteria	Number of articles	Holistic	Number of articles
T	7	T-Ec	33	T-Ec-En	24	T-Ec-En-S	18	T-Ec-En-P-S	3
Ec	7	P-S	5	Ec-En-S	9	T-Ec-En-P	1		
En	1	Ec-En	3	T-Ec-S	7	T-En-P-S	1		
S	1	Ec-S	2	T-Ec-P	4	Ec-En-P-S	1		
		En-S	2	T-En-S	3				
		Ec-P	1	Ec-En-P	2				
				Ec-P-S	2				
				T-P-S	2				
	n=16		n=46		n=53		n=21		n=3
Total n=139									

T= Technical; Ec=Economic; En=Environmental; P= Political & Institutional; S=Socio-cultural.

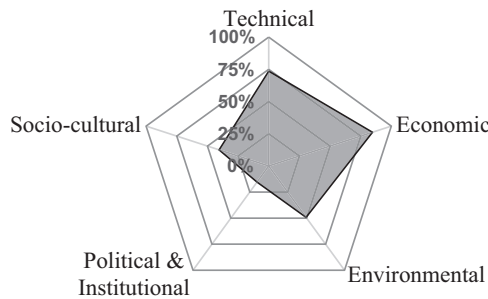


Fig. 2. Dimensions considered by rural energy planning methods, per cent of total studies.

renewable energy policy context in Greece, describing the potential for adverse consequences from an energy planning perspective that neglects to promote local engagement, and take account of the environmental, social and cultural context [45].

From Fig. 2, we see that 85% of studies in our database considered the economic dimension in the analysis, whilst the technical dimension was considered in 74% of the articles critically examined. In contrast, less than half of the rural energy planning methods addressed environmental or socio-cultural dimensions (49% and 40% respectively) and fewer still discussed matters of political or institutional concern (15%). This apparent lack of attention given to political challenges is at odds with recent literature arguing the important role of energy governance [46] and major political barriers to energy access such as poor institutional capacity, political instability, licensing and corruption, or the fragmentation of energy policies [47].

4.2. Participatory processes in rural energy planning

Given this apparent gap in socio-cultural and political interest from energy planners, a subsequent question is raised: how frequent and for what purpose do rural energy planners engage stakeholders in the process of identifying and evaluating appropriate energy solutions? We test the idea that with a predominantly techno-economic lens with which energy planners undergo decision making, there may also be little incentive or desire to engage local stakeholders in the process, other than to extract critical data to inform some technical parameters.

It is of little surprise therefore that we see limited cases in our database whereby local stakeholders are meaningfully engaged in the energy planning process (see Fig. 3). We find less than a third (43 out of the total 139 studies) providing evidence of having engaged local stakeholders in the process.

Applying our analytical framework to better understand these participatory processes in rural energy planning, we find the leading purpose for employing a participatory method beyond exclusion is to consult stakeholders in the act of informing the planning process (see Fig. 3). 30 out of the total 43 participatory planning processes appeared to be underpinned by a consultative purpose, predominantly for the use

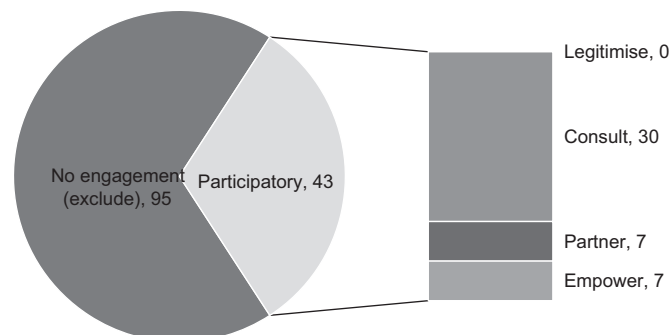


Fig. 3. Level of participation in energy planning. Units are number of articles.

of extracting information and providing inputs for the planning process. As an example, a study undertaken in rural Scotland employs a series of interviews and questionnaires to inform the suitability of renewable energy technology in terms of economic, environmental and cultural perspectives [48].

A handful of participatory methods (seven articles) engage stakeholders for the purpose of partnering in some capacity to identify potential solutions. A 2007 study published in *Energy Policy* with a focus on evaluating energy solutions for a rural community in Colombia provides an example of this partnering engagement process. The multi-criteria decision method employed by this study was specifically designed to enable the explicit needs and priorities of the local beneficiaries to be firmly integrated into the energy selection process [49]. More recently, a study published in this journal argued the necessity of effective stakeholder engagement and collective decision-making regarding the conceptual, methodological and practical processes of technology transfer and renewable energy deployments in rural Argentina [50].

A total of seven articles represent a participatory approach with an aim towards empowerment. One clear example of an empowering agenda from our database happens to be the Bangladesh study that we have touched on previously, and also one of only three studies that incorporate all five dimensions in the energy planning analysis. The multi-criteria decision support tool in this study is built for purpose to allow local decision makers to deliberate and choose their most preferred energy solutions based on multiple and broad indicators and criteria. The preferences of stakeholders are then combined to rank order alternatives based on local acceptability and other factors determined by a similar preference ranking system.

This evidence suggests that energy planners perceive the role of engaging stakeholders insofar as enhancing or providing the necessary input to the planning process. Rarely observed is a normative paradigm of inclusionary planning: that is to include stakeholders as a given right for them to play a prominent role in the decisions that impact their lives.

None of the studies captured in this systematic review appear to engage participants as a process of legitimising the decisions that are made. Nonetheless this legitimacy classification of purpose is included in the framework as it is conceivable such circumstances may occur in situations not captured by this review.

4.3. Are participatory processes also more holistic?

We examined the seven participatory studies indicative of an empowerment agenda, and ask if these studies are more holistic than the wider sample considering selection criteria across the five dimensions. Interestingly, we do observe a different focus in this subset which manifests in the shape of the radar chart at Fig. 4, compared with that of the larger sample (see Fig. 2).

While there is evidence of a greater focus on socio-cultural and environmental factors in the planning process, these participatory

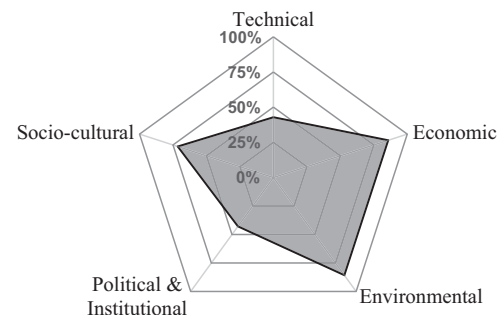


Fig. 4. Dimensions considered by participatory studies with an empowerment agenda, per cent of total studies.

studies with an empowerment agenda are less likely to address technical aspects. Only three of the seven studies demonstrated adequate consideration of technical factors. In relative terms this subset provided greater attention to political and institutional concerns than the total sample. However, these instances remained low at only three out of the seven studies. Hence on the one hand these participatory studies could be considered more human centred, on the other hand they fall short of the mark on technical concerns and political factors still remain under-examined.

Similarly, we looked at the three holistic studies that addressed all five dimensions and examined their level of participation. One such study developed a multi-criteria method using eight distinct criteria representative of all five dimensions to evaluate and select from 16 energy projects on rural farmland of Corsica island [51]. While the criteria considered were broad, this study did not appear to engage local stakeholders in the process.

Another example of a holistic approach is the process-oriented study published in 1997 applied to a case study in the Greek Islands [52]. This study aimed to investigate the trade-offs and compromise inherent in regional energy planning problems. Similar to the Corsica Island study, a multi-criteria decision process was developed to evaluate various electrification options and strategies considering human, technical, economic, political and social dimensions. This time, the procedure involved the identification and engagement of key actors in the decision process. The consultative style of engagement, whereby the authors carried out both formal and informal interviews and discussions among actors, focused on informing the methodological process rather than exemplifying a process of empowerment.

The third identified holistic study is the Bangladesh study [43] that we discussed in Section 4.1 above. This article published in 2013 is the only identified example that addresses all five dimensions while also participatory by design and illustrating an empowering agenda.

4.4. Energy planning practice and paradigms

We categorised each study in our database according to the publication year and thereby allocated it to its corresponding era or paradigm of energy access and development. This enabled us to identify the patterns and trends over time in energy planning processes, in particular how these trends correspond with contemporary paradigms on energy access and development. Fig. 5 presents three radar charts plotting the dimensions considered by energy planners for each year group that represent paradigm shifts over time.

The focus of energy planning studies in a distinct period in time changes little over the last forty years. As Fig. 5 shows, socio-cultural, political and institutional criteria have remained under-represented throughout the year groups. Only a very marginal increase in focus of political and institutional issues has been observed in the sustainable development paradigm, with 17% of studies since 2010 compared to 15% of studies in the market creation paradigm. So too has socio-cultural criteria remained under-represented over the three periods.

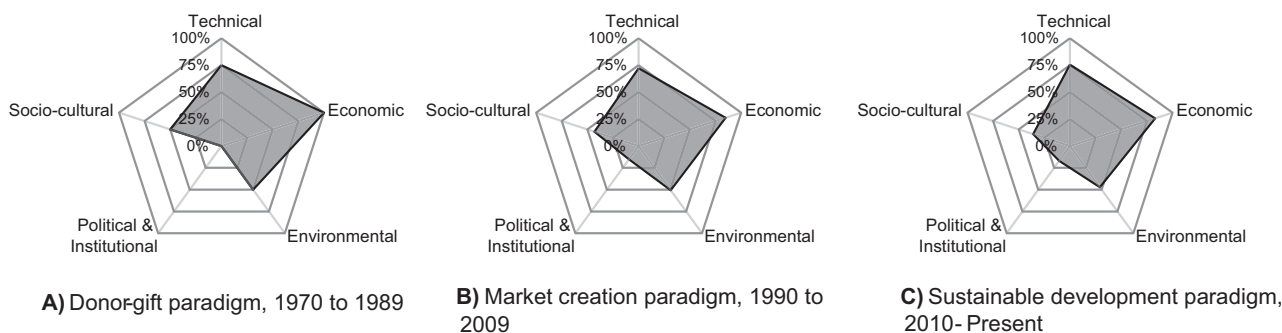


Fig. 5. Radar plot of literature categorised by era/paradigm as characterised by the 5 key dimensions.

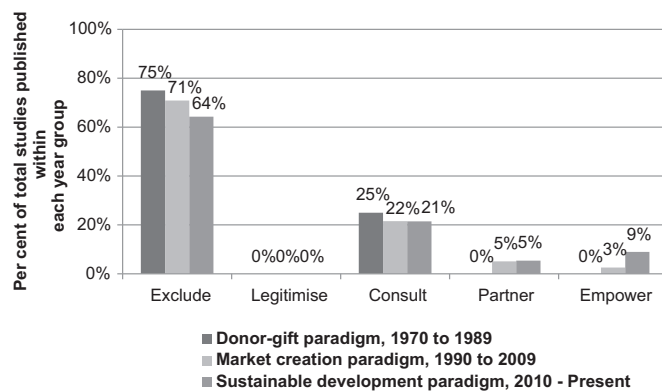


Fig. 6. Purpose for employing a participatory method in rural energy planning, by era.

36% of the studies published in the period since 2010 considered socio-cultural criteria in the energy planning process, showing only a minor change from 43% of studies published in the market creation era from 1990 to 2009. Interest in environmental criteria has remained consistent across the three eras, with roughly 50% of studies considering environmental issues. Despite the new paradigm emerging in recent years with calls for a greater emphasis on interdisciplinary research, we see little evidence of this thinking entering mainstream process-oriented energy planning literature. Noticeably, technical and economic criteria have remained dominant among energy planning studies across all three periods.

Whilst little has changed in terms of criteria considered by planners over the past 35 years, there are some changes noticeable in relation to the engagement of stakeholders in the energy planning process. Fig. 6 illustrates the purposes underpinning stakeholder engagement, across each of the distinct periods in time. Each bar in the figure represents the per cent of studies published within each year group that relates to a given purpose.

A slight trend is noticeable across the time periods toward a more participatory model of energy planning. Under the donor-gift paradigm of the 1970s and 1980s, 75% of studies were exclusionary – i.e. there was no evidence found in the text of these studies that planners engaged local stakeholders in the process. Slightly more initiatives applied a participatory process in the paradigm shift toward market creation in the 1990s and 2000s (71% of studies excluded local stakeholders), and evident once again in the shift to the sustainable development paradigm (64% of studies published since 2010 were exclusionary).

The form that these participatory processes have remained mixed across the three eras, although a slight shift is noticeable toward an empowerment agenda. During the era driven by a market creation paradigm, few examples (three per cent of studies published in the period between 1990 and 2009) have a discussion in the text consistent with an empowering agenda. Since 2010, nine per cent of the energy planning studies uses similar language in the text that may be taken as

a purpose of empowering communities to take ownership of the decisions that impact their lives. However, as we revealed in [Section 4.3](#), not all of these studies that are suggestive of an empowering agenda give attention to political and institutional, or socio-cultural considerations in the process, questioning if the language in the text fully reflects a change in paradigm.

Regardless, at least according to process-oriented literature we observe a trend toward greater inclusion and a greater fraction of those participatory processes representing a deeper level engagement that may be consistent with an empowerment agenda. To a large extent however, our analysis indicates that energy planners engage stakeholders predominantly for the purpose of consulting and the extraction of information.

5. Conclusions

Providing energy access to rural populations around the world is an enduring challenge. Planners are facing emerging and evolving challenges in the energy sector such as rapid changes in technologies, intensifying environmental concerns and impacts on and from a changing climate, and trends in population growth and migration. Further work is required to ensure energy planners are equipped with the appropriate tools and frameworks to navigate this complex system of trade offs and compromise with the intent of delivering long term, sustainable and meaningful energy solutions for those most in need.

This study undertook a systematic review of the literature to observe how energy planners, according to practice-oriented peer-reviewed literature, apply various methods to evaluate interventions in a rural energy context. Three key conclusions are offered.

First, rural energy planning processes emphasise techno-economic concerns at the expense of more human centred criteria. This is despite recognition that ignoring these localised socio-cultural and political issues jeopardises the sustainability of technical interventions. The delivery of energy access to rural populations should consider both human and technical factors and the complex and dynamic interactions between them. Reflecting on these broad dimensions in the planning phase will help to avoid unintended consequences and ensure the appropriateness and sustainability of projects. We suggest strengthening the capacity of energy planners to examine and model complex socio-ecological, technological and political interactions of rural energy solutions that taken together may determine the longevity of energy interventions.

Second, based on evidence from the literature we find that the approach towards rural energy planning remains typically non participatory. Less than a third of cases engage stakeholders in the process of identifying and proposing appropriate energy solutions. Of those studies that do reflect a participatory model, the majority are driven by the purpose of consulting stakeholders to extract information and provide input to the planning process. This suggests that the few occasions when participation plays a strategic role in energy planning, the engagement remains shallow and one-sided, with the needs of the end user often presumed and their roles prescribed. In a very limited number of cases from our database, stakeholders were engaged from a normative purpose of transferring power and ownership over the decision making process.

The use of this framework advocates for an open and transparent debate on the role of stakeholder participation, and an appreciation for the distribution of power and influence that result. This will invoke a greater discussion and debate on the pros and cons of adopting an agenda of empowerment through energy planning.

Third, our findings suggest that the typical approach to rural energy planning remains out of step with contemporary paradigms of development. The focus for energy planners committed to this emerging paradigm is therefore placed on supporting energy services, enabling local income generation, and achieving institutional and social needs. Consistent with this thinking, one may expect to observe a greater

emphasis on interdisciplinary activity and the participation of stakeholders in the energy planning process over recent years.

In contradiction our study reveals little change from the techno-economic focus of energy planning studies of the past 35 years, including the recent period from 2010 to 2016. We do, however, find evidence to suggest energy planning processes are trending slowly toward a more inclusive and participatory model of planning, alongside an emergent emphasis on energy empowerment within the sustainable development paradigm. We advocate for mobilising a new research agenda on understanding the role of empowerment in energy planning. Research questions that may fit such an agenda include: how would a business, non government or government led institution map their own engagement strategy in energy planning according to this analytical framework? To what extent is this representative of common practice in rural planning broadly such as water, health or agricultural infrastructure development? And what are the implications on the long term sustainability or otherwise of the rural energy solutions that have been carried forward?

Recent energy literature continues to remind us of the complex and dynamic nature of the rural energy challenge, and the need to engage local stakeholders for a better understanding of these issues. Yet evidence provided in this paper highlights an opportunity to better integrate these lessons into how we approach energy planning and decision making in a rural and remote context.

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