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UNIVERSITÄT LÜNEBURG

***Designing knowledge-action networks for supporting energy focused
sociotechnical change in illiberal democracies:***

*Interfacing science, policy and transformation processes towards sustainability in
Andean Countries.*

*Der Fakultät Nachhaltigkeit der Leuphana Universität Lüneburg zur Erlangung des
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DEDICATION

To my father, Dr. Xavier Eduardo Noboa Chaves, my inspiration, who taught me the value of knowledge and hard work, this achievement is fruit of his example and love. He sadly passed away during the development of this scientific research.



February 1946 – September 2017

DECLARATION

I, Eduardo Noboa Campana, declare that the work presented in this thesis is my own. Information that has been derived from other sources, I confirm has been clearly indicated in the thesis.

Lüneburg, June 2019

A handwritten signature in blue ink, appearing to read 'Eduardo Noboa Campana', with a horizontal line underneath.

Eduardo Noboa Campana

ACKNOWLEDGMENT

To start, I would like to thank my wife, Paola Maya and my children Agustina Noboa and Tadeo Noboa, for their support and for the many sacrifices they have made during the time I was developing this research project. Without their unconditional love, this journey would have been extremely difficult if not impossible.

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SUMMARY

The energy sector is regarded as one of the decisive subsystems influencing the future of sustainable development. Consequently, there is a need for a comprehensive transformation of energy generation, conversion and use. The importance of building capacities for energy policy development in developing countries is bound up with the need to formulate global strategies to meet the challenges that humanity face, especially to achieve the targets manifested in the Agenda 2030 and Paris Agreement.

The aim of this research is to better understand how to empower marginalised key societal actors, co-produce alternative discourses about energy futures and articulate those discourses to influence policy change within a context of illiberal democracies in Latin America. The research concerns the design, function and effectiveness of scientifically grounded participatory process, which has been justified theoretically and tested empirically.

The process presupposes theoretical perspectives relating to theory, method and empirical application. The first draws on theories of sustainability transition and transformation, including transition management. The second draws on ideas taken from the knowledge co-production and transdisciplinary sustainability research. The empirical application, concerns the implementation of a Transdisciplinary Transition Management Arena (TTMA) and its effectiveness, measured by potential for the co-production of knowledge and for stimulating collective action.

As result of the process, a conceptual model of the energy system, long-term visions and transformation strategies were developed. The TTMA processes demonstrated that cross-sectoral and inter-institutional, combined efforts, can help actors visualize possible, future alternatives for sustainable energy development and how to realize such alternatives. The structures provided were helpful for the emergence and empowerment of new sustainable-energy-transition coalitions in both Ecuador and Peru.

Chapter 1 describes the general context in which this scientific project is developed and presents a synthesis of the processes and its main outcomes. The research results are described in detail in the scientific papers presented in chapters 2,3 and 4.

ZUSAMMENFASSUNG

Der Energiesektor gilt als einer der entscheidenden Einflussfaktoren für die Zukunft einer nachhaltigen Entwicklung. Folgerichtig besteht die Notwendigkeit einer umfassenden Transformation der Bereiche Energieerzeugung, -umwandlung und -nutzung. Die Bedeutung der Schaffung von Grundlagen für die (Weiter-)Entwicklung der Energiepolitik in sog. Entwicklungsländern steht im Zusammenhang mit dem Erfordernis, globale Strategien zur Bewältigung der Herausforderungen zu formulieren, mit denen die Menschheit insbesondere im Rahmen der Erreichung der UN Agenda 2030 und den Zielen des Pariser Übereinkommens konfrontiert ist.

Ziel dieser Forschung ist es, besser zu verstehen, wie marginalisierte gesellschaftliche Schlüsselakteure befähigt werden können, alternative Diskurse über die Zukunft der Energie mitzugestalten und ob und wenn ja wie solche Diskurse, einen politischen Wandel in illiberalen Demokratien in Lateinamerika katalysieren können. Diese Arbeit befasst sich mit der Gestaltung, Funktion und Wirksamkeit eines wissenschaftlich fundierten Partizipationsprozesses, der theoretisch begründet und empirisch getestet wurde.

Der Partizipationsprozess setzt drei Perspektiven in Bezug auf Theorie, Methode und empirische Anwendung voraus. Die erste Perspektive stützt sich auf Theorien zu nachhaltigen Transitionen und Transformationen, einschließlich des Transition Management. Die zweite Perspektive stützt sich auf Forschungsergebnisse zur Ko-Produktion von Wissen in Gruppenprozessen und Ideen aus der transdisziplinären Nachhaltigkeitsforschung. Die dritte Perspektive betrifft die Implementierung einer „Transdisciplinary Transition Management Arena“ (TTMA) und die Bestimmung deren Effektivität, gemessen am Potenzial für die gemeinschaftliche Produktion von Wissen und der Stimulierung kollektiven Handelns.

Als Ergebnis des Prozesses wurden ein konzeptionelles Modell des Energiesystems, langfristige Visionen und Transformationsstrategien entwickelt. Die TTMA-Prozesse haben gezeigt, dass gemeinsame Sektor übergreifende und interinstitutionelle Anstrengungen den Akteuren helfen können, mögliche zukünftige Alternativen für eine nachhaltige Energieentwicklung aufzuzeigen und zu realisieren. Die bereitgestellten Strukturen haben in Ecuador und Peru zur Entstehung neuer Koalitionen für den Übergang zu nachhaltigen Energien beigetragen.

Kapitel 1 beschreibt den allgemeinen Kontext, in welchen diese Forschungsarbeit einzuordnen ist und stellt eine Synthese des Prozesses und seiner wichtigsten Ergebnisse dar. Die Forschungsergebnisse werden in den wissenschaftlichen Artikeln in den Kapiteln 2, 3 und 4 vorgestellt und ausführlich beschrieben.

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CHAPTER 1

ASSEMBLING THE RESEARCH SPHERE

1. Introduction:

This doctorate thesis articulates, implements and evaluates a design for a knowledge-action network that is based on various theoretical approaches, particularly transition management and transdisciplinary sustainability research. The aim of thesis is to illustrate how processes of change towards energy sustainability may be stimulated when applying 'scientifically-guided participatory processes' in contexts where democratic rights are constrained and state institutions are facing circumstances in which they are potentially captured by commercial interests and clientelism (Smith and Ziegler, 2008).

Chapter 1 synthesizes a sustainability research process that has been developed for and applied to the purpose of this doctorate thesis. It explains the overarching questions, objectives, methods and results that have been interpreted, tested and evaluated during the scientific process.

The Transdisciplinary Transition Management Arena (TTMA) framework was developed during the first research phase. It is comprehensively described in Chapter 2 and is based on transition management and transdisciplinary research perspectives, which are additionally complemented with theoretical aspects derived from political science and social psychology (Noboa and Upham, 2018).

The TTMA framework was put into practice in processes where a context-specific participatory research method was applied. These processes took place in Ecuador and Peru. It involved policy entrepreneurs, whose interaction built knowledge and capabilities, created networks of social capital and generated alternative discourse coalitions in the respective countries. The particular focus was on processes for the

development of low carbon energy scenarios in Latin America, yet the framework could also be adapted to other contexts.

The combined insights from various conceptual approaches offer a mechanism for engaging with local stakeholders and developing energy policy understandings, visions, and intervention strategies if policy windows arise.

Chapter 3 describes the application of the TTMA framework in Ecuador. Civil society and other stakeholders convened in a protected transition space for policy development - outside of formal institutions - in order to engage in envisioning new energy futures. The knowledge co-production process was documented, interpreted and evaluated, yielding an analytical framework which can be used to guide energy transition policy analysis in similar contexts (Noboa et al., 2018).

Chapter 4 describes the implementation of the TTMA framework in Peru, where a vision of a decentralized, resilient and low-carbon national energy system was developed. The Peruvian example focuses on understanding the characteristics of such fora, and how they can empower policy entrepreneurs to generate knowledge that can give rise to coalitions for change (Noboa et al., 2019).

It is yet to be seen to which extent such experimental arenas can exert political influence in the medium and long term. Nevertheless, the TTMA processes demonstrated that they are effective for establishing an initial phase of socio-political readiness and knowledge co-production. Furthermore, they have the potential to legitimize informal institutional efforts aimed at energy policy change.

The energy visions that were produced by participants in the cases of Ecuador and Peru favoured distributed renewable and sustainable energy generation, decentralised decision-making at the subnational level, participatory energy planning

governance and heterogeneous poly-technological solutions at small and medium scales, ascertaining that TTMA processes produce more democratic and sustainable solutions.

2. Global sustainability context

The current global political-ecological situation is constituted by multiple crises, which are caused by the ever-growing exploitation of natural resources, fuelled by fossil capitalism markets (Malm and Hornborg, 2014) and the undervaluation, exploitation and societal separation of ecosystem services. As shown by (Steffen et al., 2015), this has caused us to edge closer to and even step over the earth's planetary boundaries.

At stake is the limit of the planetary capacity to generate conditions for the production of environmental goods and services that allow for the existence of plant and animal life, putting at risk the security and subsistence of humanity itself (Figure 1).

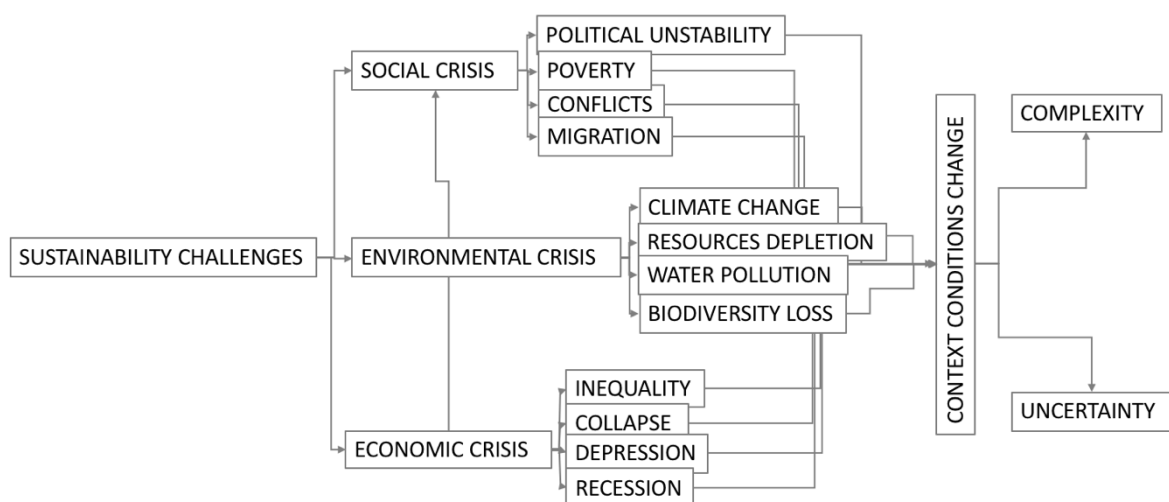


Figure 1: Sustainability challenges and crisis (based on Steffen et al., 2015)

Such crises are known as sustainability or 'wicked' problems'. Such problems cannot always be traced to a singular cause or ascribed a singular effect. This is due to their systematic nature and how their causes and effects are connected to many places simultaneously (Head and Alford, 2015). To find one 'complete' solution is difficult. Therefore, solutions to these problems must take into account a number of actors and stakeholders, as well as question the mainstreamed systems in which they exist. The challenge is to create situations and environments, where we are able to overcome these problems, through transformative efforts which change the current status quo and form new patterns of interactions (Patterson et al., 2017) in order to find sustainability-oriented solutions.

2.1 Global political frameworks towards sustainability

In recent years, efforts to address climate change and the unsustainability in our global system have taken place on an international platform. 2015 was an important year globally for agenda setting. Firstly, the United Nations' 17 "Sustainable Development Goals" (SDGs) and the 21st Convention of the Parties (COP21) were finalized in Paris, resulting in 'The Paris Agreement', which stated that global warming should not exceed 2 - 1.5 degrees, post-industrial levels, so as to prevent 'catastrophic warming'. The agreement also set out parameters for and the creation of sustainable societies. The importance of the Paris agreement, as well as the 2030 Agenda, cannot be overstated. Because of the adoption of the SDGs and the new international climate Paris Agreement, 2015 will go down in history as a crucial year in the quest to place human development on a more sustainable corridor (von Stechow et al., 2016).

2.2 Agenda 2030: Sustainable Development Goals

International agreements and the SDG's have set short time frames in which change has to take place. In order to achieve these goals, sustainability has to be understood as an integrated approach, which is open to adopting new ways of governance.

The 2030 Agenda for Sustainable development synthesised and represented the greatest challenges into 17 Sustainable Development Goals (SDGs). Heads of state and representatives of the United Nations agreed on the goals in September, 2015 in New York City, USA. The UN states that the goals were designed to build “upon the achievements of the Millennium Development Goals (MDGs) and to address their unfinished business to achieve sustainable development in its three dimensions - economic, social and environmental - in a balanced and integrated manner” (UN, 2015). These goals, in addition to building on previous success, also addressed the flaws in the MDG's.

The SDGs recognise that the previous 8 goals could not address all sustainability challenges as their focus was, firstly, anthropocentrically and economically focused (Kumar et al., 2016). Secondly, they did not account for a geopolitical framework as the goals were directed only at the global south, meaning that they failed to take into account north-south relations, choosing instead to ignore the global north's role in creating social inequality and environmental problems, as well as the communities in the global north who experience relative poverty. Finally, they turned a blind eye to the actions of those trapped in patterns of socially and environmentally destructive behaviour and how such behaviours affect global systems, especially in the global south (Vallejo and Wehn, 2016).

As demonstrated in the scientific review of the 17 Sustainable Development Goals (SDGs) and 169 targets, prepared by the International Council for Science (ICSU) in

partnership with the International Social Science Council (ISSC) and submitted to the UN General Assembly by the UN Open Working Group (OWG), many of the targets may also contribute to numerous goals, and some goals and targets may be contradictory. In short, they all have synergies and trade-offs (Le Blanc, 2015). The attempt to meet one target could have unintended consequences for others if they are pursued independently. "Most of the goal areas are interlinked, where many targets might contribute to several goals, and that there are important trade-offs among several goals and targets. By tackling targets in an integrated manner, the desired results can be achieved for many targets" (ICSU, 2015). "Goals and targets can be seen as a network, in which links among goals exist through targets that explicitly refer to multiple goals" (Le Blanc, 2015).

2.3 The Paris Agreement

The Paris Agreement and the 2030 Agenda were established in December 2015 at the Paris Climate Conference of the Parties (COP21). 195-member countries adopted the first universal compulsory global climate deal. The agreement sets out a global action plan that includes, among other things, the implementation of mitigation and adaptation measurements, appropriate technology transfer mechanisms, capacity building, and sufficient financial resources to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C (UNFCCC, 2015). Under the agreement, each nation is to contribute Intended Nationally Determined Contributions (NDCs) which are then fed back to the UNFCCC in order to foster transparency and compliance.

The legal character of the Paris Agreement and the extent to which it can enforce compliance is complicated. Although the Paris Agreement is a treaty under the Vienna Convention Law on Treaties, the law does not apply to all provisions. The Paris Agreement is simultaneously mandatory and non-mandatory because not all

rules can be enforced with sanctions and domestic law. Although states must submit NDCs they the emission targets are not legally binding. While there is an obligation to communicate efforts, economy-wide mitigation efforts are recommendations, as absolute emission reductions are seen as a goal to pursue rather than a goal to achieve (Article 4.4). Compliance and transparency however can be enforced through non-legal institutions and pressure from other nations (Bodansky, 2016). Participation is also not legally binding, and nation states were given three years to opt out. So far, the USA is the only country to choose not become a signatory (Schleussner et al., 2016).

2.4 Interconnection of Agenda 2030 and Paris Agreement

Global climate policy and SDG agendas are highly interconnected: the way that the climate problem is addressed drastically affects the likelihood of meeting several SDGs and vice versa (von Stechow et al., 2016). These global political frameworks are accepted by and applicable to all developed and developing countries who become signatories, while taking into consideration “different national realities, capacities and levels of development and respecting national policies and priorities” (UN, 2015). Both instruments, the 2030 Agenda and the Paris Agreement, contain universal objectives which require a progressive and incremental transformation of our social-ecological and socio-technical systems towards sustainability. For the applicability of these global instruments, the agreements have to be subsequently adapted to the respective multi-level (regional, national, local) and sovereign policy frameworks of the member countries.

The climate change summit in Paris, as well as the 2030 Agenda for Sustainable Development, take for granted the fact that, to keep the temperature from rising less than 2 °C, we will need to transform the global energy sector. At the global level, energy systems are migrating towards largely decentralized models - with important

roles for wind, solar and storage. With the help of Incentive policies, the deployment of non-conventional renewable technologies has reached a level of technical-economic development, in which photovoltaic and wind systems are competitive with traditional sources of electricity generation. However, at the same time, low oil prices threaten the financial viability of clean technologies that are not yet fully capable of competing. The processes of policy formulation, and their respective regulatory and institutional frameworks, must be responsive and transform in tandem with global system dynamics. Such changes can include other investment mechanisms, new business models and social innovation to turn end users into active agents of the system and potential energy producers (Bidmon and Knab, 2018).

2.5 Energy Sustainability

By taking a closer look at SDG7, "Clean and Affordable Energy", synergies and trade-offs can be better understood. (Fuso Nerini et al., 2018) noticed that 113 (65%) of the targets relied on actions to be taken regarding energy systems. In addition, there were twice as many synergies for SDG7 than in the other goals, meaning that if this goal was ignored for the sake of another would have detrimental consequences on many of the goals that relate to human wellbeing. This is because energy exists within, "constellations of social practice" (Shove and Walker, 2014).

Energy is essentially what fuels society (Figure 2) (our heating, electricity, industrial processes, hospitals, government buildings, trade, etc.). On the one hand, it is seen as a technological "driver" or precursor to societal and institutional change (Lawhon and Murphy, 2012) (Mazur et al., 2015). On the other hand, it is intertwined with, and itself mutually affects and is affected by, ongoing social reproduction.

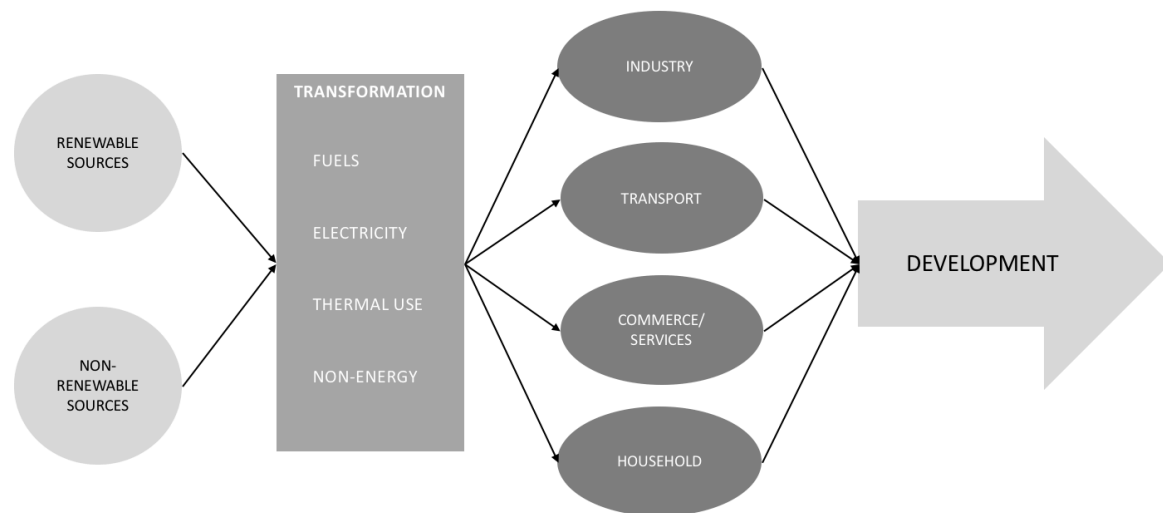


Figure 2: Energy fuelling societal development (based on Davis et al., 2010)

In short, it is an ‘ingredient’ that constructs society and is constructed by interlinking social practices and is, therefore, an essential element of everyday life (Shove and Walker, 2014). However, when the environmental factors are brought into the equation in discussions of SDG7, the Sustainable Development becomes more complex. (Fuso Nerini et al., 2018) found that SDG7 has 46 environmental synergies and 36 trade-offs. Despite these trade-offs action still has to be taken on SDG7 so as to make sure that other goals and other international agreements, such as the 2°C limit on global warming as stipulated in the Paris agreement, are met.

This research will focus on developing an understanding of energy system change in developing countries as a key cross-cutting process that could dynamize and influence sustainability transformation in other sectors and regions. Multiple factors have determined the need for an integral transformation in the field of energy production and utilization, considering energy as one of the main engines that drives the processes of economic development and fosters the welfare of human beings. The importance of building capacities for policy development in developing countries is bound up with the need to formulate global strategies to meet the challenges that

humanity face, especially as they pertain to the efficient management of natural resources, global warming, and the consolidation of new circular economic models (Folke et al., 2002).

The global, regional and national energy structures are influenced by the changing dynamics of postmodernity and connected to the economic, social, technological, political, regulatory, institutional and environmental processes. The complexity and speed of these changes renders tomorrow uncertain, forcing us to look for new ways to understand the multidimensionality of the energy system as a sustainability problem. These changes, moreover, force us to anticipate possible future scenarios and develop strategies to reform processes and redirect objectives towards a sustainability transformation with the democratic participation and articulation of societal actors and a new social contract for sustainable energy development (Schellnhuber et al., 2011).

Climate change, non-renewable resource depletion, ecosystem degradation, oil price volatility, technological development and global geopolitical and local socio-political processes of energy governance are restructuring energy systems. Predominantly centralized systems, which rely only on fossil fuels, should be replaced by systems which are heterogeneous in nature and depend mainly on renewable energy. Such a transition however, involves fundamental changes at a social, cultural and institutional level, from the point of view of consumption, as well as in the ownership, control and production of energy (Kemp and Rotmans, 2009).

The unsustainability of the current energy model creates an uncertain and complex future. Such uncertainty has triggered a voracious and urgent competition for the control and management of the planet's natural resources with the aim of converting the planet's resources into energy products to satisfy economies and maintain the excessively high standard of living of developed countries (Omeje, 2008).

(Wallerstein, 1976), in his thesis on the World-System, describes how in modern societies an economic-social-ecological dynamic has been installed and institutionalized which demands the subjugation of peripheral societies for the sake of those societies at the centre. According to Wallerstein's, peripheral societies are those nations that possess a wealth of raw materials (e.g. energy resources) - in most cases non-renewable natural resources - while, central societies are those nations which set the rules of the game by maintaining cultural, scientific, market, and political hegemony.

Thus, in line with the aforementioned dynamics, the central countries control the trade of finished goods, that is, goods produced with energy, raw materials and labour from peripheral societies. The peripheral nations, for their part, control only the exploitation of their resources, and are also, paradoxically, markets for these goods. That is, they acquire finished goods that have already been given a surplus value, in addition to the value incurred through operating costs, transactional values and tariffs. Furthermore, central countries, also market knowledge and technology, creating technological dependency (Svampa, 2015). In the end, what is produced from the central societies generates profits in their favour. Peripheral countries are left with two alternatives: either increase the extraction of their natural resources - such as primary energy products (e.g. oil, gas) -, or go into debt (Redding and Schott, 2003).

Many social, economic and health indicators demonstrate that this dynamic generates wealth, well-being and satisfaction, worldwide for various modern societies. Since modernity itself, as (Baudrillard, 2016) suggested in his essay on consumer society, is an invention of the hegemonies, demands and the creation of needs obey the logic and interests of elites; the same ones that, at present, are no longer confined to a single territory but are transnational and are often wealthier than

even the wealthiest nations (Swilling et al., 2015). These are also the people and corporations that control financing mechanisms and investments, industries, and their value-added processes (including incessant advertising in mass media), as well as commodity markets. At the same time, such dynamics generate poverty, inequality and ruin in the peripheral countries that deplete their natural resources, exhaust their indebtedness capacities, and miss the opportunity to base their economies on sustainable alternatives (Evans and Phelan, 2016).

This global dynamic is well reflected by energy systems and has multi-level characteristics, that is to say it is repeated at regional, national and local scales. The elites that control non-renewable natural resources at the national level (e.g. interest groups linked to oil and mining) have evidently developed an articulated network and institutional frameworks around the extractive industry. The institutional framework is based on coalitions made up of networks of actors (connected to the international networks) of different sectors of society such as government, public and private companies, and other beneficiaries of the system that obtain income and profit from the status quo. In addition, there are rules of operation, laws, and standards that support the stability of the system as such and function as a bulwark against change (Smink et al., 2015). With the above factors in mind, it becomes clear that we need to develop arenas that can help support political and policy change. In the next section, we sketch out how such arenas might be instituted and developed.

2.6 Sustainability transformation discourse

Despite the progress on sustainability since Rio de Janeiro's first Earth Summit in 1992, including the continued growth of sustainability-awareness within political spheres, accompanied by global policy instruments (2030 Agenda, Paris Agreement) and national institutional and regulatory frameworks, the actions taken by states, companies and civil society have not altered the unsustainable dynamics of our modern system. More ambitious sustainability-oriented policy is needed in order to initiate a greater transformation. Hence, sustainability ends up being an essentially political issue, requiring collaborative and innovative policy-making with a pluralistic perspective (Heinrichs et al., 2015) (Figure 3).

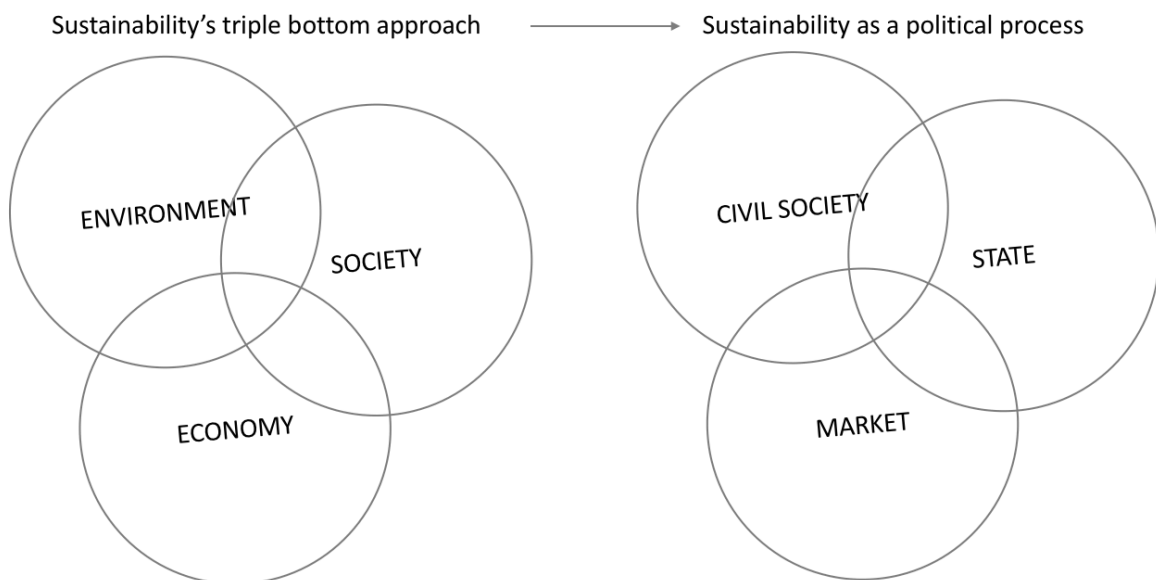


Figure 3: Sustainability as an essentially political issue (based on Heinrichs et al., 2015)

In that sense, international frameworks must also be understood through definitions of sustainability and the thought processes from which they emerged. Discourse today focuses on sustainability as a 'mind-shift' in the modes of governance in order to transform unsustainable local and global systems. However, since the Brundtland

Report of 1987 defined Sustainable Development as the achievement of intra- and intergenerational justice, it has been both criticised and redefined a number of times. Critics have focused on the dichotomy between the term 'Sustainability' and 'Development', when framed as exponential economic growth. Authors suggest that the two cannot be at harmony with one another, especially when 'development' is seen as wholly synonymous with an economic growth that is dependent and built upon the exploitation of the environment and labour (Keeble, 1988). If sustainability transformations truly seek to change current systems, they must look beyond conventional ideas of development which privilege the economy, at the expense of the environment and less economically privileged nations and people (Gladwin et al., 1995).

Sustainability is generally regarded to include three aspects: environmental, social and economic, all of which must work together and not independently of one another. Here, the function of the economy should be subverted (Figure 2). Instead of the economy dominating environmental and social systems, it should operate within their limits (Göpel, 2016). This visualisation moves away from previous approaches of the 3 pillars of sustainability, that were established in Rio in 1992. In the past, each "pillar" was understood as three separate, and seemingly equal constituents, all of which contributed to sustainability. The new approach visualises each component as being related intricately related to on one another, where no single part is more important than another. When these three areas are placed together, it demonstrates the multidimensional nature of sustainable systems and the intricacies of creating transformative pathways that are interdisciplinary in nature.

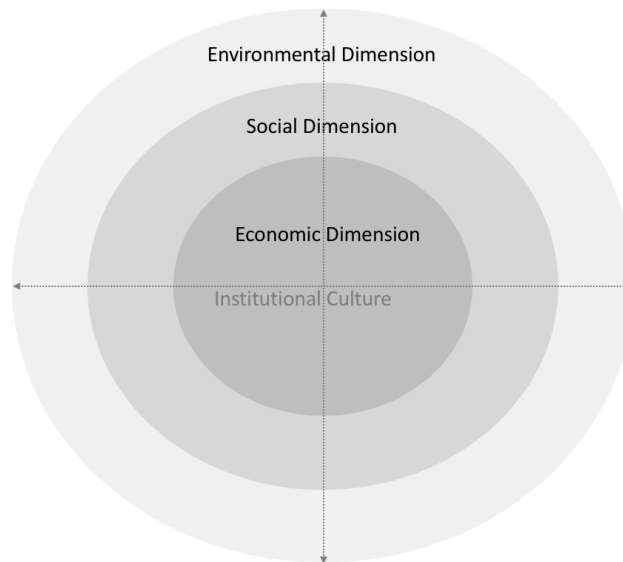


Figure 4: Towards a new sustainability approach (after Göpel, 2016)

More recently, a fourth aspect, institutions, has been suggested as a way to deepen definitions of sustainability (Law and 2007, n.d.). It draws on both the social and technological change that has to occur within systems and recognises the role that institutions play in navigating action that can realise goals and sustainable realities (Figure 4).

In some ways, sustainability is still understood just as it was in 1987: namely, an intergenerational project which takes place in the present. It is an way of coming to grips with and meeting the present needs of societies, without jeopardizing the needs of future generations, whilst maintaining the integrity of natural systems (Keeble, 1988). Yet, in many ways, such definitions fail to conceptualise the transformative change that needs to take place within institutions within a short time frame. Discourse on sustainability transformations can help to push such limits. By bringing to light the complex and often destructive relations and functions of socio-ecological-technical systems (Mühlemeier and Binder, 2016), it recognises the need to create

new interactions among institutions, actors, disciplines and human and biophysical systems (Patterson et al., 2015).

2.7 Transition Management and Transdisciplinary Research

Transition management is intended to provide fora in which the main actors of specific transitions can collaborate in generating new futures, with such fora paralleling formal institutions (Loorbach, 2010). By linking the concepts of transition management and transdisciplinary research (Scholz and Steiner, 2015), this study explores ways to increase the diversity of knowledge taken into account in energy policy planning and the range of actors involved. Knowledge and actors are seen as particularly relevant when dealing with uncertainty and normative ambiguity in the context of problem-solving or solution-oriented process regarding 'wicked' problems (Valkenburg and Cotella, 2016).

The research connects transition management and transdisciplinary sustainability research practice by focusing on the processes of collaborative knowledge creation. Whereas transition management provides the macro-framework for the steering of societal change, transdisciplinary research provides us with the specific tools and methods for the co-production of knowledge by stakeholders operating in a specific context of analysis (Wiek and Lang, 2016).

In order to produce socially-robust solution-oriented knowledge for sustainable transformation via mutual learning, social reflexivity and empowerment (Scholz, 2017), transdisciplinary sustainability research literature seeks the integration of the differing epistemics held by scientific researchers and practitioners, where the researchers act as catalysts within the transition process. In a complementary manner, transition management focuses on the system framing for those societal process of change (Scholz and Tietje, 2002).

Based on the notions of Transdisciplinary Sustainability Research, a proactive state is ideally searching for participatory means of solution-oriented knowledge co-production processes that can be subsequently applied by the energy sector's decision-makers as a result of an effective science-society-policy interface network dynamic (Scholz and Steiner, 2015).

The knowledge-outcomes from this dynamic are (ideally) to be translated into policy-efforts designed to contribute to the achievement of profoundly interlinked goals (SDGs, Paris Agreement) of sustainability at a global, regional, national and local level (Hadorn et al., 2008). This transdisciplinary process is thus intended to support the development of new visions and the conceptualisation of implementing measures. The process is intended to empower change agents and, in particular, by providing access to power (Scholz, 2017).

Transition management has been developed and tested in Europe. Much less work has been carried out within this frame in developing countries in the Global South, where state institutions confront captured by commercial interests, clientelism and democratic rights are often limited (Smith and Ziegler, 2008). This research argues that, by putting together the approaches of transition management and transdisciplinary research, a basis for the co-production of policy strategies can be developed to take advantage of the policy windows (Kingdon and Thurber, 1984) that may arise periodically (Zahariadis, 2007). The study develops and applies a conceptual framework to support such strategies that stresses the role of knowledge brokers as energy policy entrepreneurs, helps to build capacities, articulate supportive networks, and develop alternative discourses (Klein, 2015).

2.8 Latin America context: Illiberal Democracies

The literatures of Transitions Management and Transdisciplinary Research advocate for 'experimental' fora and science-practice co-production processes in which possibilities for sociotechnical change can be explored amongst multi-sector stakeholders (Frantzeskaki and Kabisch, 2016). These have been variously theorised (Kemp et al., 1998)(Smith et al., 2014)(Raven et al., 2016) but, to date, the contexts have been predominantly in developed countries with relatively well-functioning democracies. Here, we develop and discuss a forum suitable for supporting multisector energy focused sociotechnical change in Latin America where illiberal democracies (Smith and Ziegler, 2008) are represented by weak state institutions which have often been captured by commercial or clientelistic political interests (Hellman et al., 2003); contexts where democracy is institutionalised, but where its expression is considerably inhibited, which include a multifaceted combination of authoritarian and democratic features (Hagan, 2017)(Noboa and Upham, 2018).

Latin America, as a specific context of analysis, is a geographically diverse region that emerged from state-centred dictatorships in the 1960's and underwent private-centred externally-driven neoliberal reforms in the 1980s. The transfer of assets from state to private hands has done little to increase market efficiency and productivity or to reduce the oligopolistic order of many Latin American economies. Rather, oligopolies and centralization have intensified, state and private incumbent networks have merged, connecting to international interests to transnational companies. Strategic resources governance models shifted from state-centralized to private-centralized and vice-versa. However, apart from the ownership of assets (including energy resources), closed networks of public-private actors continued to control the management of resources to the conjoint profit of a small number of parties (Bulmer-Thomas, 2003).

This study considers the particular cases of two Andean countries: Ecuador and Peru. Ecuador is a relatively small country with a stable state-centralised energy regime and a small number of energy system actors mainly connected to the government. Peru has a private-centralised system with a stable energy regime composed of a small group of incumbents who are primarily connected to the business sector. Both countries share characteristics of centralisation and state-capture but take different approaches to governing. While Ecuador nationalised infrastructure and state-control, Peru has privatised infrastructure and transnational corporation-control (Larrea, 2012)(Ríos Villacorta, 2016).

These policy-making oligopolies in Ecuador and Peru incentivize fossil-fuel-based infrastructure (oil and gas) and centralised large hydropower plants development. The international capital flows are connected to vested interests and have been configuring the energy infrastructure creating path dependence, technological lock-in and long-term debt for a long period of time (Burchardt and Dietz, 2014).

The profit from these energy-transactions has been mainly absorbed by transnational coalitions, which are connected to national incumbents. This unsustainable, centralized-(neo)extractive model alternates between a fossil-based system to a large-scale-hydropower-based system and vice-versa--processes which are controlled by interconnected interest groups that use similar financial leverage approaches to capture investments and revenues (Svampa, 2015).

Values, beliefs and interests of the incumbent state-market-alliance oligopoly are represented in the energy policies that subsequently structure the energy system. Civil society groups have different views, perceptions, understandings and visions of the energy problems, with preferred future alternatives and policy roadmaps. Despite often sharing common interests, they do not usually work together to intervene in the

policy-making process. Similarly, strong sustainability-based coalitions, counter-hegemonic discourses, and alternative guiding visions are in short supply (Markard et al., 2016). Under such conditions, there is little room for the development of non-conventional renewable energy, the decentralization and democratization of energy, the distribution of employment generation, or for discussions concerning energy justice and wealth distribution (Hendriks, 2009).

The expression of a range of values in the policy-making processes (Stirling, 2008) has been discussed in academic literatures which deal with sustainable and technological development (Wynne, 1973)(Rip, 1995). A more collaborative, innovative and pluralistic political process is needed to address unsustainable patterns of development; one in which sociotechnical, techno-economic, and political dimensions are intertwined (Cherp et al., 2018) (Smith et al., 2005). This is even more necessary in illiberal democracies, contexts that are connected to unsustainable configurations (Figure 5).

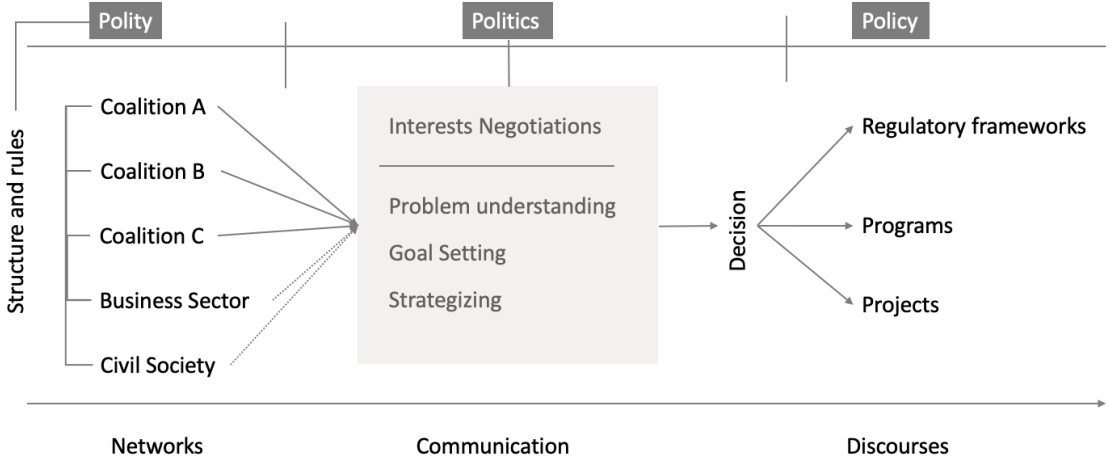


Figure 5: Policy-making process including other sectors (based on Sabatier and Jenkins-Smith, 1993)

With the above in mind, this thesis rests on a number of premises, including the following:

- Empowering civil society can help to support energy transitions in Latin America, by expressing a wider range of values.
- The developmental model of the Ecuadorian' energy system is unsustainable and (normatively speaking) needs to change.
- Energy transition takes place in the context of a complex system in which actors and their interrelations are distributed at different levels and dimensions.
- The energy sector in Ecuador is highly vulnerable to exogenous factors such as the volatility of oil prices, due to the current dependency on fossil fuels for energy generation and high costs related to fossil fuel subsidies, making the energy transition in principle a national priority.
- Energy technology innovation systems are not yet developed in Ecuador; thus, relevant technological innovation depends on actors at the global scale.
- There is no articulation of like-minded actors from different sectors that promotes alternative discourses about sustainable energy development in Ecuador.

3. Research aim

It is the aim of this research to better understand how to empower marginalised key societal actors (academia, civil society and private organisations), co-produce alternative discourses about energy futures and articulate those discourses to influence policy change, by developing, applying and assessing a process whereby civil society stakeholders and other marginalised actors may reflect, anticipate and integrate perspectives and co-produce knowledge of energy futures from within a context of state capture (Noboa and Upham, 2018).

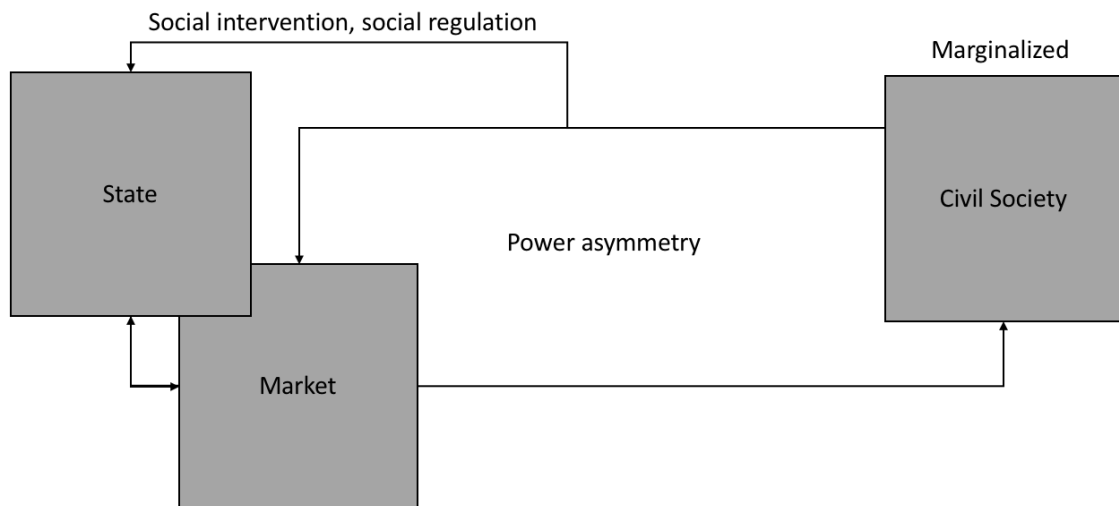


Figure 6: The context of state capture (based on Hellman et al., 2003)

Civil society can be empowered through the establishment of a platform, in which actors can articulate cross-sectoral partnerships among societal groups, business organisations, academia and governmental actors. These experimental supportive networks dynamize the co-construction of policy roadmaps and disseminate this knowledge so as to trigger socio-technical change.

In relation to the afore mentioned conceptual framework, this research explores both theoretically and practically how to configure an empowered constellation of change agents from different sectors, who can then co-produce actionable knowledge, build transformative leadership capacities and jointly engage in socio-political processes of change.

4. Research objectives and questions

The research objectives concern the design, function and effectiveness of scientifically grounded participatory process, which has been justified theoretically and tested empirically. More specifically, we seek to assess how effective such arenas are in terms of (a) the extent to which knowledge about energy system

problems, visions and transformation strategies is produced; (b) the level of satisfaction of participants with the methodology of the process and the quality of the outcomes; (c) the extent to which the process may support long-term cooperation among stakeholders; and (d) any lessons that may be gleaned for the design of such processes in future.

The set-up and design of the process draws on the combination of transdisciplinary research and transition management to theoretically justify experimental fora. In particular, given the normative commitments which underpin much of the theory behind theoretical research and transition management, such fora need to set the necessary conditions for the empowerment and cooperation of a diverse group of participants from different sectors and organisations so that they may co-generate shared understandings of problem statements, common visions and joint strategies and thereby cultivate a coalition bent on energy transformation.

The theoretical-empirical research questions are thus:

- 4.1. The first question seeks to understand the particular context within which the participants act: to what extent does the combination of transition management and transdisciplinary research enable the development of a societal forum for the co-production of actionable knowledge concerning energy policy?
- 4.2. The second question concerns the cultivation of shared values among participants, as they pertain to sustainable energy development: specifically, how might visions of a sustainable energy future in Ecuador and Peru change, if a broader cross-section of society controlled and / or were able to influence key aspects of energy policy? What knowledge might participants generate to support this vision?

4.3. The third question aims to understand the influence that the above process would have on the participants' future actions: in what ways might transition management and transdisciplinary research support knowledge-action networks and socio-political empowerment?

The three main research questions are reflected in Figure 7.

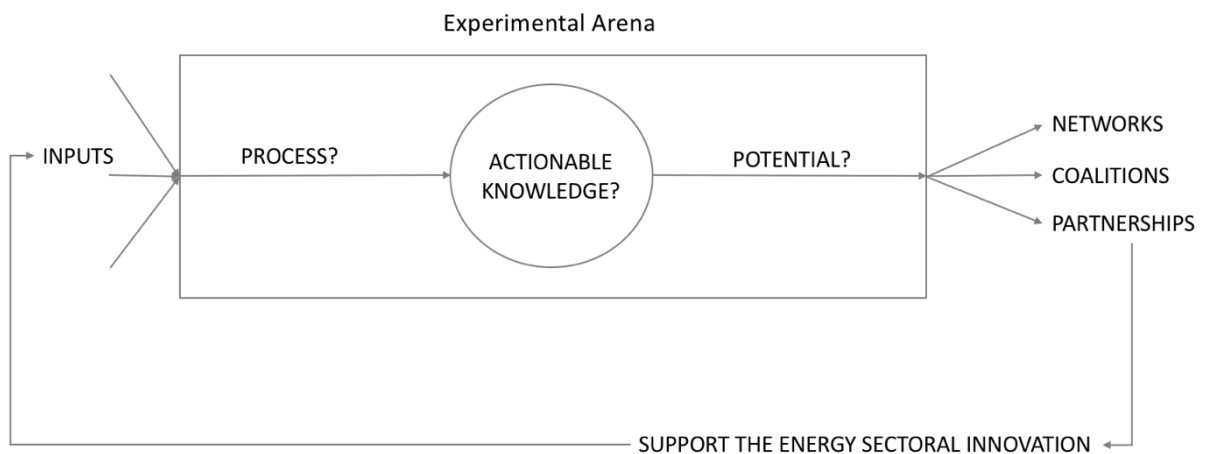


Figure 7: Process, knowledge and potential to support sociotechnical change (based on Noboa and Upham, 2018)

5. Ontological assumptions

This thesis does not make strong ontological assumptions. That said, we take here a social constructivist approach to knowledge in the sense of that we are interested in participants' own sense-making in the hermeneutic tradition, which has been shown to be of value in the context of energy social science (Ambrose et al., 2017). This study also presupposes a theory of change, where change arises from managed networking, social learning and reflection processes, as well as through the creation of social capital and the empowerment of the participating actors

(potential change agents) through dialogue and processes of discourse institutionalisation (Diez and Steans, 2005).

The constructivist perspective assumes that reality is socially constructed on the basis of a network of intersubjective meanings. Hence, this study explores the interpretations of different actors from different sectors so as to understand individual and collective mental models. The modality of this research consists in “following the actors” in a real-life context, describing interpretations, disagreements and the emergence of consensus (Geels et al., 2016a).

The experimental spaces of interaction establish a deliberative, reflexive governance process, based on consultation and participatory debate, where governance is regarded as an open-ended learning process, based on experiments, projects and sense-making (Pahl-Wostl, 2009).

6. Research Methods

The research process presupposes theoretical perspectives relating to theory, method and empirical application. The first draws on theories of sustainability transition and transformation, including transition management. The second draws on ideas taken from the knowledge co-production and transdisciplinary sustainability sciences. The third, the empirical application, concerns transdisciplinary-transition-platforms and their effectiveness, measured by potential for the production of actionable knowledge (Frantzeskaki and Kabisch, 2016) for the stimulation of collective action (Spreng, 2014).

The data gathering methodology is primarily based on a participatory observation process that integrates various conceptual approaches to how transformative change (Westley et al., 2013) is intertwined with joint decision- and policy-making

processes (Wiek and Binder, 2005). The purpose of this particular methodology is to strengthen the theoretical foundation of the whole research project by providing the context for analysis.

6.1 Methodological triangulation

Additionally, this study utilizes a process of methodological triangulation, which takes advantage of more than one method to gather data, such as policy documents analysis, interviews, participatory observation (Clark et al., 2009) and questionnaires. This triangulation facilitates the validation and cross verification of information in order to better understand the social experimentation and to provide a more detailed and balanced picture of the phenomenon (Risjord et al., 2002)(Johnson and Onwuegbuzie, 2004).

Ex-ante semi-structured *interviews* were conducted with the participants before the participatory processes. These interviews were intended to provide us with information concerning stakeholders' perspectives on the state of the energy system, the preferred scenario for a sustainable future and a roadmap for realizing this preferred scenario (Bryman, 2006).

In addition, at the end of the participatory sessions, participants filled out quantitative-qualitative *questionnaires* intended to evaluate the key features of the participatory process, including the methodology, participants, facilitation, socio-psychological dynamics and stimulated capacities. The questionnaires were also used to assess the quality of the knowledge generated during the process of co-production (Assefa and Frostell, 2007) (Figure 8).

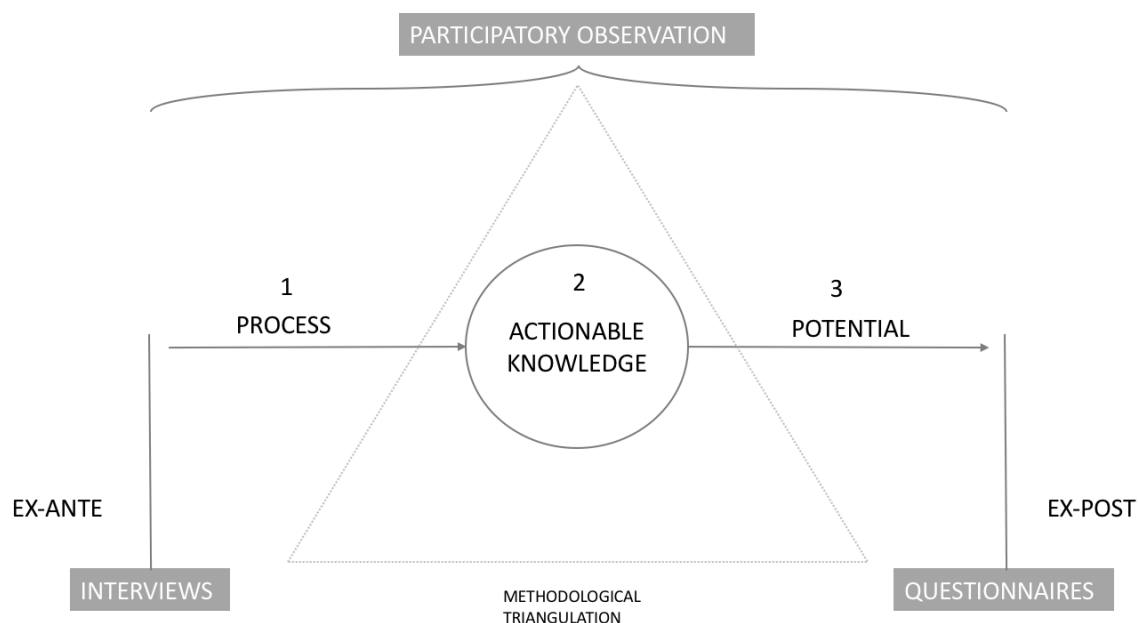


Figure 8: Methodological triangulation

6.2 Participatory Processes

A participatory form of research process was utilized in order to answer whether, according to the participants, (a) past and present energy policies have been effective in achieving sustainable energy development, and (b) what policy options and future scenarios would need to be implemented and realized for sustainability, as derived through participatory knowledge co-production methods involving several interest-groups and sectors.

The participatory process designed and applied in Ecuador and Peru connected diverse actors affiliated with the energy, government, civil society, and business sectors by providing a space for learning and interaction so that they may reflect on and develop a common understanding of the problems and challenges inherent to sustainable energy development. During the sessions, a diverse number of perspectives were elicited and integrated into a collaborative knowledge production

process. Participants were challenged to draw upon global and local dynamics. In addition, they developed key strategies for fostering and developing the necessary capacities and capabilities to reinvent current energy system models at a national level.

The participatory intervention co-produced system-, normative- and transformation-knowledge (Lang et al., 2012)(Polk, 2015) by the selected epistemic community of stakeholders conformed by scientific individuals and non-scientific change agents' (Pesch, 2015) representatives of different sectors. Reflexive, anticipatory and integration capacities at an individual and collective level were stimulated throughout the process of knowledge co-production (Ralf Lindner Bernd Beckert, Nils Heyen, Jonathan Koehler, Benjamin Teufel, Philine Warnke, Sven Wydra, 2016).

The scientifically guided dialogue was also intended to promote trust (Harris and Lyon, 2013) and long-term collaboration among the participants resulting in common understandings, the identification of a shared values and the commitment to organise joint future actions and consolidate social capital (Portes, 1998). "The process is intended to support the actors as policy entrepreneurs, ready with robust proposals for the next policy window" (Noboa and Upham, 2018).

Considering the experimental essence of the collective production of knowledge, the participatory process was subjected to a continuous formative evaluation (Luederitz et al., 2016). Evaluation motivated reflection on and alteration of the collaborative working method thereby improving the experience of experimental learning (Scholz, n.d.).

6.3 Stakeholder engagement and selection

A research team consisting of scientific and non-scientific actors, belonging to the three sectors of society - government, business and civil society (NGOs and Academia) - was convened (Fukuyama, 2001). The actors (participants) were selected through the application of a snowball-type sampling method (Noy, 2008) oriented toward experienced stakeholders who themselves were oriented towards norms of sustainability and who represented organisations whose work intersects with both environmental and energy fields and that have been involved in related projects. These experts, although from different sectors, thus shared common experiences and a proactive attitude towards sustainable energy transformations (Figure 9).

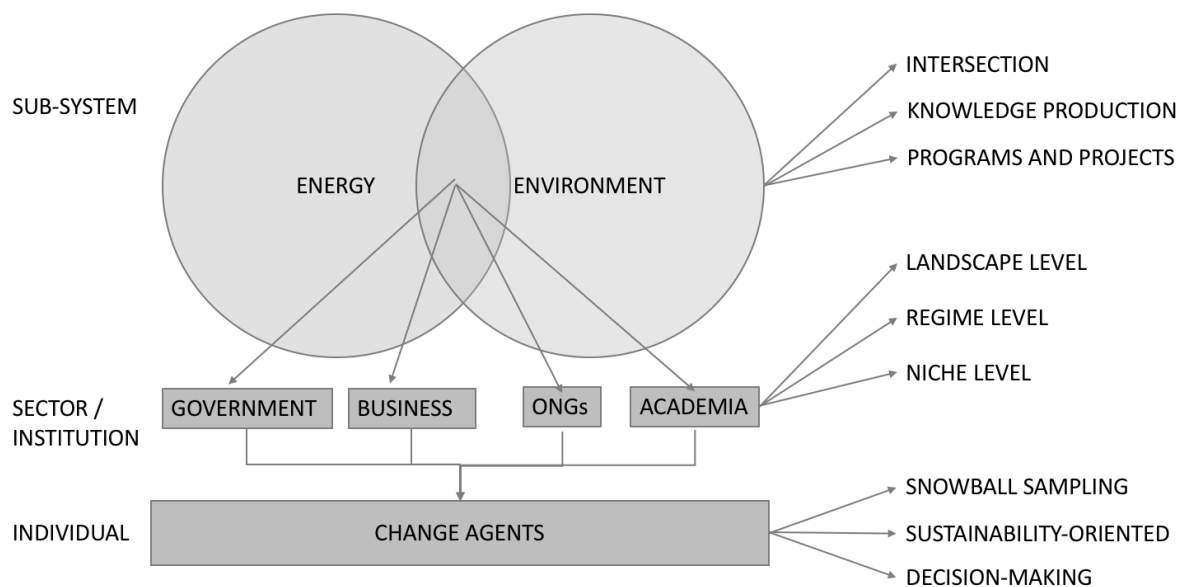


Figure 9: Stakeholder identification

7. Results

In accordance with the fundamental ideas of transdisciplinary research and in order to address “real-world problems” (Lang et al., 2012) the results were of two types: societal-practice results and scientific-practice results (Figure 9).

7.1 Societal-practice results

There are two sets of societal-practice results as an output of the explorative research practice: content- and process-based. The content-based results informed a conceptual model of the energy system (summarizes the key features of the selected system), a long-term vision (preferable vision) and an agenda for triggering the transformational readiness (strategies). Presentation of the process evaluation was undertaken using indicators relating to the degree of supportive network development and the perception of the degree of empowerment.

7.1.1 Content-based results

The societal practice results took the form of a compilation of options for addressing the unsustainability of the energy systems in Ecuador and Peru, along with the proposition of a collectively framed model of the problem, a consensual common vision and a set of solution-oriented strategies oriented towards sustainability transformation.

One of the most relevant results of the participatory interventions was the common understanding of the current energy systems dynamics, including perspectives and concerns of different sectors of the society. The idea of focusing on a few centralised power plants was broadly discussed, which is a development path that limits the possibility of diversification through other sources such as biomass, wind and solar.

Instead, participants favoured sub-national, decentralised and distributed technologies that can play a significant role for system flexibility to reduce vulnerability of the power grid, reduce socio-environmental impacts and catalyse new industrial endeavours in small and mid-sized companies.

The nexus between decentralization and democracy was a significant feature of the discussions. Participants highlighted how decentralised infrastructure can strength democratic processes and stimulate the distribution of assets and access to resources nation-wide by mobilizing the capacities of local small and medium enterprises that promote non-conventional renewable energy supply.

Another relevant point of discussion was the continuing dependence on fossil fuels and the lack of policies to encourage energy efficiency, reduction of waste and environmental impact. The participants also reflected on the need to reduce and redirect current fossil fuel subsidies towards dynamic incentives that promote renewable technologies.

The participants achieved a common sustainable vision of the energy sector and presented an advisory roadmap, which include topics such as the integrated planning and development of sector policies; decentralisation of infrastructure decision making; better governance and participative energy planning; diversification of energy sources; demand side management through education; revised energy subsidies and transparency in prices; the establishment of a zero fossil fuel objective; strengthening of energy security; resilience and sustainability of the system, among others. The details of the results are presented in the empirical papers focusing on the case studies in Ecuador and Peru, presented in the subsequent chapters.

7.1.2 Process-based results

The TTMA processes demonstrated that cross-sectoral and inter-institutional, combined efforts, based on dialogue and mutual respect, can help actors visualize possible, future alternatives for sustainable energy development and how to realize such alternatives. The similarities and differences among the visions and understandings of different sectors (government, civil society, business and academia) were examined and the extent to which the process supported an integrated vision was evaluated. The process deliberately focused on seeking points of common understanding rather than focusing on the differences (van de Kerkhof and Wieczorek, 2005). The participatory process assessment demonstrated considerable success under the above terms, but more specifically in the sense that both stakeholder selection and the structures provided were helpful for the emergence and empowerment of new sustainable-energy-transition coalitions in both Ecuador and Peru.

The TTMA processes acted effectively as spaces for dialogue, capacity building and the exchange of ideas among stakeholders, representing several institutions from the government, civil society, academia and the private sector. By means of facilitated dialogue processes, participants reflected on the current and future situation of the energy sector, perspectives for its development and the need to work in a more collaborative manner to generate a base of integral knowledge. Participants agreed that there is an urgent need to adapt to the extreme events of changing global dynamics and to articulate and mobilize collective capacities that can reinvent the institutional framework of the energy sectors (Ecuador and Peru) and spur the development of more sustainable business models.

7.2 Scientific practice results

The scientific practice results informed the development of a novel interdisciplinary approach to and scientific method for the articulation of knowledge-based science-policy interfaces so as to build 'politically activated networks' and alternative discourses that have the potential to influence political arenas and policy change. The scientific results are synthesized in the following specific outputs and are described in detail in the scientific papers presented in following chapters:

- A Transdisciplinary Transition Management Arena (TTMA) Framework as a context-based, protected participatory intervention process for Illiberal Democratic contexts.
- An analytical energy transition framework as an output of the process of identification, articulation, structuring and integration of key features of the present and future energy systems.
- Theoretical innovations related to the intersecting fields of Transition Management and Transdisciplinary Sustainability Research, particularly at their interface, offering productive theoretical and practical ways forward for niche-level policy development (Figure 10).

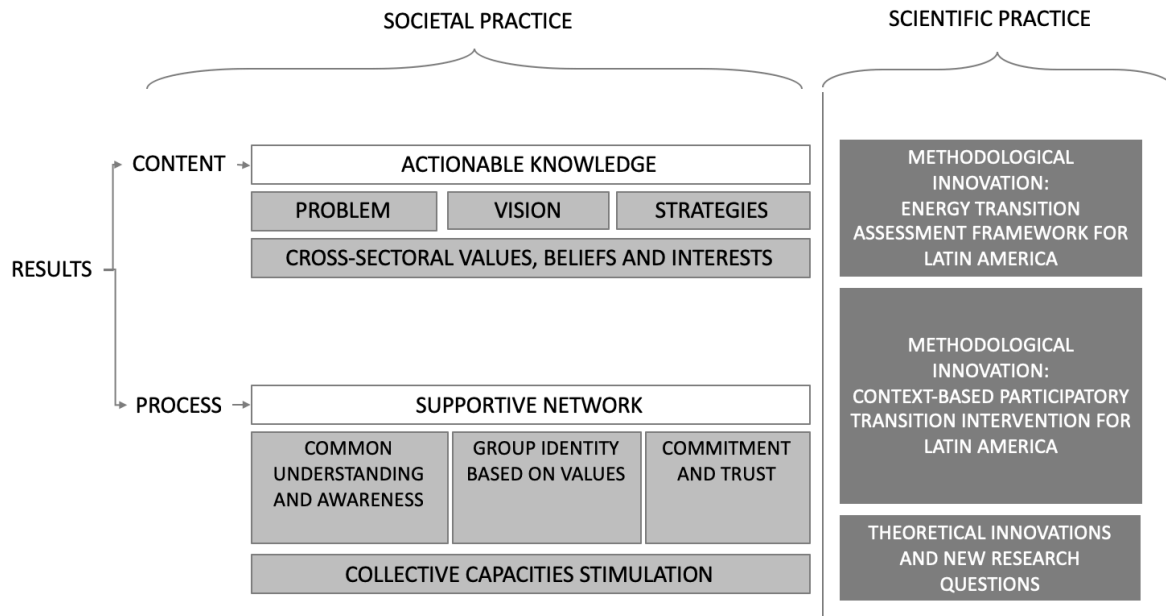


Figure 10: Societal- and scientific-practice results

7.3 Scientific papers

Drawing all of the above together, this research process has enabled the development of three scientific papers that synthesize the theoretical development and the empirical application as follows:

7.3.1 Paper No.1 (conceptual paper), “Energy policy and transdisciplinary transition management arenas in illiberal democracies: A conceptual framework (Noboa and Upham, 2018)”, describes the development of the conceptual framework of a “protected space” (Kemp et al., 1998) for the development of energy transition policy; and the development of a so called Transdisciplinary Transition Management Arena (TTMA), which provides the theoretical framework and methods for the development of knowledge-based networks and capacities for the co-creation of alternative energy scenarios and policy strategies, according to the context and limitations of an illiberal democratic context.

7.3.2 Paper No. 2 (Ecuador paper), “Collaborative energy visioning under conditions of illiberal democracy: results and recommendations from Ecuador” (Noboa et al., 2018), describes the practical application of the TTMA framework at a national level in Ecuador, the results of which inform an evaluation of the applicability of the proposed method, the quality of the knowledge co-produced within the participatory interventions and the potential of those processes to influence policy change in the local political arena.

7.3.3 Paper No. 3 (Peru paper), “Building a Coalition with Depoliticized Sustainability Discourse: The Case of a Transdisciplinary Transition Management Arena in Peru” (Noboa et al., 2019), similarly to the second paper, explores the application of the *TTMA* framework whereby multi-sector stakeholders are meaningfully engaged in the process. In particular the paper documents and discusses how the participants are empowered through the provision of a structured platform in which new networks are forged, knowledge generated and policy proposals developed.

8. Discussion and Outlook

This study demonstrates that knowledge co-produced under the participatory constellation of what is here described as a TTMA has successfully generated energy scenarios and policy options intended to be more democratic and sustainable than the *de facto* situations. The depoliticized sustainability discourses of transdisciplinary research and transition management have been shown to have the potential to play a key role in helping to legitimize informal institutional efforts towards environmental policy change. The premises of transition management and transdisciplinary research have been tested and found helpful in fashioning an informal network and vision.

In terms of participant characteristics, like-mindedness (sustainability-orientation) among the participants played an important role in the achievement of the results and the commitment towards future actions. The process helped participants realize their intention to engage in long-term collaboration by providing them with the necessary tools to generate a common understanding of the problem, identify a shared vision and commit to organize joint future actions. The results of the implementation of the TTMA framework owe a great deal to the bonds of trust that were cultivated by the team, the fluidity of the dialectic processes, the quality of the contributions, and the commitment of the participants. The mobilization of informal networks, operating in parallel to formal institutions of the State and that build new science-policy interfaces protected from the domination of the incumbents, are essential for the development of alternative energy policy in the illiberal democratic contexts considered.

Figure 11 depicts the TTMA process and shows how empowered change agents, acting as science-policy brokers, co-produce solution-oriented knowledge, capabilities and networks of social capital results in alternative discourse coalitions ready to disseminate proposals during next windows of policy change. The TTMA focuses on theories such as transition management and transdisciplinary research, yet is designed to include various other disciplines such as energy democracy, energy modelling and planning (qualitative and quantitative nexus), political communication, policy change, innovation and societal learning.

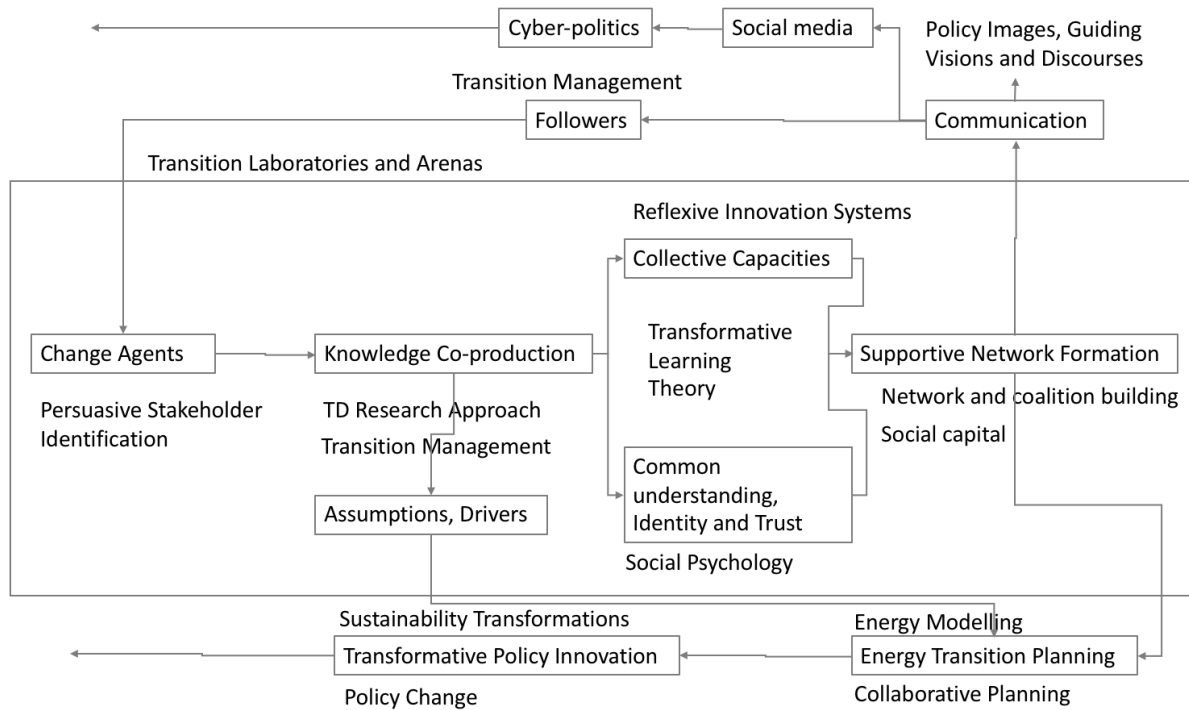


Figure 11: Knowledge-action, communication and impacts

The research has shown how the justification and creation of alternative knowledge spaces can empower the production of new energy discourses amongst civil society and begin a process of readiness that prepares for enactment, with a view to simulating change over time (van der Hel, 2016). While the long-term effects of such spaces in terms of material change is beyond the scope of this research, the study has nonetheless laid the groundwork for a larger programme of action research.

The study has revealed that the process here developed has the potential to stimulate enduring networks and that the alternative discourses and understandings concerning energy sector problems created amongst the actors have the potential to enter the wider political arena and thereby contribute to regime destabilisation in the sociotechnical sense (Geels et al., 2016b). Nonetheless, it remains to be seen how transferable the knowledge to the political and societal spheres truly is and the problem of how to fully integrate the innovative scientific and societal solutions with

the “real-world” remains a challenge which will require the application of various techniques, including ongoing communication and collaboration, lobbying, social media campaigning, and others to address.

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CHAPTER 2

A CONCEPTUAL FRAMEWORK

Energy policy and transdisciplinary transition management arenas in illiberal democracies: a conceptual framework

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Abstract

While the theory and practice of transition management has been articulated and tested in Europe, little work in this vein has been undertaken in illiberal democracies, where state institutions may be captured by commercial interests, clientelism may operate and democratic rights may be constrained. We argue that a combination of insights from transition management and transdisciplinary research offers a basis for developing local strategies by which informal institutions can nurture alternative energy policy visions and prescriptions, in order to exploit policy windows that periodically arise. We articulate a conceptual framework to underpin such strategies, which emphasises the role of academics or other knowledge brokers as policy entrepreneurs, helping to build knowledge and capabilities, create networks of social capital and establish alternative discourse coalitions. While our particular applied interest here is in arenas for the development of low carbon energy scenarios in Latin America, the framework is also intended to have wider applicability.

Keywords

Transition management; transdisciplinary research; illiberal democracies; policy windows

1. Introduction

Notwithstanding progress on raising the profile of sustainability concerns within governments, the private sector and civil society, globally we continue on unsustainable pathways and are far from achieving inter- and intra-generationally just development that encompasses ecological, social, and economic needs in a balanced manner (Figueres et al., 2017; Rockstrom, 2009). Greenhouse gas emissions continue to increase; biodiversity loss is accelerating; global poverty reduction is lagging behind United Nations goals; social inequality has intensified over the past 30 years and economic instability threatens societal cohesion and political stability (Heinrichs et al., 2015). Overall, despite the continued growth of sustainability-awareness also within international political spheres, accompanied by global policy initiatives (e.g. the 2030 Agenda (United Nations General Assembly, 2015) and the Paris Agreement (UNFCCC, 2015)), as well as national institutional and regulatory frameworks, to date the actions taken by states, companies and civil society around the world have not succeeded in reversing the unsustainable dynamics of contemporary systems of provision at an aggregated, global level.

A key issue in this problematique is that unsustainability is as much a political problem as a technical one. From a (co-evolutionary) sociotechnical transitions perspective, socio-economic development, technological innovation and policy change are intertwined. Hence in the context of energy transitions and indeed in other contexts, a co-evolutionary perspective clearly implies the need to take account of the role of politics (Cherp et al., 2018) (Smith et al., 2005). As a response,

calls for more collaborative, innovative and pluralistic policy-making (Heinrichs et al., 2015) and the expression of a wider range of values (Stirling, 2008), while not seen as a panacea, have long been widespread among a variety of academic literatures dealing with the societal and environmental consequences of development generally, including technological development specifically (e.g. (Wynne, 1973)(Rip, 1995)).

Our aim here is to set out a rationale for fora by which the above plurality may be sought, specifically in contexts where state institutions are in some significant way weak, which often involves capture by commercial or clientelistic political interests (Hellman et al., 2003). Such contexts are often associated with illiberal democracies – where some form of democracy is institutionalised, but the expression of which is significantly constrained, as in Latin America (Smith and Ziegler, 2008). This type of political system is also referred to as anocratic, with a complex mixture of authoritarian and democratic elements (Hagan, 2017). We focus particularly on the conceptual rationale of fora intended for the exploration of alternative energy futures, though the framework may also be capable of providing theoretical support for the collaborative design of other sectoral futures. We base our framework on a key premise: that the involvement of academics as policy and institutional entrepreneurs, while not guaranteeing outcome-or process-related ‘success’ in terms of consensus or formal policy change, does offer potential through the catalysis and preparation of alternative environmental policy options (Huitema et al., 2011). The role of academics as policy entrepreneurs, among many other types of actors working as change agents, can include the supply of ideas, helping to build coalitions, helping to open windows of opportunity, managing networks and the exploitation of relevant policy venues (Huitema et al., 2011). Of these, the functions that we focus on below – with supporting material selected from the transition management and transdisciplinary research literatures – are the inter-related activities of coalition

building, network management and preparation for windows of opportunity (rather than actually opening such windows).

Given the central role here of both experimental fora and the involvement of knowledge-focused actors perceived as including actors from academia, we bring together insights from transition management and transdisciplinary research and advocate a blending of these. While these literatures have a shared commitment to the involvement of stakeholders in the co-generation of sustainability solutions, they have different emphases, with transdisciplinary research focusing more on issues relating to knowledge. Moreover transition management has previously been critiqued for lacking context-sensitivity (Rauschmayer et al., 2015). Here we make particular use of insights from transdisciplinary research in relation to the role of the researcher in transitions processes (e.g. (Wittmayer and Schöpke, 2014)), with the aim of further enriching the practical applicability of transition management in different contexts. We focus particularly on the contribution of transdisciplinary research in terms of its identification of the differing types of knowledge required for such processes and capacity building through shared reflexivity and engendering trust. We envisage such a process as taking place in parallel with formal institutions and in which academic or other third party, knowledge-focused policy entrepreneurs are critical at the initiation and facilitation stage, as part of action research processes that include 'middle actors' (Parag and Janda, 2014).

The specific context of the fora that we have in mind - and hence to which the conceptual framework relates – is energy policy development in Latin America. While geographically diverse, politically this region emerged from dictatorships in the 1960s onwards, followed by externally-driven, neoliberal reforms in the 1980s that promoted privatization. Rather than leading to assumed conditions of increased market efficiency and productivity, however, the transfer of state assets to private hands has done little to reduce the oligopolistic condition of many Latin American

economies. Rather, new oligopolies have arisen and access to international capital has strengthened the power of transnational companies (Bulmer-Thomas, 2003).

There is variation. Some countries in the region have a centralised-privatization (mono-oligopolies) form of political economy, with a strong presence of international corporations controlling the exploitation of energy-related natural resources (e.g. in Colombia, Peru and Chile). Others have a neo-socialist model (e.g. Venezuela, Ecuador, Bolivia and Nicaragua) following renationalisation of strategic resource management to state-owned companies. Thus, ownership and management models have shifted from state-centralized to private-centralized. Nonetheless a common theme has been that resources, including energy resources, have been controlled by closed networks of public-private actors acting to the mutual benefit of a relatively small number of organisations.

This ownership pattern is represented by the top two quadrants in Figure 1, in which the two axes represent the degree of centralisation of power and the role of the State; and in which our main point is that the concentration of power may or may not involve the State. Our contention below is that while such a concentration of ownership and power is not necessarily antithetical to the development of decentralised renewable energy, it is at the very least not a conducive environment for energy policy change, because it concentrates decision-making power within a political system in such a way that the more powerful actors are relatively insulated from civil society pressures. Distributed energy politics posits that distributed energy sources and technologies enable and organise distributed political power and vice versa (Burke and Stephens, 2018). Hence Sovacool (Sovacool, 2014) refers to Winner's paradigmatic example of the nuclear reactor necessitating an authoritarian state due to the need for strict guard and control (Winner, 1986); Blowers and Leroy's 'social peripheralisation' to describe how energy infrastructure planners may target politically weaker communities (Blowers and LeRoy, 2006); as well as the way in

which democratic deficits can be associated with the ‘resource curse’ (Karl, 1997)(Hancock and Vivoda, 2014).

Burke and Stephens (Burke and Stephens, 2018) similarly characterise the renewable energy transition as fundamentally a political struggle, arguing that efforts to shift from fossil fuels and decarbonize societies require the confrontation and destabilisation of dominant energy systems; and that, conversely, more democratic, renewable energy futures are likely to benefit from strengthening democratic practices and outcomes.

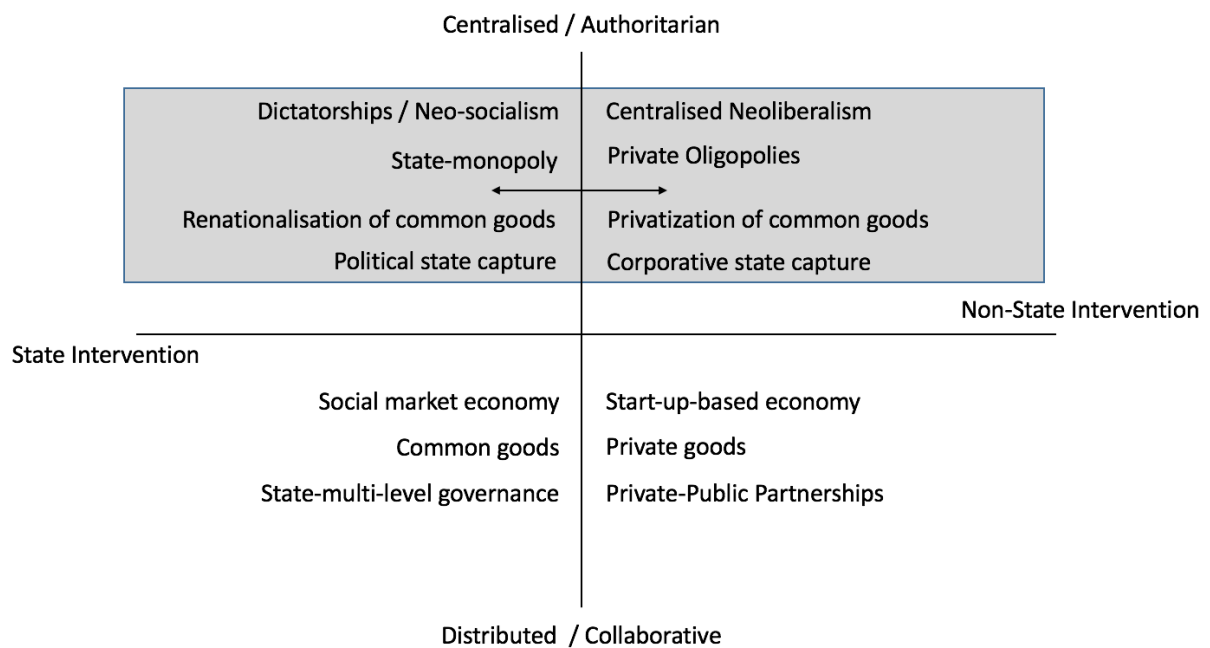


Figure 1: A fourfold typology of political economy (Based on (Rifkin, 2012))

This view is not offered in a simplistic or dichotomous way, but reflects the argument that renewable energy systems offer the possibility, not certainty, of more democratic energy futures (Burke and Stephens, 2018). The arguments apply equally to large scale hydropower, the politics of which are notoriously contentious and require centralized management and consolidation of capital investments (Sovacool and

Brossmann, 2013). Hence the promotion of international development of hydroelectric dams by the US has historically been linked to efforts to expand business interests and oppose communism (Burke and Stephens, 2018). Latin American illiberal democracies are the archetype of this experience, with centralised non-renewable energy systems and/or large scale hydropower. Oligopoly, unsustainability and corruption are all often variously involved, not of course by necessity, but by tendency and contingency.

What we offer here is both a framework and supporting rationale to support the theory and practice of an initial attempt to address the above. We are not offering a blueprint for resolving what might be summarily described as energy system centralisation. Rather we show how the literatures of transition management (Loorbach, 2010) and transdisciplinary sustainability research (in the specific sense of co-producing knowledge with stakeholders) (Lang et al., 2012) can be used to infer a type of informal energy policy venue applicable in illiberal democratic contexts. We do not argue that such a forum or rationale is *only* applicable in such contexts. Our purpose is to show that these literatures, developed in more democratic, market economy contexts, do have a contribution to make in other contexts too. As alluded to above, this also says something about the interconnections of technology scale and democratic form.

We also draw on Kingdon's (Kingdon, 2003) theory of multiple streams, including the ideas of policy windows and policy entrepreneurs (Huitema et al., 2011) as important to agenda setting. While most Latin American countries have undergone energy policy reforms during the last 60 years, the degree of centralisation of the energy sectors has remained virtually unchanged and arguably there is a need to empower policy entrepreneurs to support the possibility of change (Llamosas et al., 2018). In addition, energy policy change is necessary if the region is to meet climate imperatives (Marczak et al., 2016). This is highlighted by on-going, large fossil fuel

reserve discoveries and the estimate that while the region holds 19.4% of proven oil reserves in the world, second only to the Middle East, it represents only 8.6% of global production (Hollanda et al., 2016). In other words, the region as a producer, in tandem with the consuming nations to whom it exports, have significant potential to continue to destabilise the climate system in future.

More generally, the paper responds to the call to help reveal the roles of social and cultural considerations in shaping energy regimes (Hirsh and Jones, 2014), in this case through analysis of energy policy and political dynamics outside of developed country democracies. Similarly the paper connects with the call for strategies by which the social sciences can engage with energy policy makers to support new and durable alternative energy policy, as part of which, the development of new modes of policy governance are required (Fri and Savitz, 2014). These new forms of governance clearly need to take account of the political context, both general and specific. Moreover, a key implicit issue in energy transitions discussion concerns the powerful, general pressures that can act to suppress discussion of 'wider and deeper issues and forces' (Stirling, 2014); and how specific understandings arise of sustainability, transitions and planetary governance can favour and suppress particular political interests (Stirling, 2014).

With this in mind, our main aim is to articulate a conceptual framework for how a combination of the theory and practice of transition management (Coutard and Rutherford, 2010) and transdisciplinary research (Lang et al., 2012) that is mindful of Kingdon's account of policy change (Kingdon, 2003) might support more inclusive energy policy innovation in illiberal democratic contexts. More particularly, how these approaches might be brought together to provide an account of a protected space for energy policy innovation. Our applied context is Latin America, particularly – but not only – Ecuador and Peru, where, in further papers, we explore the application of the framework. We should emphasise that we are not claiming that such a

framework, nor its application in practice, have characteristics that necessarily differ from similar processes in more democratic contexts. Rather the opposite: we aim to show the heightened relevance of transition management (Coutard and Rutherford, 2010) and transdisciplinary research (Lang et al., 2012) for other political contexts.

We structure the paper so as to be consistent with those functions of policy entrepreneurs that are particularly relevant to our present purpose: coalition building, network management and preparation for windows of opportunity. This is not to say that other functions of policy entrepreneurs are unimportant. Our conceptual focus reflects our empirical focus in subsequent papers, which document and assess the lead author's role as a supporting agent in - coalition building, network management and preparation for windows of opportunity relating to energy policy in Ecuador and Peru. Moreover, the participants in these coalitions and networks can also be viewed as nascent or active policy entrepreneurs.

We begin with an overview of transition management and transdisciplinary research, focusing on those aspects that are particularly relevant to the context under consideration and the roles described above, and using these as key components of a conceptual framework and rationale for a transdisciplinary transition management arena (TTMA) intended as a response to the challenge of alternative energy policy formation under illiberal democratic conditions. As an additional caveat: even in a liberal democratic context, the ideas underpinning the TTMA are arguably inherently optimistic. By this we mean that the challenges to social steering of transitions are considerable (Shove and Walker, 2007). As such we are under no illusions as to the degree of political potency of transition management and transdisciplinary research that can be reasonably expected.

2. Transition management

“Transition management focuses on the complex adaptive systems nature of transitions, and draws on systems thinking concepts (e.g. self-organisation, attractors, feedback) to underpin a purposeful approach to shaping transition processes through cultivating experiments, focusing on front runners, and collaborative visioning...” (Foxon et al., 2009)(Loorbach, 2010).

Transition management employs a heuristic of four levels of nested activity: the strategic level, at which a transition arena is created, namely a forum for socially defining a shared vision; a tactical level, at which a concrete transition agenda, including specific measures and barriers to be overcome are specified; an operational level, where transition experiments are operationalised; and a reflexive level, where monitoring and evaluation take place (Loorbach, 2010)(Patterson et al., 2017). The aim of transition management is to transform regimes towards sustainability by supporting niche activity (Smith and Stirling, 2010), not just per se, but specifically through inclusive stakeholder engagement in an iterative cycle (Loorbach, 2010), allowing space to develop, improve and enrol support (Kemp et al., 1998)(Smith, 2007). Scenario-building techniques are often used to turn sustainability goals into practical visions (Sondeijker et al., 2006) (Rotmans, 2001) (Smith and Stirling, 2010). Learning and adaptation are intermediate goals, with a view to informing options for institutional reforms and more sustainable practices (Hoogma et al., 2002) (Smith and Stirling, 2010). The new institutionalization that transition management ultimately aims at involves mobilizing significant selection pressures against the incumbent regime and “redirecting vast institutional, economic, and political commitments into promising niches along desired pathways.”(Smith and Stirling, 2010). Not surprisingly, this is even more challenging in countries with authoritarian regimes or with weak and captured institutions.

An additional aspect of transition management that is particularly relevant here is knowledge generation among actors from multiple sectors (Leydesdorff, 2000)(Scholz and Steiner, 2015). Transition management aims to increase both the types and breadth of knowledge taken account of in policy-related decision-making and aim to increase the range of actors involved (Valkenburg and Cotella, 2016). Both are seen as particularly relevant in the context of 'wicked' problems of high uncertainty and normative ambiguity (Valkenburg and Cotella, 2016). For the purpose of highlighting the process of knowledge creation, here we connect transition management to the emerging field of transdisciplinary research in the sustainability sciences (e.g. (Wiek and Lang, 2016)). Whereas transition management might be viewed as a theory of societal change management, transdisciplinary research focuses on solution-oriented knowledge production within stakeholder-engaged (or even stakeholder-led) processes relevant to sustainability (Wiek and Lang, 2016).

3. Transdisciplinary sustainability research

The transdisciplinary sustainability research literature seeks to achieve an objective similar to that of transition management: to develop socially robust solutions for sustainable transitions via mutual learning, social reflexivity, empowerment and the building of social capital (Scholz, 2017). There is a difference in emphasis, however: transdisciplinary research focuses on the integration of the differing epistemics (ways of knowing) held by scientific researchers and practitioners. Hence whereas transition management emphasises a systems framing, transdisciplinary research, while sharing similar aims, focuses more centrally on the role of the scientific researcher as a catalyst "in inducing processes of strategic (societal) transition when including certain stakeholder groups." (Scholz and Tietje, 2002).

Perhaps the most significant area of overlap between the two approaches is their shared acknowledgement of knowledge and the generation of new knowledge as a particularly valuable form of social capital. The drive for this may arise, for example, from disappointment with formal public participation outcomes, leading to the initiation of informal grassroots participatory initiatives to intervene in planning-related decision making (BERMAN, 2018). The intention, at least, is that participatory processes will facilitate social learning, empowerment and the development of social capital, which in turn can lead to practical changes (Schäpke et al., 2017). Those committed to transdisciplinarity remain of the view that wider epistemic participation can lead to greater scientific effectiveness (e.g. (Balsiger, 2005)).

Transdisciplinarity can be regarded as a form of scientific activity that produces, integrates and manages knowledge (see (Scholz et al., 2000)). It supplements traditional disciplinary and interdisciplinary scientific activities by incorporating processes, methodologies, knowledge and goals from science, industry, and politics, to contribute to sustainable development by organising processes of mutual learning between science and society (Scholz, n.d.). As such, a key feature of transdisciplinarity is that it is intended to involve processes of mutual learning between science and society (Scholz, n.d.). There are a variety of models characterizing types of transdisciplinarity and their implications in terms of the integration of different types of knowledge, e.g. (Jahn et al., 2012)(Scholz et al., 2006) (Pohl and Hadorn, 2007)(Wiek and Walter, 2009)(Carew and Wickson, 2010)(Krütli et al., 2010) (Stokols et al., 2010) (Talwar et al., 2011)(Lang et al., 2012). Figure 2 embodies the issues that are typically given emphasis, drawing on Lang et al. (Lang et al., 2012). In contrast, transition management has tended to give less emphasis to these types of knowledge-focused analysis (Scholz and Tietje, 2002)(Vilsmaier et al., 2015)(Bergmann et al., 2012). Rather, the approach to knowledge within transition management theorisation has been secondary and

rather instrumental, focusing on “influencing transitions”(Grin et al., 2010) by supporting processes of framing, visioning, strategizing and experimenting.

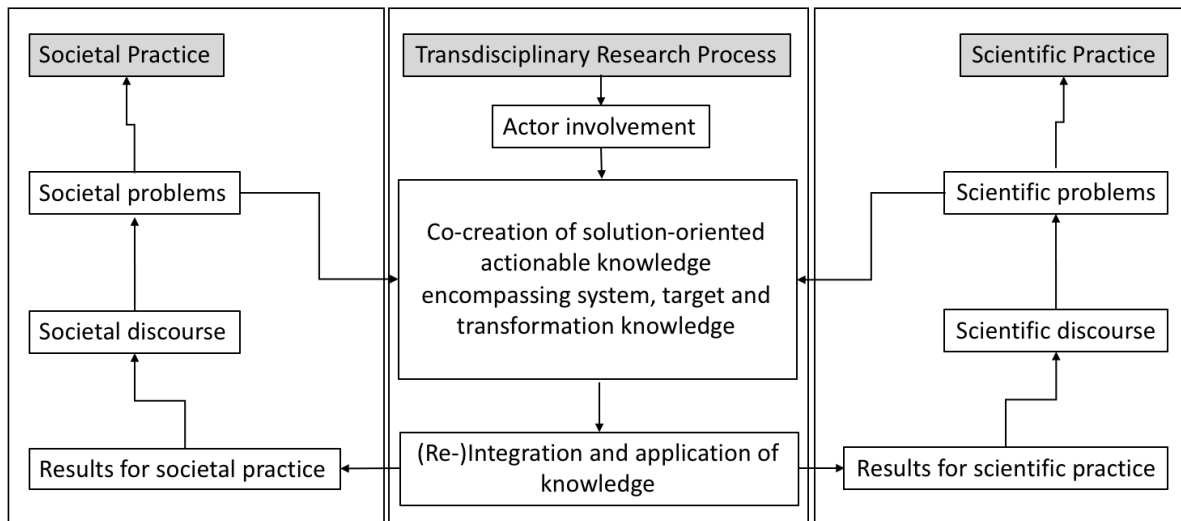


Figure 2: An idealised Transdisciplinary Research process (after (Lang et al., 2012)).

4. Connections between transition management and transdisciplinary research

Transition management and transdisciplinary research both explicitly acknowledge the inevitable impact that researchers have as part of transition contexts and processes and the need for a reflexive attitude, i.e. self-awareness (Wittmayer and Schöpke, 2014). The rationale for what might also be described as a form of participative action research (Tuck, 2009) is that researchers need “to be in the place where transitions happen” to produce relevant knowledge (Kemp and Rotmans, 2009)(Scholz, 2017). Hence the connection between transition management and transdisciplinary research can be characterised in terms of their range of shared understandings of science-society relationships: the scientist as catalyst, lobbyist, activist, knowledge worker, ‘luggage carrier’ or reflexive facilitator (Scholz, 2017). Also important is the mutual acceptance of different needs by practice and science partners, as both required for and leading to trustful cooperation. A condition for this

trust is a high quality communication structure within the teams and between practice and science teams, enabling anticipation and overcoming of any problems at the practice-science interface (Binder et al., 2015).

Knowledge integration in transdisciplinary processes refers to modes of thought, (inter-)disciplinary, perspectives, interests, systems and cultures. The latter distinguish between different types of knowledge: i.e., the intuitive, experiential knowledge of case agents and the analytic, abstract knowledge of scientists as shown in Figure 3 (Scholz and Steiner, 2015). Both types of knowledge constitute real world system expertise. In transdisciplinary research processes, mutual learning should be arranged such that it integrates and assembles these types and domains of knowledge (e.g. in agriculture, the system expertise of a farmer with the theoretical expertise of an agricultural engineer).”(Scholz, n.d.). In a sense this is also a call for action research. Hence action research has been assessed for its potential role in citizen empowerment (Wittmayer and Schöpke, 2014) and in terms of how researchers involved in action research in transition contexts should deal with power issues - both internal and external to group processes (Patterson et al., 2017). This reflects the way in which the more general rationale for action research includes that of expressing norms of democratic freedom and equitable decision-making power in sustainable community development (Christens and Perkins, 2008). Some authors go one step further in referring to ‘transdisciplinary action research’ and its facilitation of long-term, future collaborations among researchers, community members and policy makers (Stokols, 2006). Historically, though, the action research literature itself has rather rarely referred to sustainability (Greenwood and Levin, 2007)(Reason and Bradbury, 2008).

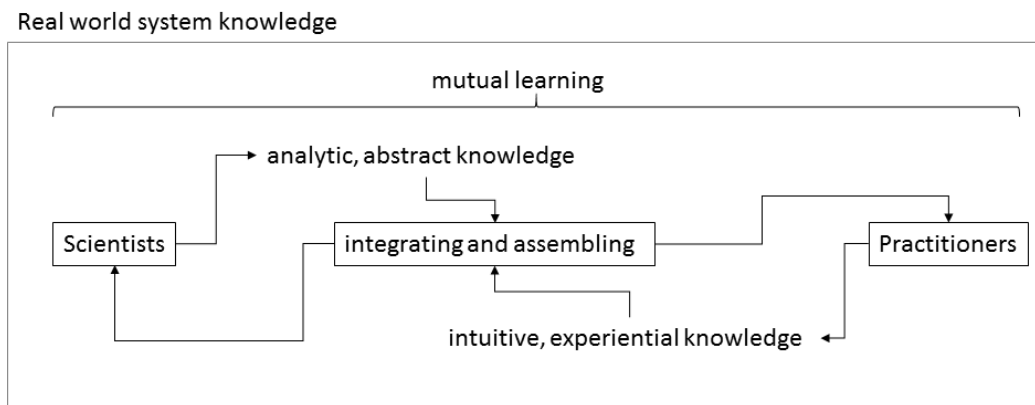


Figure 3: Real World System Knowledge (based on (Scholz and Steiner, 2015))

Moreover, transdisciplinary research scholars contend that definitions of sustainability need to be contextualised and agreed upon as an open-ended process with an open agenda, which includes a continuous redefinition of goals and a diversity of pathways (Wittmayer and Schöpke, 2014). Clearly this implies a co-definition of goals among researchers and practitioners or stakeholders, in which transition management creates spaces for shared learning about sustainability (both process and content) (Frantzeskaki et al., 2012)(Wittmayer and Schöpke, 2014) and in which transdisciplinarity in the sense of knowledge co-production is important. Indeed transition management scholars do sometimes explicitly refer to action research in this regard, in terms of providing analytical input and normative orientations towards sustainability as part of action processes (Loorbach et al., 2011). In addition, transition management, transdisciplinarity and action research all view “the changing of history” as the “principal justification for action research”(Kemmis, 2010) pp.425. Figure 4 summarises the relationship between transition management, transdisciplinarity and action research.

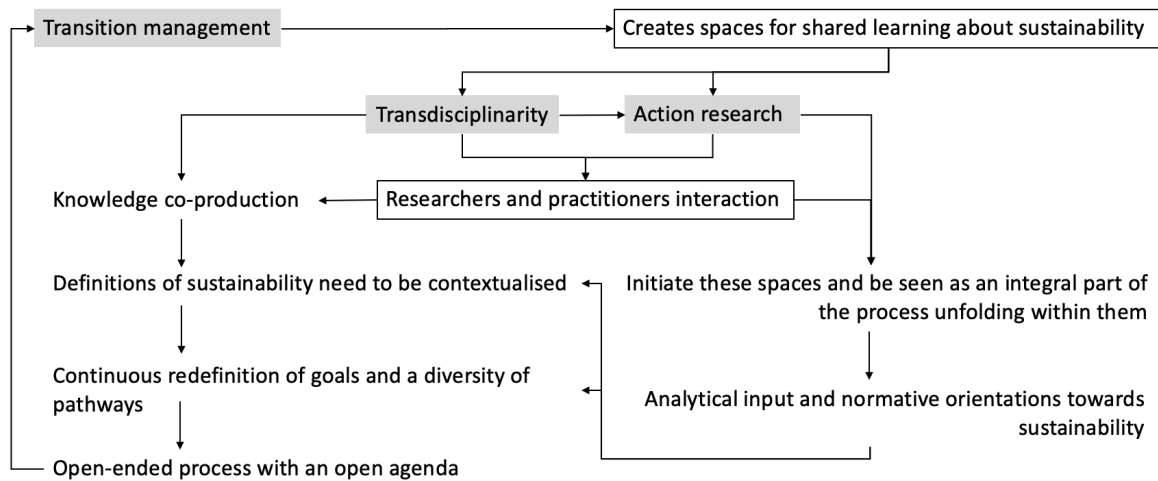


Figure 4: Transition management, transdisciplinarity and action research in co-relationship

The above notwithstanding, it should be noted that transdisciplinarity (as transition management) is absolutely not without its limitations. While transdisciplinarity in the sense described above uses scientific research to contribute to societal problem solving for sustainability; can achieve in-depth participation of involved actors; and can achieve the integration of practical knowledge, this does not necessarily result in the power to actually influence change in sustainable directions (Polk, 2014). Transdisciplinarity may create “new, hybrid problems regarding knowledge transfer and scalability, which bridge the boundaries and challenge the praxis of planning and policy making.” (Polk, 2014) and may at times realise its ambitious (idealistic?) set of objectives, but the politics of transitions of course involve power and power is not lightly given up (Avelino and Rotmans, 2009). Nonetheless, the creation of alternative policy visions, networks and coalitions is arguably a necessary prerequisite for policy change, even if not a sufficient condition.

5. Informal arenas as protected spaces for energy policy windows

As described above, transition management and transdisciplinary research have complementary ideals, objectives and methods. If integrated and pursued in practice, they would likely contribute to sustainability in a 'socially inclusive' way. Yet it is equally clear that these perspectives and practices face the possibility or even the likelihood of marginalisation in even the most democratically accountable of societies, operating as they do partly outside of formal institutions. Nonetheless policy changes occur and one of the most influential accounts of the reasons why and how they occur is Kingdon's multiple streams theory (Kingdon, 2003). Essentially this argues that policy change requires the conjunction of a problem with suitable political conditions and policy 'solutions' ready for selection and enactment. It is this preparedness that we emphasise here.

Governance and politics are central to understanding and analysing transformations towards sustainability, because those who govern are able to impose their framings and priorities (Smith and Stirling, 2010). Politics is pervasive in sustainability contexts (Meadowcroft, 2009) and power in sustainability transitions has been receiving increasing attention (Avelino and Rotmans, 2009) (Avelino and Wittmayer, 2016). Forms of power vary at different levels of structured practice (Hoffman and High-Pippert, n.d.) (Hoffman, 2013) (Grin, 2010) (Geels, 2002) (Patterson et al., 2017). Unsurprisingly, the redistributive consequences of system change - which entails new institutional arrangements, policies and sector structures - engenders opposition (Kern, 2011) (Kern, 2015), also described as regime resistance (Geels, 2014).

Given this resistance, from a transition management perspective, power asymmetries require the creation of new opportunities and venues, whereby new possibilities for vulnerable groups and societies' futures may be co-created

(Patterson et al., 2017). Yet – as said - if transitions experiments are vulnerable to capture and democratic deficit in liberal democracies (Hendriks, 2009), in the form of influencing agendas via direct participation or sponsorship of others' participation, it is even less likely that authoritarian regimes or institutions in relatively weak democracies will respond to calls for value pluralism. Box 1 provides an overview of the type of energy policy context that we have in mind as justifying and benefitting from the rationale and approach that we set out here.

Box 1 Ecuador as an exemplar energy policy and resource context for policy window preparation in protected fora

While Latin American countries have made considerable and varied progress towards democracy, they continue to struggle with conditions of state and institutional capture and limited civil liberties (Smith and Sells, 2016). One of the consequences of a weak civil society has been is that insufficient attention has been given the environmental impacts of resource extraction and energy supply. The elites that control non-renewable natural resources at the national level (notably the interest groups linked to oil and mining) have developed an extended network around the energy-extractive industry that involves clientelism, corruption and state capture (Mitchell, 2009). The rules, norms, laws and standards support the stability of this system and help to resist change (De Graaff, 2011).

The Ecuadorian context illustrates the type of energy policy and resource context in which transdisciplinary transition management processes involving civil society in protected spaces offers some prospect of at least preparing for policy windows that may arise, for example at the political junctures of presidential electoral cycles. Attributes of such a context include: economic vulnerability due to dependency on oil exports and its fluctuating price (Svampa, 2015); oil production approaching a peak; fossil fuel prices being highly subsidized (Chavez-Rodriguez et al., 2018);

significant potential for the use of hydropower and/or other renewable energy sources (Carvajal et al., 2017)(Escribano, 2013); high dependence on knowledge and technology transfer processes (Vernengo, 2006); compromised institutions for social and environmental governance (Omeje, 2008); and a highly centralised energy system (Escribano, 2013).

In 1979, after a decade of military dictatorship, Ecuador returned to a nominally democratic system. This had a significant impact on every aspect of national governance. Prior to democratization, formerly nationalistic policies gave way to a political stance that allowed aggressive private, inward investments (Svampa, 2015). Strategic national resources were privatized, including the exploitation of primary energy resources and electricity generation. Crude oil and fossil fuels were given significant incentives for production and trade. The electricity sector pursued a hydrothermal electricity mix, consisting of large scale hydropower and fossil-fuel based thermal-electric plants (Carvajal et al., 2017)(Chavez-Rodriguez et al., 2018). This period of neoliberalism lasted for nearly three decades, from 1979 until 2007. The period was characterised by instability and political change, extensive economic liberalisation policies, with fiscal austerity and deregulation (Berrios et al., 2011).

In 2008, a new constitution was written. Taking advantage of revenue from oil exports, the new approach intended to return to a state-controlled natural resource management system and the country adopted the objective of making its energy matrix cleaner and more environmentally sustainable (CONSTITUCION DEL ECUADOR, 2008). Control of the energy sector passed from a mainly private-owned governed system to a state-owned centralised system (Escribano, 2013). The period 2008 until 2014 has generally been characterized by economic prosperity as a result of high oil prices and the increase of production from mature oil fields in the Amazon. These factors, among others, have further cemented the neo-extractive economic model of the country. The government implemented policies to promote hydropower

and there were failed attempts to boost other forms and scales of renewable energy (Burchardt and Dietz, 2014). By 2017, Ecuador was expected to attain 90% of its electricity generated through renewable energy sources, mainly hydropower (Carvajal et al., 2017). In principle, this objective might secure a sustainable energy supply for industrial innovation. However, state indebtedness capacity has reached its limit, oil prices have fallen and these have proved significant barriers to the industrial transformation intended to diversify export commodities and reduce the country's dependence on oil. Overall, the centralisation of energy production threatens to suppress the development of other renewable options for decades, stifling diversification, flexibility and local resilience.

It is with the energy policy and resource context of Box 1 in mind that we make a case for transition management arenas being well-suited to act as protective fora for the support of civil society actors or change agents working for the design of alternative (non-formally instituted) energy policy and scenarios, outside of formal institutional contexts. Such protected spaces have the potential to support the development of knowledge and capabilities, networked social capital, coalitions and alternative discourses, as said, to be ready with solutions for policy windows that may occur through unexpected shocks or by design (Kingdon, 2003). Figure 5 summarises the role of transdisciplinary transition management arenas as we conceive of them functioning in illiberal democracies.

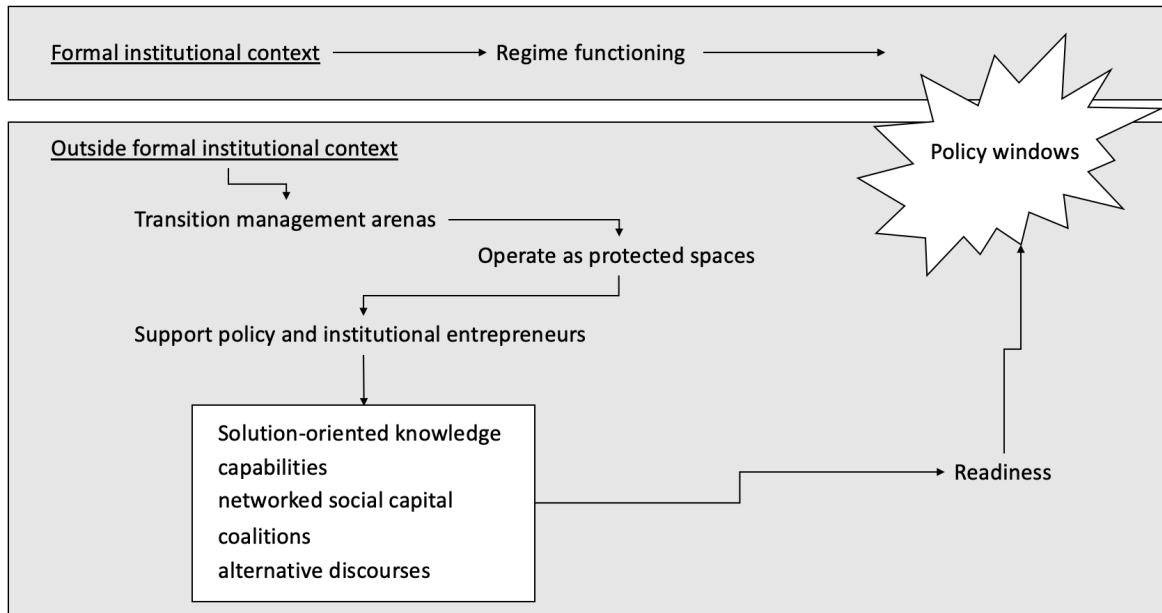


Figure 5: Protected spaces creating policy solutions ready for policy windows

While sociotechnical perspectives have proven theoretically and practically useful in European countries, little attention has been paid to the limitations of these frameworks for understanding change in developing country contexts, authoritarian regimes, or where countries exhibit a mix of both well- and ill-functioning institutions (Ramos-Mejía et al., 2017). As such, the characteristics of institutional settings need to be taken into account, as these shape the ways in which niche structuration processes develop. Similarly, sectoral change arises not only from the specific transformative capacity of new technologies themselves, but also the sectoral adaptability of socioeconomic structures, institutions and the actors confronted with the opportunities that these technologies present (Dolata, 2009).

From a sociotechnical perspective, economic systems, institutions, technological innovation and policy co-evolve in a quasi-evolutionary manner, with the constituent regimes of economies continuously facing selection pressures in four generic types of context: endogenous renewal; re-orientation of trajectories; emergent transformation; and purposive transitions (Geels and Schot, 2007)(Smith et al., 2005). Yet the power to effect change depends upon regime membership, the

distribution of resources for change and expectations (Smith et al., 2005). Alternative visions of the future are conceived of within this perspective as a selection pressure, while associated civic debate, often with NGO campaigns, are conceived of as articulation pressures (Smith et al., 2005). Yet this conception presumes a functioning democracy in which alternative visions can be voiced and campaigned for, without fear of oppression, imprisonment or worse. In Ecuador, civil society organisations and media outlets that are critical of the government may be subject to disproportionately burdensome financial penalties, unfair court proceedings and may be dissolved by an administrative procedure (International Center for Not-for-Profit Law (ICNL), 2017).

As we have observed, transition management is optimistic even in liberal democracies (Shove and Walker, 2007). Specific contexts require a degree of modification to transition management designs, so as to fit the complexity of local political dynamics. Moreover, few historical regime transitions have been explicitly directed by collective, socially deliberated, long-term goals and one of the few examples is public health and sanitation in industrialized countries in the late 19th century (Smith and Stirling, 2010). The German *Energiewende* is a key contemporary example but still has a considerable way to go to achieve its goals (Agora, 2015). Nevertheless, here we choose to persist with the hope that normatively driven conceptions of purposive sustainability transitions, from whence the notion of transition management derives (Loorbach and Rotmans, 2010), will be possible within a range of forms of political system – given suitable conditions. Creating alternative energy visions and the conditions to support their conception is arguably one such condition, even if only one.

The Transdisciplinary Transition Management Arena concept set out here is intended to provide the conceptual framework, structure and methods required to design and develop protected informal institutions, where stakeholders can interact

within a specific context and where normativity and specific transdisciplinary processes act both as a driver for transformation processes and for preparedness for policy windows.

6. Network and coalition-building as a key function of protected fora for collective action

It is axiomatic in sociotechnical perspectives on sustainability transitions that techno-economic, political and socio-technical processes are interconnected and subject to the critical roles of not only the state, but also vested interests at the core of the 'regime'. What are more variable and complicated are the specific ways in which these interactions play out in space and time, as different actors in different places make their choices. States often use their power to work with vested interests in maintaining regimes, while at the same time helping to protect niche innovations that later come to influence or even supplant those regimes (Cherp et al., 2017). However, if there is a strongly supportive dynamic between vested interests and the state, a lack of industrial-commercial interests supportive of niche innovation and a suppressed civil society that struggles to openly advocate alternative visions of the future, then the prospects for sustained path dependence are high.

Societal participation in transitions involves (variously) processes of enrolment and mediation, exclusion and resistance; such participation may be orchestrated by State or other agencies, or may be bottom-up, grassroots in origin and citizen-led (Chilvers and Longhurst, 2016). Here we envisage a particular type of participation, namely the deliberative, facilitated form that is outside of formal institutions but that relies on mobilising socio-professional policy entrepreneurs, epistemic knowledge and discourse, to build trust and an awareness of overlapping interests and visions. Where civil society is relatively disempowered, socio-professional or epistemic commonalities help to underpin the building of the social capital that networks and

coalitions comprise. Arguably, new networks thus built among individuals connected by epistemic commonalities, but located in different organisations, can help to capitalise on tensions within dominant policy storylines (Bosman et al., 2014). When successful, policy learning can be a direct and indirect outcome of these trust-building processes (Wyborn, 2015). For both transition management and transdisciplinary sustainability research, this learning arises through reflection, particularly as a result of the way in which the presence of policy entrepreneurs from different backgrounds can support cognitive reframing of current policy developments, their impacts and other societal developments, towards a more integrated perspective (Frantzeskaki and Kabisch, 2016). Reflexivity is also held to build *self-reflection capacities* that include critical reflection about participants' values and orientation (Lindner et al., 2016); *bridging and integration capacities*, (Weber and Rohracher, 2012) which relate to both the actor and system levels. At the actor level, these include the capacity, inter alia, to be open to new and different knowledge sources. At the system level, these capacities include the ability to make discursive and institutional spaces for connecting these differing knowledge sources and developing corresponding policy responses. Thirdly *anticipation capacities*, again at both the actor and system level, concerning the ability to project forward in time and anticipate future consequences, including the use of adaptive policy portfolios to keep options open (Weber and Rohracher, 2012), as well as anticipating user needs (Lindner et al., 2016). Fourthly *experimentation capacities*, primarily at system level, allowing for parallel approaches and learning through failure on all levels and in different contexts (Voss et al., 2006; Weber and Rohracher, 2012) (Kuhlmann and Rip, 2014) (Lindner et al., 2016). In short, *enabling capacities for purposive, collective action*, both despite and in response to the recognition that such action is challenging in ambiguous and contested situations involving multiple issues, actors, levels, and drivers and weak or missing feedback (Patterson et al., 2017).

Overall, the above section articulates some of the agentic processes of policy entrepreneurs and other key actors, with this agency viewed as likely to be strengthened through the building of a shared identity, trust and social capital. Again, this agency is viewed as in part temporally contingent, specifically connected to windows of opportunity, with informal institutional arenas supporting and stimulating preparedness for collective action.

7. The production of actionable knowledge for alternative energy pathways

The final stage of a transdisciplinary transition management forum is the application of shared knowledge and capacities to generate new energy visions informed by a wider range of values. This process can be specified in more detail, in terms of four types of sequenced knowledge needed for system transformation (Brandt et al., 2013): (i) *system knowledge*, which refers to understanding the context of a system and interpretation of its underlying drivers and processes. System knowledge includes knowledge of the current state of a system and its ability to change (Hadorn et al., 2006). (ii) *Target knowledge*, which refers to the scope of action and problem-solving set by the natural constraints, social laws, norms and values within the system, as well as the interests of actors and their individual intentions (Jahn, 2008). This entails a comprehensive specification and evaluation of desired target states; and a definition of potential risks and benefits under the prevailing uncertainties. In this way target knowledge (that which the group seek to know) determines what is envisaged as plausible (ProClim, 1997). (iii) *Transformation knowledge* refers to the practical implications that can be derived from target knowledge, in respect of changes to existing habits, practices and institutional objectives. Transformation (operational) knowledge enables practitioners to evaluate different problem solving strategies and to achieve the competences to foster, implement, and monitor progress and to adapt and change behavioral attitudes (Hadorn et al., 2006). (iv)

Actionable knowledge (Wiek et al., 2012)(Caniglia et al., 2017)(Schäpke et al., n.d.), understood as the solution-oriented integration of the three aforementioned knowledge types: a shared problem understanding is combined with mutually acknowledged visions or scenarios and co-produced strategies in a process that fosters *reflection, anticipation and integration* as key capacities of a successful learning loop. Effective knowledge-action processes rely on all of these knowledge types due to their mutual interdependencies. Building on the above, Figure 5 summarises the types of knowledge and capacities involved.

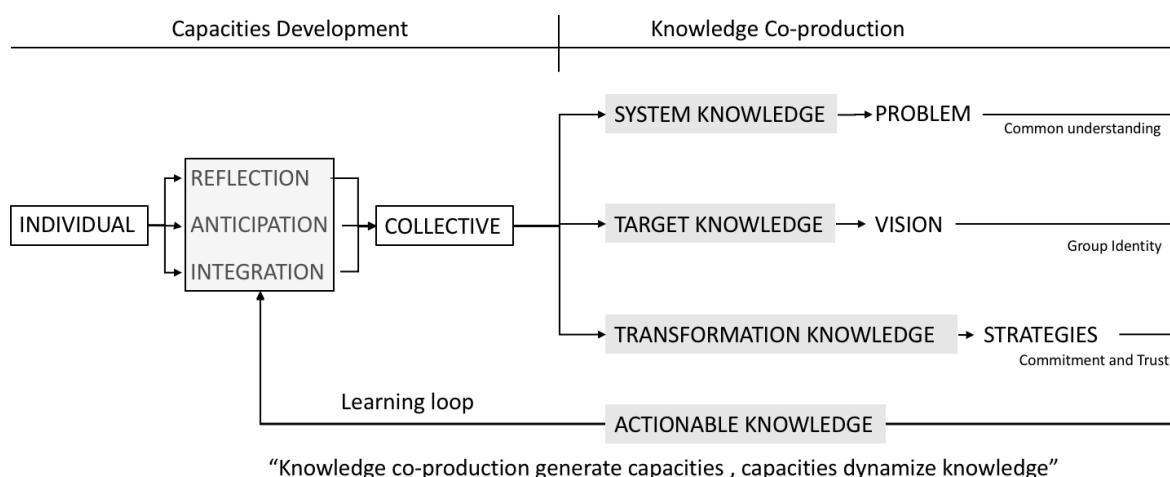


Figure 6: Types of knowledge and capacities involved in a transdisciplinary transition management process

Drawing all of the above together, Figure 6 summarises the proposed conceptual framework for what can be described as ‘protected space’ energy policy development, or a transdisciplinary transition management forum for the same: the development of alternative energy scenarios and strategy, as well as the building of networks, coalitions and knowledge-related capacity. The Transdisciplinary Transition Management Arena (TTMA) provides the theoretical framework and methods for the development of a knowledge co-production and stakeholder articulation platform for energy futures, to be adapted according to the context and limitations of an illiberal democratic context. The intention is that participants of the

participatory process mobilize their capacities and strengthen their ties through a process of participatory scenario creation, by developing either a common understanding or recognising plural variants, vision(s) and roadmap(s). The process is intended to support the actors as policy entrepreneurs, ready with robust proposals for the next a policy window.

In short, processes of reflexivity among the participants in the informal arena are conceived of as producing a common understanding of the problematique of the energy system, while stimulating processes of anticipation of alternative energy futures and further processes of the integration of values, beliefs and interests for a common transformation agenda. Of course, this presumes – and is only possible with - a relatively high degree of like-mindedness. Where there are irreconcilable differences, the production of multiple visions of the future will be necessary if democratic norms are to be adhered to.

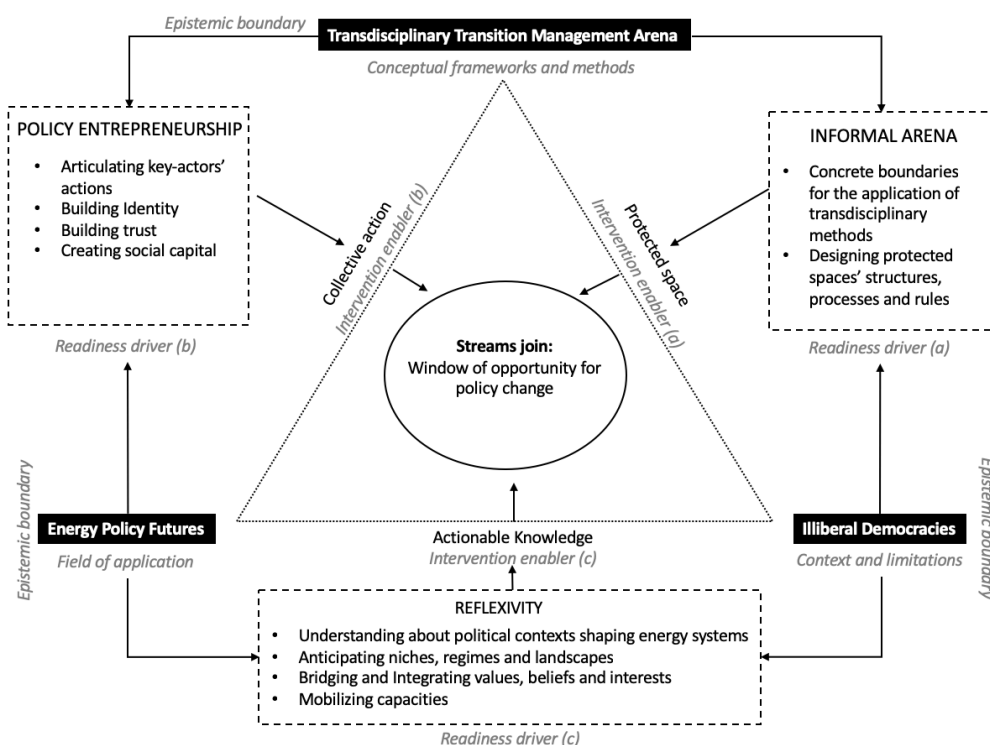


Figure 7: A conceptual framework for a transdisciplinary transition management arena in illiberal democracies

8. Conclusions

Our aim here has been to draw in some depth on the transition management and transdisciplinary research literatures to provide a theoretically grounded rationale for transdisciplinary transition management for application in Latin America, particularly under conditions of illiberal democracy. Transdisciplinary research in the sense of stakeholder-engaged scholarship arguably has significant potential, but remains under-incentivised for many reasons (Fazey et al., 2018). Here we have brought two, allied approaches together, as a rationale to underpin niche-protected energy scenario development in the illiberal democracies of Latin America. Our argument is not that such a rationale or process is unique, relative to transition management processes applied in (mostly to date) Europe. Rather, that the creation and support of informal, institutions and networks that parallel formal state institutions and that create new science-policy interfaces away from the domination of vested interests is likely to be helpful – one could argue necessary - in illiberal democratic contexts. That is, that transition management, especially when coupled to transdisciplinary research, offers productive theoretical and practical ways forward for niche-level policy development, particularly that which is heavily science or knowledge-based, in illiberal democracies.

Our hypothesis is that policy so developed may function as the *solutions or policy stream* in Kingdon's model of problem, policy and politics (Kingdon, 2003). That is, whereby pre-developed policy options find their practical expression when windows of opportunity arise as conjunctions of conducive political and problem-related circumstances (Kingdon, 2003). In subsequent papers, we apply this framework to the design and implementation of transdisciplinary transition management arenas for the production of alternative energy scenarios in Latin America. Here, though, our purpose has been to provide a theoretical justification for such a framework. We are well aware of the constraints on those seeking energy policy change in this

region, through both formal and informal routes (Llamosas et al., 2018), and admit that the literatures of both transition management and transdisciplinary sustainability research can appear optimistic at best and naïve at worst. Nonetheless, through our own action research experience, we know that such processes can help to give a sense of empowerment to the actors involved and can deliver strategy and visions for new energy futures.

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CHAPTER 3
THE ECUADORIAN CASE

Collaborative energy visioning under conditions of illiberal democracy: results and recommendations from Ecuador

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Abstract

Sociotechnical transitions require pressure to be exerted from inside or outside of the prevailing 'regime', without which various path dependencies combine to maintain the status quo. Change agents including policy entrepreneurs within the regime, or civil society voices outside, can be sources of such pressure. However, in illiberal democracies or authoritarian regimes, these voices may be little heard or even suppressed. With the premise that this situation calls for protected transition spaces for policy development that are outside of formal institutions, so that policy windows may be taken advantage of should they arise, this paper applies a Transdisciplinary Transition Management Arena (TTMA) process [1], whereby civil society and other stakeholders can be engaged in the envisioning of new energy futures.

With an example of such an arena in Ecuador and presenting a rationale and design that draws on transdisciplinary research and transition management theories, problem statements, visions and strategies for a more decentralised energy system were set out, as generated by participants from government, NGOs, business and academia. The visioning process was evaluated and an analytical framework is proposed, by which to guide energy transition policy analysis in similar contexts in the future.

Although compromised in illiberal democracies, sociotechnical transitions benefit from the voices of change agents through the building of new alternative discourses, stimulating policy entrepreneurship and crafting readiness for policy windows. The new alternative energy visions that were produced by participants in the process described here emphasise distributed renewable and sustainable generation; decentralised decision-making at subnational level; participatory energy planning governance; and heterogeneous poly-technological solutions at small and medium scales.

Keywords

Ecuador; illiberal democracy; transition management; transdisciplinary research; energy visions

1. Background

'Energy visioning' is generally understood as the development of qualitative, energy-focused scenarios, often on a participatory, socially inclusive basis and taking the form of storylines, narratives or other more specific formats (Ernst et al., 2018). Visioning processes can complement energy planning processes and techno-economic modelling post-hoc or ex-ante, using model results, or can shape

modelling according to differing, explicitly normative possibilities, such as alternative levels of consumption or patterns of economic production.

The aim here is to explore the application of a *Transdisciplinary Transition Management Arena (TTMA)* framework whereby multi-sector stakeholders may be meaningfully engaged in the co-construction of new energy futures (Noboa and Upham, 2018). The study tests the application of a theoretically grounded rationale for TTMA, particularly under conditions of illiberal democracy in Latin America. That is, whereby civil society and other entrepreneurial but marginalised voices may be empowered through the provision of structured 'experimental' fora or platforms in which new networks can be forged, knowledge shared and generated and alternative policies developed. The process is premised on theoretical perspectives that relate to both theory and method. Regarding the first, the TTMA draws on theories of sustainability transitions and transformation, including transition management. For methodological insights, it draws on ideas from transdisciplinary sustainability sciences and action research. For empirical application the process is applied in the country of Ecuador. The framework and its use in practice have strong commonalities with transition management and transdisciplinary sustainability science processes characteristics, but the rationale is quite different, a key objective being to demonstrate the value of both approaches for other political contexts.

The study gives equal emphasis to the sociotechnical sustainability transitions literature and the transdisciplinary sustainability science (research) literature, approaching these from an action research perspective in order to co-produce actionable knowledge. In so doing, another underlying premise is Kingdon's theory of policy change via the conjunction of a policy problem with a political window of opportunity for change, with a policy ready to be enacted (Kingdon, 2003)(Cairney and Jones, 2016)(Llamosas et al., 2018). The framework that we apply here is intended to prepare for such policy windows, should they arise, by providing a

protected space for energy policy innovation(Kingdon, 2003). The applied and assessed process is unofficial and informal in the institutional sense: the focus is on how informally instituted governance processes might lay the ground for subsequent, formal change through empowering network actors, strengthening their network and (as said) preparing alternative policy for readiness in case of opportune policy windows arising, as shown in figure 1 (Kingdon, 2003). In this way, we aim to create informal institutions and networks away from the domination of vested interests.

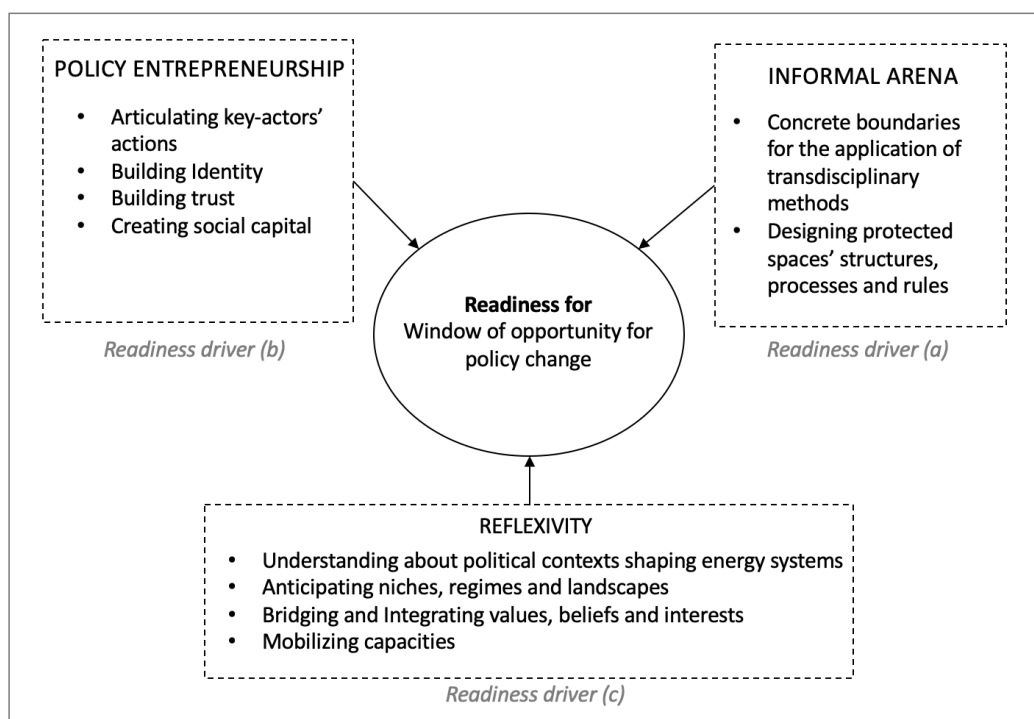


Figure 1: The TTMA framework (after (Noboa and Upham, 2018))

Transition Management advocates 'experimental' fora in which possibilities for sociotechnical change can be explored amongst multi-sector stakeholders (Frantzeskaki and Kabisch, 2016). The approach responds to the way in which sociotechnical systems are complex and adaptive (Foxon et al., 2009)(Loorbach, 2010), and the way in which transitions management seeks to guide transition processes via experiments and collaborative visioning, coupling this with participatory futures or scenario design processes. Often the latter involves the use

of back-casting methods (e.g. (Quist, 2007)) to identify pathways that guide the development of niche experiments (Rotmans, 2001) (Smith and Stirling, 2010).

To date, however, the contexts in which transition management has been applied have predominantly been in developed countries, with relatively well-functioning democracies. Here, a forum suitable for supporting multisector energy focused sociotechnical change in Latin America is developed and discussed. Latin America has experienced political conditions in recent decades substantially different from those in Europe, where Transitions Management ideas were developed. This has implications for the design of transition management processes, as new forms of institutionalization pose a threat to the incumbent regime (Smith et al. 2005, Shove and Walker 2007), which, in conditions of illiberal democracy, can meet with a severe response.

The Ecuadorian context provides a test-bed for the socio-political process of transition management in similar countries where some of the following Ecuadorian characteristics may be present: economic vulnerability due to dependency on oil exports and its fluctuating price (Svampa, 2015); oil production approaching a peak; fossil fuel prices being highly subsidized (Chavez-Rodriguez et al., 2018); significant potential for the use of hydropower and/or other renewable energy sources (Carvajal et al., 2017)(Escribano, 2013); high dependence on knowledge and technology transfer processes (Vernengo, 2006); compromised institutions for social and environmental governance (Omeje, 2008); and a highly centralised energy system (Escribano, 2013).

With these characteristics in mind, our premise is that empowering civil society and supporting cross-sectoral networking will promote energy system change through the expression of a wider range of values in alternative policy options. Within a sociotechnical frame, alternative visions of the future are conceived of as selection

pressures, while associated civic debate and NGO campaigns are conceived of as articulation pressures (Smith et al., 2005). In this regard there can be seen a value in the involvement of academics as facilitators, in effect operating as policy and informal institutional entrepreneurs, helping to catalyse the preparation of alternative environmental policy options (Huitema et al., 2011).

The transition management design tested in this study draws on features of transdisciplinary research, which are intended to develop socially robust solutions for sustainable transitions via mutual learning, social reflexivity, empowerment and the building of social capital (Scholz, 2017). Transdisciplinary research focuses on the integration of the differing epistemics (ways of knowing) used by scientific researchers and practitioners from different disciplines and with different interests. Both approaches share an acknowledgement of knowledge and the generation of new knowledge as a particularly valuable form of social capital and advocate a view of participatory processes as encouraging social learning and empowerment that can lead to practical change (BERMAN, 2018) (Schäpke et al., 2017). Accordingly, fora such as the TTMA bring together two allied approaches as a rationale for underpinning niche-protected energy scenario development in the illiberal democracies of Latin America.

The novelty of the study lies in the investigation of the functioning of a forum that blends transition management and transdisciplinary research, in terms of the extent to which this is able to offer new, productive, theoretical and practical policy options in the context of Ecuador. The questions seek to answer concern to the design and functionality of the TTMA framework developed by (Noboa and Upham, 2018): how effective such arena is, as assessed in terms of the extent to which compatible visions and actionable knowledge are produced; how satisfied participants were with the process, which is intended to support identification of points of commonality

rather than a focus on differences; and what lessons there may be for the design of such processes in future.

In terms of the structure, the paper begins with an overview of the energy policy context of Ecuador, contextualised within its political-economic history. Then the theoretical rationale for the transition arena is set out, followed by the case study methods, the results in terms of the energy vision developed through the process and an evaluation, along with recommendations on the design of the analytical framework, intended to guide energy transition policy analysis in similar contexts in future.

2. Energy and the Ecuadorian political-economic context

Ecuador's economy operates around the supply of non-renewable natural resources: principally crude oil and to a lesser extent gas and other minerals. In Wallerstein's terms (Wallerstein, 1976), it is one of the 'peripheral' countries which – for some commentators, in neo-colonial fashion (Watts, 2016) - deliver raw materials to the 'central' countries that control trade in finished goods; goods produced with raw materials and labour from peripheral societies and that feed consumer societies (Baudrillard, 1988).

While countries of the Latin American have made considerable and varied progress towards democracy, they continue to struggle with conditions of state and institutional capture and limited civil liberties (Smith and Sells, 2016). One of the consequences of a weak civil society is that insufficient attention has been given the environmental impacts of resource extraction and energy supply. The elites that control non-renewable natural resources at the national level (notably the interest groups linked to oil and mining) have developed an articulated network and an institutionality around the extractive industry that involves clientelism, corruption and

state capture (Mitchell, 2009). The institutional frameworks are based on coalitions made up of networks of actors (also connected to transnational firms), in which powerful sectors of society participate - government, public and private companies – as well as other beneficiaries of the system. Corresponding rules, norms, laws and standards support the stability of this system and help to resist change (De Graaff, 2011).

A key point in time for Ecuadorian energy policy was 1979, when, after a decade of military dictatorship, Ecuador returned to a nominally democratic system. This had a significant impact on every aspect of national governance. Prior to democratization, formerly nationalistic policies gave way to a political stance that allowed aggressive private, inward investments (Svampa, 2015). Strategic national resources were privatized, including the exploitation of primary energy resources and electricity generation. Crude oil and fossil fuels were given significant incentives for production and trade. The electricity sector pursued a hydrothermal electricity mix, consisting of large scale hydropower and fossil-fuel based thermal-electric plants (Carvajal et al., 2017)(Chavez-Rodriguez et al., 2018). This period of neoliberalism lasted for nearly three decades, from 1979 until 2007. The period was characterised by instability and political change, extensive economic liberalisation policies, with fiscal austerity and deregulation (Berrios et al., 2011).

In 2008, a new constitution was written. Taking advantage of revenue from oil exports, the new approach intended to return to a state-controlled natural resource management system and the country adopted the objective of making its energy matrix cleaner and more environmentally sustainable (CONSTITUCION DEL ECUADOR, 2008). Control of the energy sector passed from a mainly private-owned governed system to a state-owned centralised system (Escribano, 2013). The period 2008 until 2014 has generally been characterized by economic prosperity as a result of high oil prices and the increase of production from mature oil fields in the Amazon.

These factors, among others, have further cemented the neo-extractive economic model of the country. The government implemented policies to promote hydropower and there were failed attempts to boost non-conventional renewable energies (Burchardt and Dietz, 2014). Energy subsidies remained among the highest in the world (Chavez-Rodriguez et al., 2018) (having been strengthened during the previous neoliberal period), which *inter alia* has led to the transport sector becoming the fastest growing sector of the economy in terms of energy consumption (Sierra, 2016). Despite the sustainability aspirations of the reforms, Ecuador both exports crude oil and imports fossil fuels (Fontaine, 2011).

The concept of "energy matrix change" or "energy transition" has legitimised the new energy policy by promising a gradual increase of the share of renewable energy (Carvajal et al., 2017)(Chavez-Rodriguez et al., 2018). This increase of renewables is intended mainly to be implemented by the electricity sector, by decreasing fossil fuel-based thermal-electric plants and investing in eight new hydropower plants, the latter funded mainly by the pre-sales of crude oil to the Chinese government (Escribano, 2013). The policy discourse has centred on the idea of funding assets of crude oil into large hydropower plants, in the name of climate change, sustainability and a new post-oil period. Nonetheless, the governance structure of the system has remained centralised, controlled by incumbents.

By 2017, Ecuador was expected to attain 90% of its electricity generated through renewable energy sources, mainly hydropower (Carvajal et al., 2017). In principle, this objective might secure a sustainable energy supply for industrial innovation. However, state indebtedness capacity has reached its limit, oil prices have fallen and these have proved significant barriers to the industrial transformation intended to diversify export commodities and reduce the country's dependence on oil. Moreover large scale hydropower is highly contentious for its environmental and social externalities (Ansar et al., 2014). The further centralisation of energy production also

threatens to suppress the development of other renewable options for decades, stifling diversification, flexibility and local resilience.

3. Methods

The research design is consistent with the objectives of producing and evaluating a TTMA capable of producing actionable, policy-relevant knowledge for the redesign of the energy system in an illiberal democracy context. In terms of methods, firstly the capacity of the arena to support the co-production of energy policy visions and strategies was documented. Then, evidence on the effectiveness of the arena from the perspectives of the participants is provided.

3.1 Rationale for specific design features

In terms of evaluative criteria based on the goals of transition management and transdisciplinary sustainability science, the arena should enable the convening of an empowered constellation of change agents, from different sectors, to co-produce transformative knowledge (including end-state visions), build transformational leadership capacities and jointly contribute to the development of policy options for changing the energy system. It is hypothesised that such knowledge may be of most use and influence at times when policy windows occur (Kingdon, 2003). As such, the group and its facilitator(s) may be viewed as policy entrepreneurs (Huitema et al., 2011) following a strategy of preparedness for the combination of elements that (Kingdon, 2003) suggested are prerequisites for policy change. The latter are namely the conjunction of: (a) pre-prepared policy option(s); (b) a problem that fits the pre-prepared policy options or perceived solution(s); and (c) political conditions conducive for change (i.e. the conjunction of three multiple policy streams). The approach reflects particular, pre-identified roles of policy entrepreneurs: coalition building, network management and preparation for windows of opportunity. Figure 2

describes this situation, in which the arena supports the framing of a problem for an agenda opportunity, the creation of a preferred vision for a policy goal and the formulation of collective-action strategies for the opportune implementation in the wider political arena.

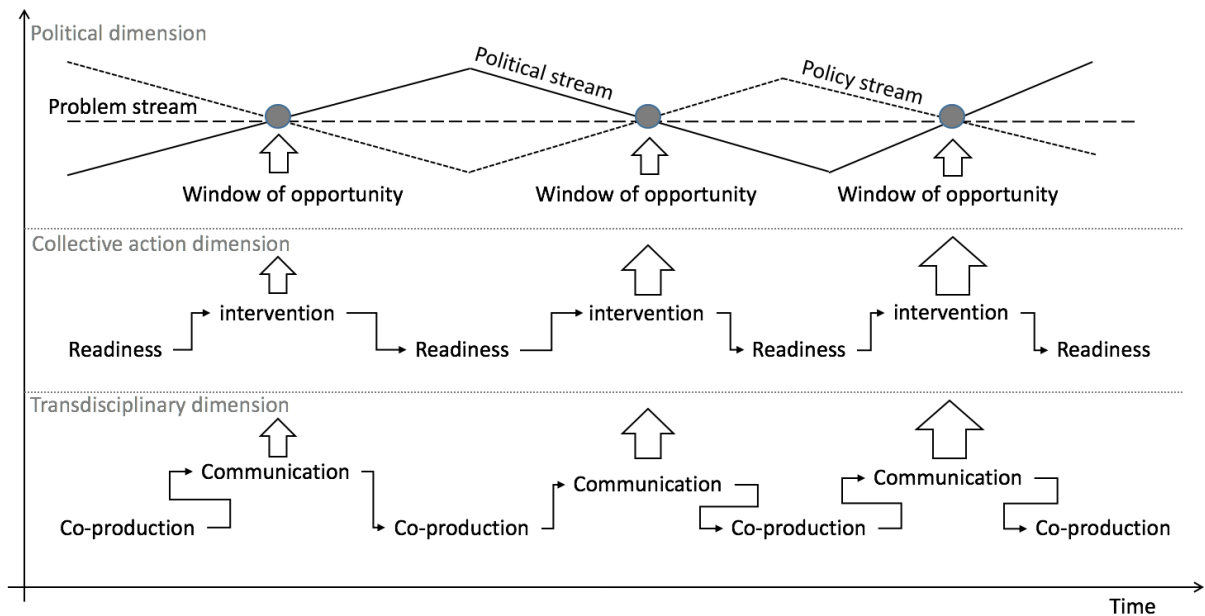


Figure 2: Synchronising Multiple Policy Streams, Collective Action and Transdisciplinary Co-production

The case study country is, as said, Ecuador, as both an instance of illiberal democracy and where the lead researcher has been and is embedded within the national energy policy process in both formally and informally instituted ways. Selection of participants was partly based on a convenience principle of known contacts but also with the intention of representing different sectors. Table 1 provides the affiliations of individuals involved, who had professional affiliations with 30 organisations, agencies and institutions across the government, society civil and

business. Together they constitute an epistemic community of stakeholders who are professionally engaged with energy policy¹.

Table 1: Affiliations of participants

Affiliations	Number
Energy Ministry	4
Environmental Ministry	1
Agricultural Ministry	1
Total Government	6
Chamber of Industry	1
Renewable Energy Companies	4
Consultancy Companies	1
Total Business	6
Local Universities	3
International Universities	3
Total Academia	6
Regional NGOs	3
Global NGOs	4
Professional Networks	1
Total NGOs	8
United Nations Development Program	2
Bilateral Cooperation	1
Multilateral Banks	2
Intergovernmental Organizations	1
Total International Organization	6
Total Stakeholders	32

Participants were guided through a dialogue process, reflecting on and integrating the knowledge held in the group, plus knowledge provided via presentations and policy documents. The first stage was to create a common understanding of the problems of the energy sector – a shared problem statement; the second stage was to anticipate future challenges, bearing in mind global and local dynamics; and the

¹ This particular arena did not involve members of the lay public. Although a case can certainly be made for doing this, the purpose of the arena was to co-produce primarily scientifically and technically informed policy visions.

third stage to develop a roadmap for future collective actions - specifically, to create visions for the reinvention of the current energy system. These stages are considered in more detail in section 3.2 and Figure 2 summarises the objectives of the arena.

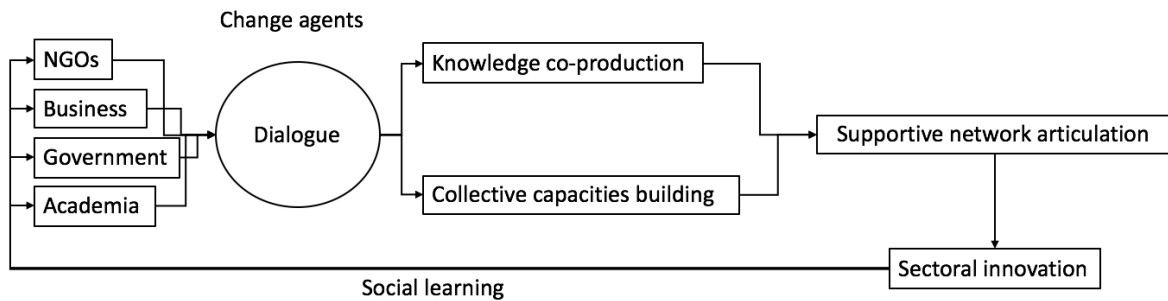


Figure 3: The objectives of the arena

(Scholz and Steiner, 2015) distinguish between different types of knowledge in transdisciplinary processes, reflecting different modes of thought, (inter-)disciplinary, perspectives, interests, systems and (organisational) cultures. Figure 3 summarises the types of knowledge involved in such an arena (Brandt et al., 2013), where *system knowledge* refers to the current state of a system and the key social and other factors involved and the capacity of the system to change (Hadorn et al., 2006). *Target Knowledge* refers to the more specific scope of action and problem-solving measures relating to natural constraints, social laws, norms and values within the system, as well as the interests of actors and their individual intentions (Jahn, 2008). *Transformation Knowledge* refers to the practical implications that can be derived from target knowledge, in respect of changes to existing habits, practices and institutional objectives. Transformation (operational) knowledge enables practitioners to evaluate different problem solving strategies and to achieve the competences to foster, implement, and monitor progress and to adapt and change behavioural attitudes (Hadorn et al., 2006). Accordingly, the evaluation takes

account of the contribution of transdisciplinary research regarding the differing types of knowledge that are helpful for such processes and how capacity building takes place through providing opportunities for shared reflexivity and trust-building. Such processes are intended to take place alongside those of formal institutions, generating alternative policy solutions via the involvement of multiple partners and scientific assistance [17] (Figure 4).

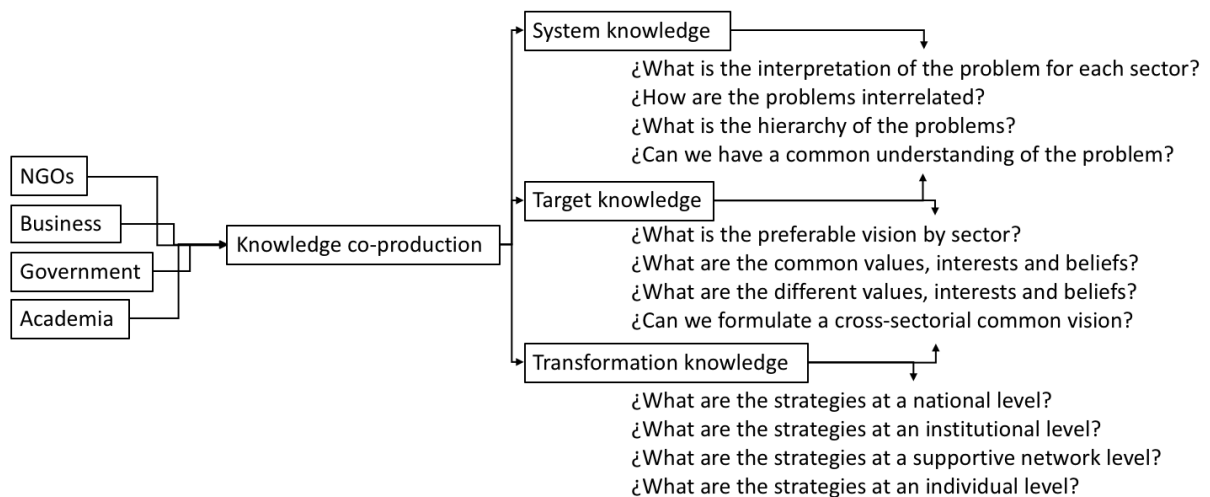


Figure 4: Co-production of knowledge

The arena design is intended to encourage reflexivity as part of consensus building, following (Popa et al., 2015). That is, to support critical reflection on participants' values and orientation as well as the ability to adapt one's own positions and goals, thereby supporting and enabling capacities for purposive, collective action (Patterson et al., 2017). This in turn is theorised to involve and develop the capacity to anticipate problems and integrate knowledge, helping to generate the relevant forms of knowledge described above. Figure 5 describes this development of collective capacities.

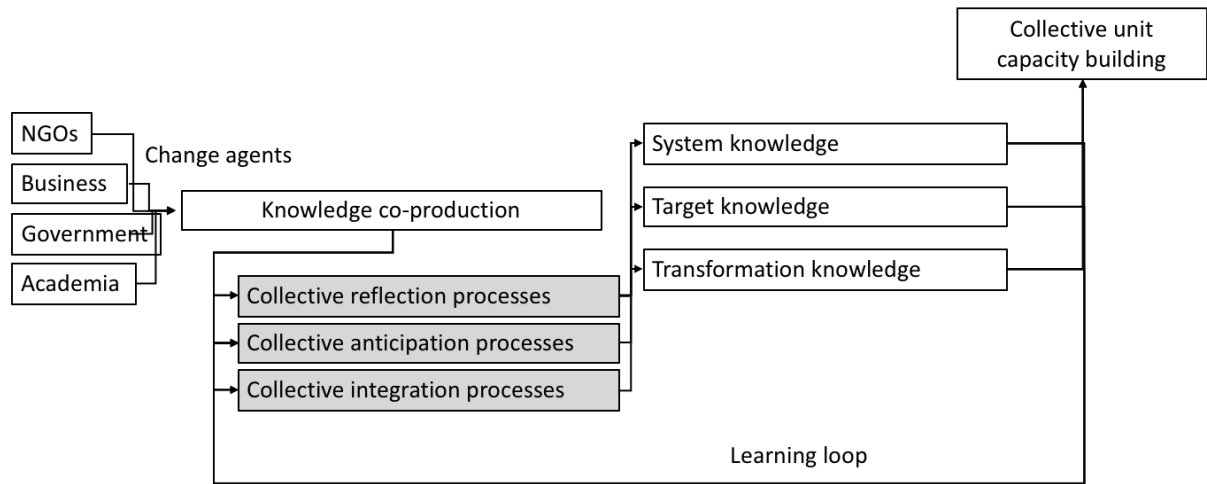


Figure 5: Development of collective capacities

Another objective of the arena is to promote trust and long-term collaboration among the participants (individual and institutional), resulting from common understandings of the problem, the identification of a shared values and the commitment to organise joint future actions. Figure 6 places these in relation to each other in order to build supportive networks and social capital. Group identity formation is important in engendering a commitment to collective action: hence (Thomas et al., 2009) refer to the psycho-social normative alignment model of promoting ongoing commitment to collective action via the crafting of a social identity based on norms for emotion, efficacy and action that contribute to a dynamic system of meaning and hence commitment to a cause. Similarly (Reicher et al., 2010) refer to social identity as shared and relational and as the product of a group's collective history and present. A shared identity also implies a need for trust building. (Harris and Lyon, 2013) observe that trust among stakeholders is shown to be built by having information on others, prior experience of working together, norms of cooperation and sanctions exerted on those who might transgress norms of behaviour (Harris and Lyon, 2013).

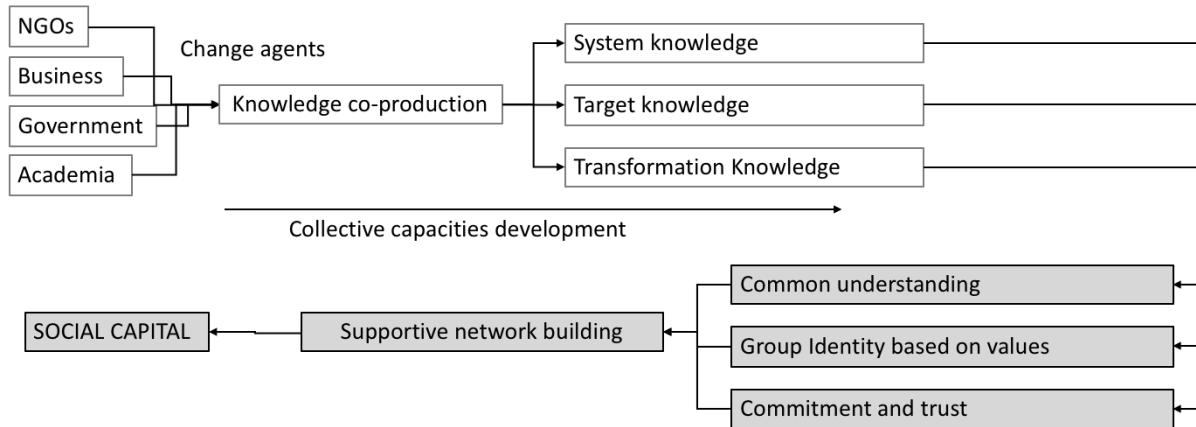


Figure 6: Supportive network building

3.2 Phases of the arena process

The phases of the arena process were sequenced so as to support the above processes and either generate or use particular types of knowledge.

(i) Contextualization (information inputs)

The contextualization phase firstly provides information on the global and national context of the energy sector, and secondly, provides information on the background, objectives and the process of the arena. This included presentations by experts and local authorities about their views of the energy sector's development towards the future.

(ii) Problem definition

Generating knowledge of the problem was based on a descriptive analysis of the problems of the Ecuadorian energy sector, investigating the lessons from the past and the present, taking into account the perspectives, concern and experience of the different actors. A common understanding of the problem was created by decomposing the elements that make up the socio-technical-ecological, techno-economic and political subsystems of energy and then discussing how they interact

and influence (positively and negatively) the continual reconfiguration of the macro system. The sequence of doing this is described in Figure 6.

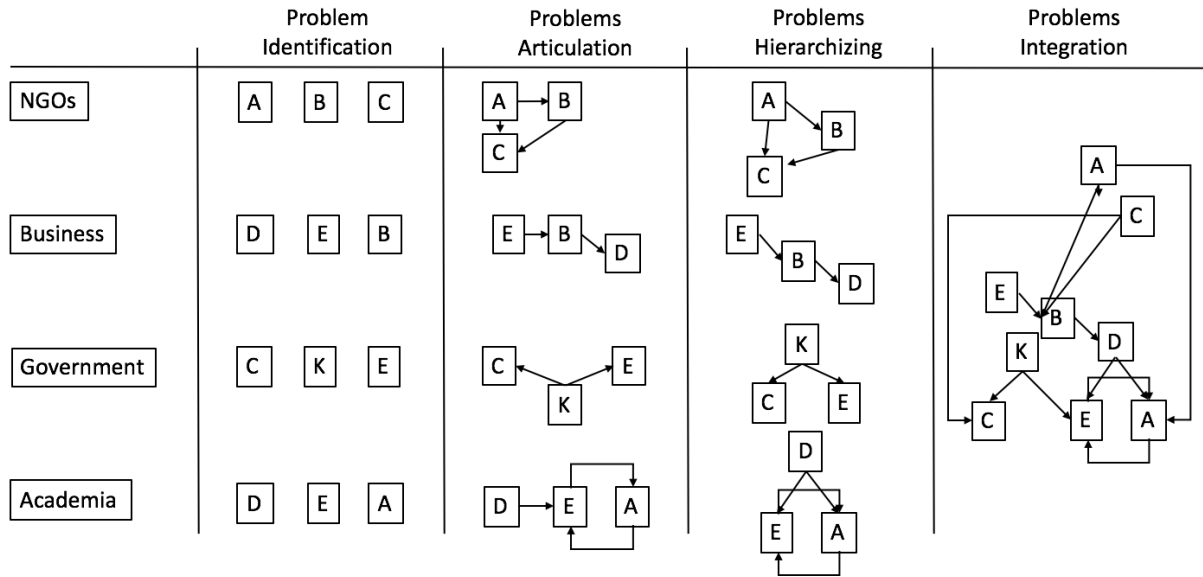


Figure 7: Common understanding of the problem

(iii) Vision development

The generation of multiple visions consisted of a reflective participatory process through which the values, beliefs, and interests of the actors, representing the different sectors of society, could be examined within the framework of the collective construction of common visions. Future visions were generated where conflicts and differences were managed via the generation of ‘preferable’ solutions instead of ‘perfect’ solutions. These used the system knowledge co-produced in Phase 2. Key elements and their interrelationships were identified, taking into account the variety of perceptions and how their arguments and reasoning may be contrary or complementary to one another. This process allows participants to identify spaces of consensus whilst emphasizing the creativity and experimentation of a reflexive governance process. The development of visions took place in sectoral groups (Government, Business, Academia, NGOs), where each sector had the task of exploring a future scenario in which the most relevant current issues can be solved,

proposing a "preferable" vision of the future of sustainable energy in Ecuador. These were then presented to the other sectors, in order to generate new perspectives, facilitate understanding and the co-production of knowledge. Figure 7 illustrates the process.

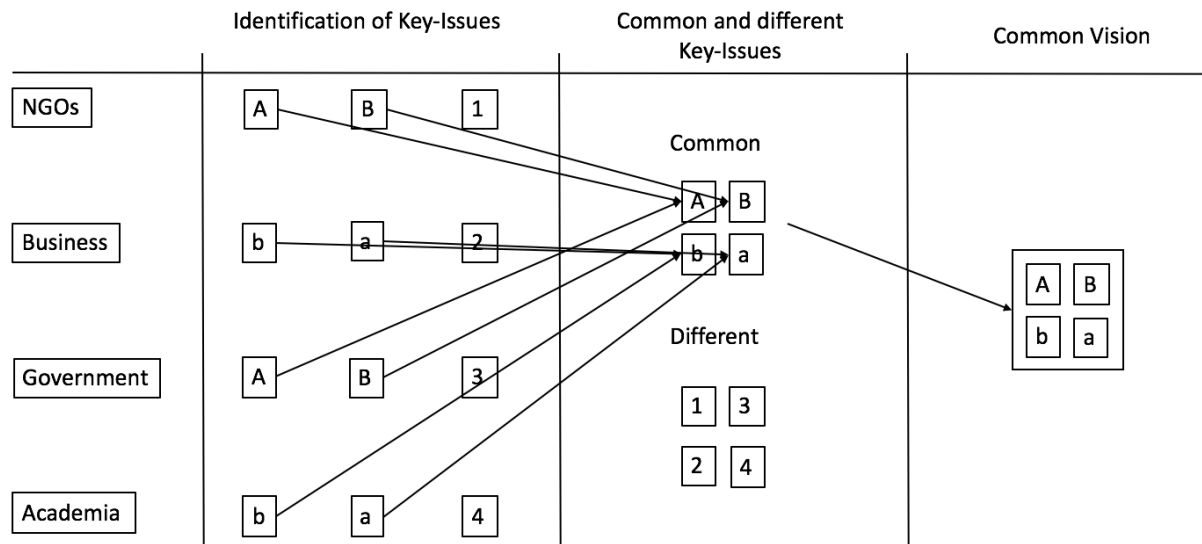


Figure 8: The development of visions in initially separate groups

(iv) Strategy development

The collective production of knowledge about strategies consisted of the formulation of the potential strategies needed to achieve the normative vision proposed in phase 3. Strategies represented the path or roadmap to be followed, taking as orientation the changes required in the elements, subsystems and dynamics to hypothetically achieve a restructuring of the system as a whole. The collective production of transformation knowledge is embodied in the formulation of potential strategies that are needed to achieve the normative vision proposed in phase 3. The strategies represent a roadmap to guide the actions required to hypothetically stimulate change in the energy system's structure. Figure 8 represents this formulation of multilevel strategies as a collective process of understanding the need for cooperation and

linking of the different levels; from the individual contribution, collective action and institutional commitment, to the involvement of decision-makers at a national level.

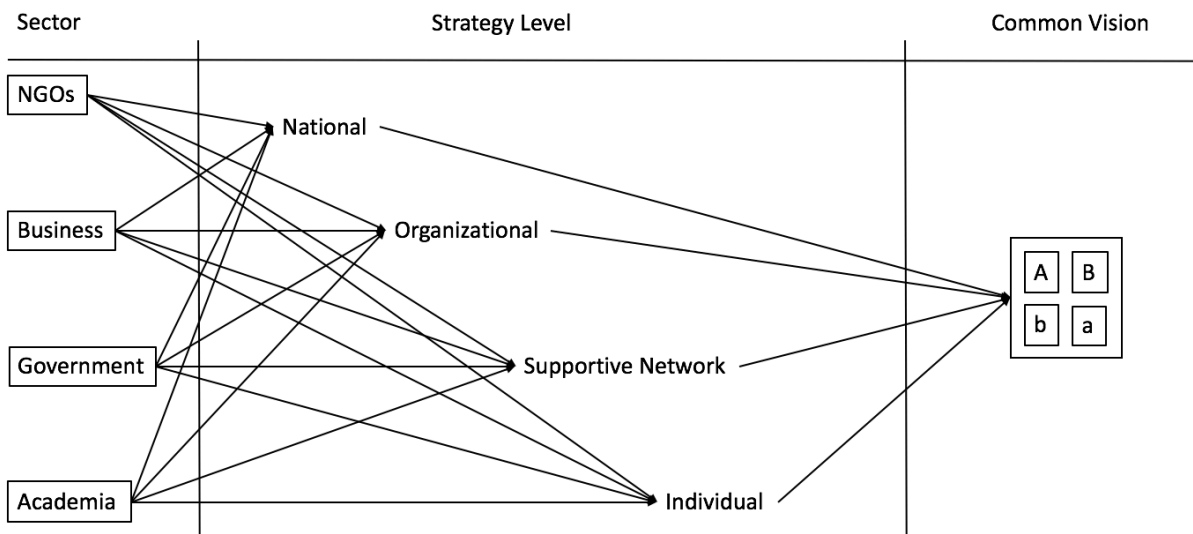


Figure 9: Formulation of multilevel strategies

Through the previous processes of reflection, anticipation of future scenarios and integration of varied perspectives, the participants in the final phase of the participatory process managed to: a) reach a common understanding about the complexity of the energy problem; b) build a group identity and vision based on common values, beliefs and interests; and, c) articulate a group strategy to potentially influence the processes of energy policy formulation. This strategy is enacted through the collaborative generation of knowledge, the construction of an alternative discourse, and strategic cross-sectoral actions which promotes transformation towards a sustainable energy system.

In terms of potential windows of opportunity, the arena was implemented between the first round of presidential elections and the second round of presidential elections and in general such junctures offer situations of policy uncertainty during which alternative policies may find a receptive audience. Another advantage of undertaking

this during or close to election periods is that governmental actors who normally empowered and indeed authoritarian are temporarily in a situation of uncertainty and more inclined to engage with those who are normally disempowered. In other words, they are more open to dialogue with stakeholders and power asymmetries are temporarily reduced. Figure 9 provides additional detail on the wider political juncture relevant during the period of the study.

Regarding data collection and analysis: firstly, ex-ante interviews with the participants were conducted and transcribed; secondly silent observers recorded and observed the arena process; and finally a post-hoc questionnaire was administered. Themes and issues identified during the session informed the Tables and framework below and further reflection was undertaken via thematic coding of the transcripts in qualitative data analysis software Atlas TI.

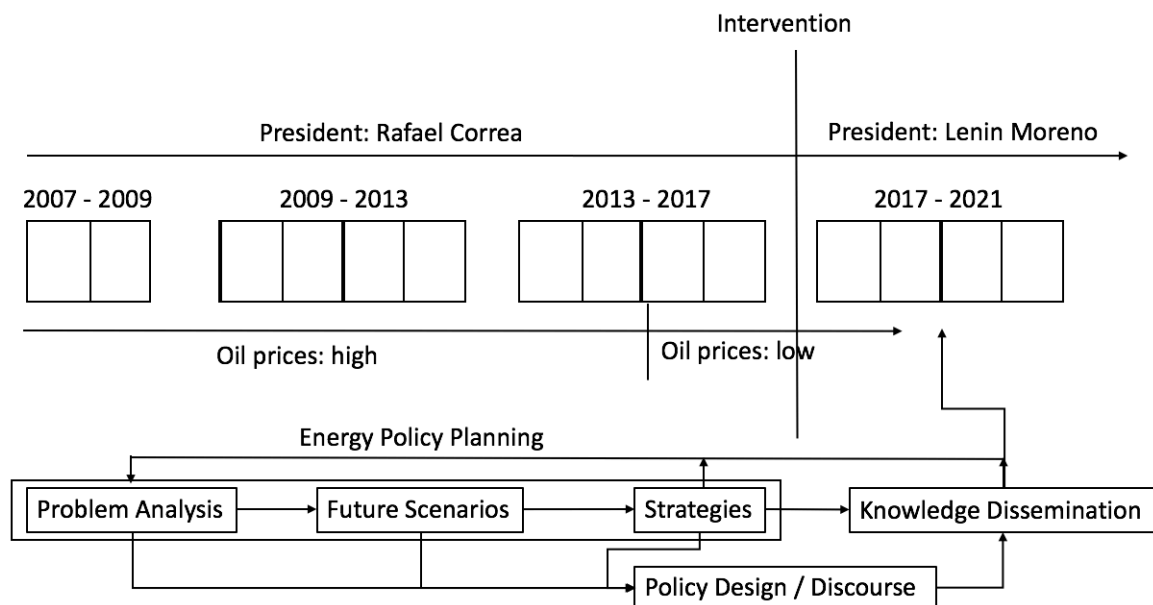


Figure 10: Window of opportunity by design, Presidential Elections, new cycle of energy policy planning

4. Results

Given our objectives of trialling and evaluating a process, as well as making recommendations regarding any refinements of that process, the results relate to both content and process. The content-based results consist of a conceptual model of the energy system as it currently is; a preferred, long-term vision; and a strategy for its implementation.

4.1 *Process and content*

Overall, the arena design supported joint cross-sectoral and inter-organizational effort, enabling the visualisation of alternative futures and the development of policy strategies for realising these. The arena also facilitated a better understanding of the positions held by those in the different sectors, supporting solutions-oriented approaches that are complementary rather than competing, based on a common understanding of the current energy problem that included the perspectives and concerns of the different sectors of the society involved. Table 2 summarises this, alongside perceptions of the key features (right hand column) and problems (centre column).

The results presented are a summary and synthesis of perspectives of the different stakeholders on the participatory process. As can be seen in Table 2, the current development path is viewed as over-reliant on a small number of large hydropower plants, with limited opportunity for diversification into other forms and scales of renewable energy supply that might reduce the vulnerability of the power grid, reduce socio-environmental impacts and catalyse new initiatives among small and medium sized companies. In terms of ownership, there is a preference for the private sector to have a role, but not to the extent that state monopoly becomes private

monopoly or oligopoly: it is diversity that is sought, for its presumed resilience and dynamism.

The participants' views favour micro, small and medium scale energy supply at different subnational levels, paralleling the results of United Nations Habitat III meeting that was held in Quito-Ecuador in 2016, where the need to decentralise energy systems to municipal levels was highlighted (UN-Habitat, 2015)(Barragán-Escandón et al., 2017). Stakeholders were similarly concerned about the lack of development of the microgeneration and/or distributed generation to date in Ecuador. The linkages between decentralization and democracy was also a priority within the discussions, where participants pointed out how decentralised infrastructure can strength democratic processes and stimulate the distribution of investments, benefits and wealth around the country and at the same time create a nation-wide industrial constellation by supporting and mobilizing the capacities of small and medium enterprises currently trying to promote non-conventional renewable energy supply.

Moreover, the participants proposed a future energy matrix that is a hydro-solar mix, where the existing large hydroelectric supply acts as base-load, synchronizing and coordinating with micro, small and medium solar-photovoltaic systems that would more fully exploit the solar potential of the equator in locations with suitable conditions, as well as residential solar thermal-water-heaters in Amazonian and coastal regions. Other types of non-conventional renewable energy technologies such as biomass (solid, liquid and gas), wind and geothermal were also consider as part of a preferable future scenario that would replace fossil-based sources at a progressive pace.

The energy matrix diversification according to the participants would, overall, reflect heterogeneous solutions on a multi-level and multi-scale basis, diverse in terms of

technologies and plural in terms of decision-making and investment (e.g. public-private partnerships, municipal-private partnerships, etc.). This is reflected in Table 2 below.

Table 2: Shared understanding of current energy system problems and a future vision

CATEGORIES	SUB-CATEGORIES	PROBLEM	VISION
Energy Planning	Interconnection with National Development Plan	No interconnection with the National Sustainability Plan	The National Plan sets the principles and values of the energy system
	Planning Horizon	Short/middle political terms planning	Long-Term multi-stakeholder visions
	Planning Goal	Only focus on electricity / short term: 90% Hydropower in 2017	Zero Fossil Fuels in 2040
	Regional Integration Approach	National Sovereignty: Protectionism / Competition with neighbour countries	Regional Sovereignty: renewable energy resources complementarity among countries
Enabling environments	Financial Mechanisms	Only Public investments with international Chinese loans and multilateral credits are directed to centralized extractive projects	Private-Public-Partnerships (PPP) attracting international direct investment
	Knowledge Production and transfer	Lack of processes of knowledge transfer, production, research and development	Existence of sectoral knowledge production loops. Cooperation between academia, state and industry via knowledge platforms
	Capacity building	Lack of capacities for system transformation	Existence of sectoral learning loops. Cooperation between academia, state and industry via knowledge platforms

Technology and infrastructure	Technological Diversification in the Supply	Low: Large Hydro-Thermal	High: small and middle size poly-technological (Mainly: Hydro-solar+ (biomass/waste/wind))
	Energy Conversion	Promotion of Fossil Fuel-based refineries and fossil fuel-based infrastructure	Bio-refineries and renewable power plants are in operation
	Demand / Consumption	Fossil fuel-based technology use	Electrification of the final uses
Regulatory Frameworks	Ownership of the infrastructure	State-owned	Private-Public-Partnerships
	Supply Subsidies / Incentives	Fossil fuel subsidies and traditional electricity subsidies	Transparent / fair competition between technologies
	Demand Subsidies / Incentives	Incentives for the use of fossil fuels	Incentives for the use of efficient electricity-based technologies
	Market access	No regulations that incentivize the participation of private sector in the supply of renewable energy	Regulations incentivize the participation of private sector in the supply of renewable energy via Feed-In-Tariffs (FITs) and Auctions
Institutional Framework	Degree of centralization in decision making	Centralized and Top-Down	Decentralized & Centralized: Bottom-up, Middle-out and Top-Down
	Market structure	Mono / Oligopolies	Multi-SMEs
	Cross-sectoral integration	Disconnection of sectoral agendas	Mutually consistent and reinforcing policy mixes
	Institutional Networks structure	Formal sectoral networks with disconnected agendas	Informal and formal cross-sectoral networks interacting
	Governance type	Authoritarian, state-driven technocratic governance type	Participatory and reflexive dynamic among societal sectors; polycentric
	Civil Society Role	Civil society unable to participate in the decision-making processes of the energy sector	Civil society is supporting decision-making, promoting dialogue, production of knowledge,

			and integrating new perspectives
Cultural Change	Education	No nation-wide environmental education programs for the different levels of education	Society is well educated about environment and sustainability through formal programs for all levels of education
	Mindset change	Neither information nor knowledge are regularly disseminated about the changes needed in the energy system.	Long-term communication campaigns are disseminating information driving mindset change
		There is no experimentation with new models of organization, business and sectoral interaction.	Knowledge and social innovation platforms are part of the sectoral culture
	Consumer behaviour	Consumers are not environmentally aware	Consumers are socially and environmentally responsible in regards to the selection of efficient artefacts and their energy use
		Consumers are not actively part of the renewable energy market	Consumers are becoming prosumers (producers and consumers). Prosumers sell and buy renewable energy
Agenda Intersection	Water-Food-Energy Nexus	Lack of integration of the political agendas of the Ministry of Energy with the Secretary of Water and the Ministry of Agriculture	There are formal and informal fora's where actors of the three sectors interact and produce solution-oriented knowledge
	Environment/Clim ate Change-Energy Nexus	Environmental Ministry does not have strong influence on the decision-making process of the energy planning	Environmental and renewable energy actors from academia, business sector, NGOs and government have developed mechanisms

			for interactions and decision-making support
Transportation (Mobility)-Energy Nexus	Transport and Energy Agendas do not have a strong interface. Inefficient individual fossil-fuel-based systems are promoted	Efficient, social and environmental friendly multi-modal systems are implemented with the support of participatory planning process involving the Ministry of Transport, subnational levels (Municipalities) and cross-sectoral stakeholders	
Social Development-Energy Nexus	There isn't an Energy Social Agenda where social and energy strategies have an interplay	A cross-sectoral Energy Social Agenda is implemented in order to deal with energy-justice, energy-poverty, energy-equity, energy-democracy	
Productive Matrix-Energy Nexus	Crude oil is the main export product and will remain for the next 10 years until the reserves decline dramatically	Renewable electricity is fuelling the productive matrix transformation by electrifying the production of goods and services for export	
International Affairs-Energy Nexus	Weak regional energy integration processes. There are not complementarity strategies	Strong energy systems integrations processes within the South American Region promoting resources complementarity	

Another key theme in terms of output from the TTMA is the need for attention to the ongoing dependence on and subsidy for fossil fuels in the transport (mobility) sector and residential LPG (Liquefied petroleum gas) for cooking and water heating, as well as the lack of policies for encouraging energy efficiency or reduce waste and

environmental impacts. The group reflected on the need to reduce and redirect current fossil fuel subsidies towards dynamic incentives that promote renewable technologies in these sectors.

Building on this, participants produced a set of strategies for achieving the vision (Table 3). The latter covered topics including integrated planning and political agendas intersection (water-food-energy nexus); decentralisation of infrastructure and decision making; good governance and participative energy planning; diversification of energy sources; demand side management through education; correct endowment of energy subsidies and transparency in prices; the establishment of a zero fossil fuel target; strengthening of energy security; resilience and sustainability of the system, among others.

Table 3: Co-produced strategies for achieving the new energy system vision

STRATEGIES FOR ENERGY SYSTEM TRANSFORMATION	
Cross-sectoral Participatory Scenario Planning	To create a common vision about the future of Ecuador, not only energy. This vision will guide the shaping of the energy system
	To institutionalize participatory planning process with long-term visioning processes
	To develop cross-sectoral key-expert dialogues and participatory planning workshops about political agenda intersections
Educational Strategies for Sustainable Development	To develop and articulate educational proposals to be transfer for the implementations by the National Authorities
	To institutionalize knowledge co-production for the innovation of the sectoral culture
Financial Strategies	To develop regional expert dialogues and workshops about energy complementarity in order to co-produce knowledge about the energy complementarity in the region

	To produce technical robust knowledge about redirecting investment to sustainable alternatives. Divesting Carbon and investing in Renewability
	To develop a regulatory framework proposal to promote legal security and Private-Public-Partnerships for investments
	To develop a regulatory framework proposal to promote small and middle size poly-technological (Mainly: Hydro-solar+ (biomass/waste/wind)) investments
	To incentive the use of electricity-based alternatives. Creating awareness of the need to eliminate fossil fuels subsidies and incentive the use of local renewable energy sources
Knowledge Co-production Platforms	To institutionalize knowledge co-production for the innovation of the sectoral culture
	To develop regional expert dialogues and workshops about energy complementarity in order to co-produce knowledge about the energy complementarity in the region
	To produce technical robust knowledge about redirecting investment to sustainable alternatives. Divesting Carbon and investing in Renewability
Regulatory Frameworks Development	To develop a regulatory framework proposal about sustainable energy pricing policies
	To develop a regulatory framework proposal to incorporate future participation of private companies in the process of energy supply
	To develop a regulatory framework proposal to incorporate future participation of private SMEs companies in the process of energy supply
	To develop a regulatory framework proposal to promote legal security for Private-Public-Partnerships and Investments
	To develop a regulatory framework proposal to promote small and middle size poly-technological (Mainly: Hydro-solar+ (biomass/waste/wind)) developments

Strategic Communication Strategies	To develop and implement multi-channel communication campaigns to create awareness, understanding, engagement, and action by societal actors
	To incentive the use of electricity-based alternatives. Creating awareness of the need to eliminate fossil fuels subsidies and incentive the use of local renewable energy sources
Supportive Networks Articulation	To empower cross-sectoral partnerships of civil society, academia and business sector by generating and transferring knowledge and articulating networks

Figure 11 summarises the interconnections among the elements of the reconfigured system envisaged.

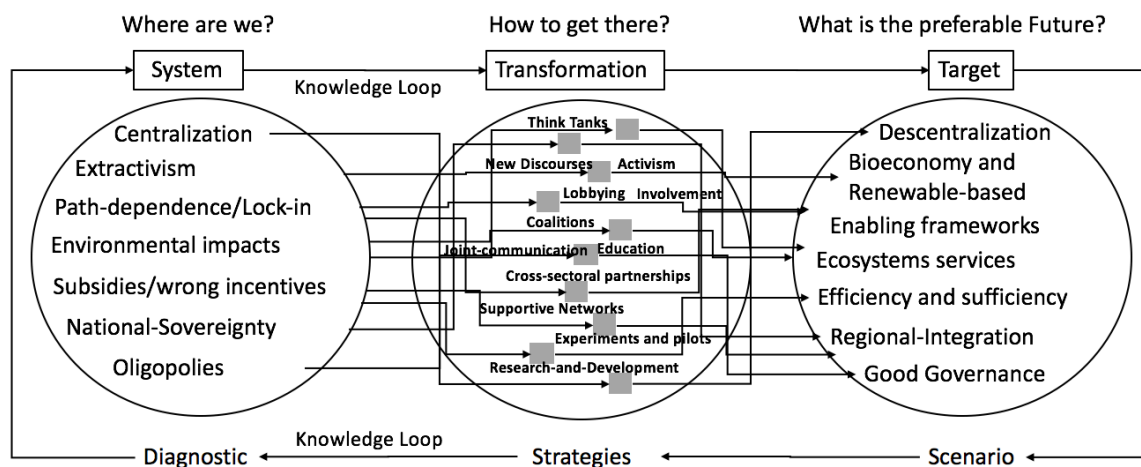


Figure 11: Detail of interconnections

Figure 12 describes some of the strategies by which the new vision would be reached, encompassing new knowledge co-production and capacity building, networks and coalition articulation and various strategic communication strategies and channels (fostering interface spaces and dialogue, participation and involvement, lobbying, think tanks, policy support, cyber-politics) creating a knowledge and communication loop and a learning and empowering loop.

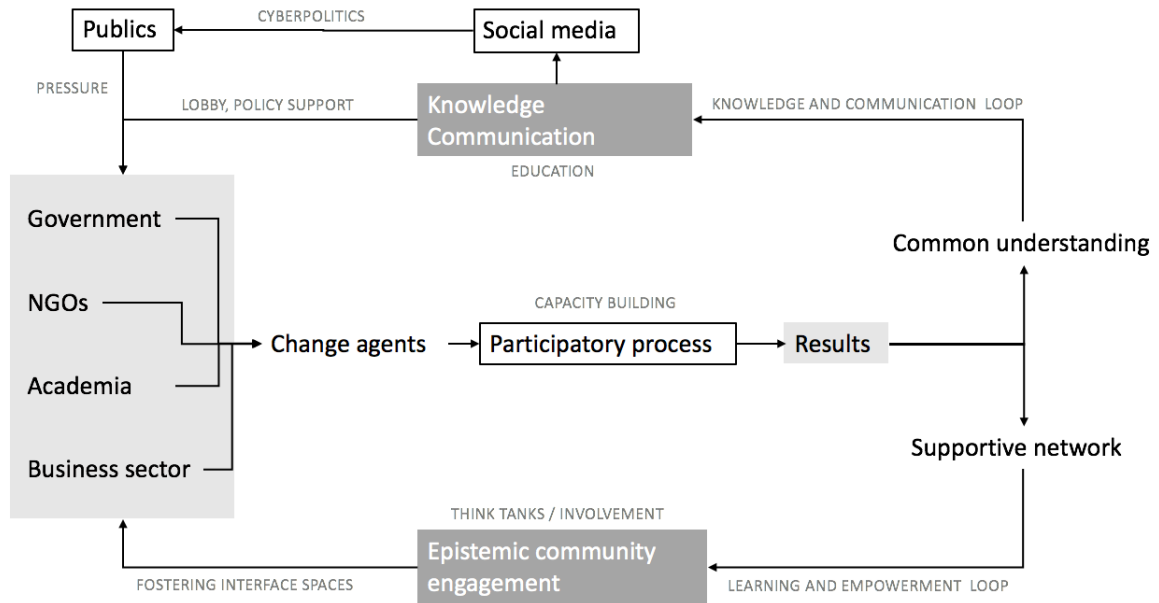


Figure 12: Transformation strategies towards sustainable energy

4.2 Evaluation and framework to guide energy transition policy development

In terms of evaluation, the participants concurred that the transdisciplinary transitions arena succeeded in stimulating socio-professional networks that were likely to endure in the medium to longer term. Nonetheless, there is clearly scope for longitudinal study, to assess any changes in the access to power, changes in discourse and understandings of energy sector problems both in the niche and the political arena. Table 4 presents descriptive statistics for selected process evaluation questions, drawing on over 30 such questions, all inviting responses on a 5-point Likert scale. All show a large majority positive view.

Table 4 Selected process evaluation questions (n=30 participants)

Question	Strongly agree	Agree
The knowledge generated is relevant to the current circumstances.	83%	7%
The knowledge generated contains ideas that question the status quo.	47%	33%
The knowledge generated helps to understand the logic between the elements of the system.	37%	57%
The process stimulated self-reflection about my position (orientation of my values, beliefs and interests) regarding the energy system.	30%	40%
The process stimulated the connection of various types of knowledge and integration of different perspectives on the energy sector.	43%	37%
The process encouraged the expansion of my knowledge about the sustainability of the energy sector	43%	27%
The group dynamics generated a common understanding of the key elements of the energy problem.	43%	40%
Group dynamics enriched the understanding of the problem by including new perspectives.	53%	37%
The group dynamics identified elements that can articulate a sustainable vision of the future of the energy sector.	50%	30%
Group dynamics facilitated the process of developing strategy proposals to achieve the vision for the future.	33%	40%

Based on the above rationale, sequenced structure and effectiveness of the arena in the terms described above, an Energy Transition Assessment Framework is proposed as follows in Figure 12. The purpose of this framework is to aid and guide thinking in similar contexts, building on the experience in Ecuador. It begins with development and planning principles for orientation that draw on the principles of transition management and transdisciplinary (sustainability science) research, particularly those relating to the inclusion of a range of stakeholders in the design of policy and practice for sustainability (Loorbach and Rotmans, 2010). It also draws on the knowledge-related principles of transdisciplinary (sustainability science) research, which seeks to incorporate and cohere different types and sources of knowledge (Pohl and Hadorn, 2008). Finally it draws on the systems perspective of

sociotechnical transitions thinking in general, in which the different realms of society (politics, economics, resources, technology etc.) are viewed as inter-related, mutually influencing and hence requiring policy responses that recognise this (Geels, 2002). As such, the framework lays out and categorises recommended, core elements for consideration in such arenas.

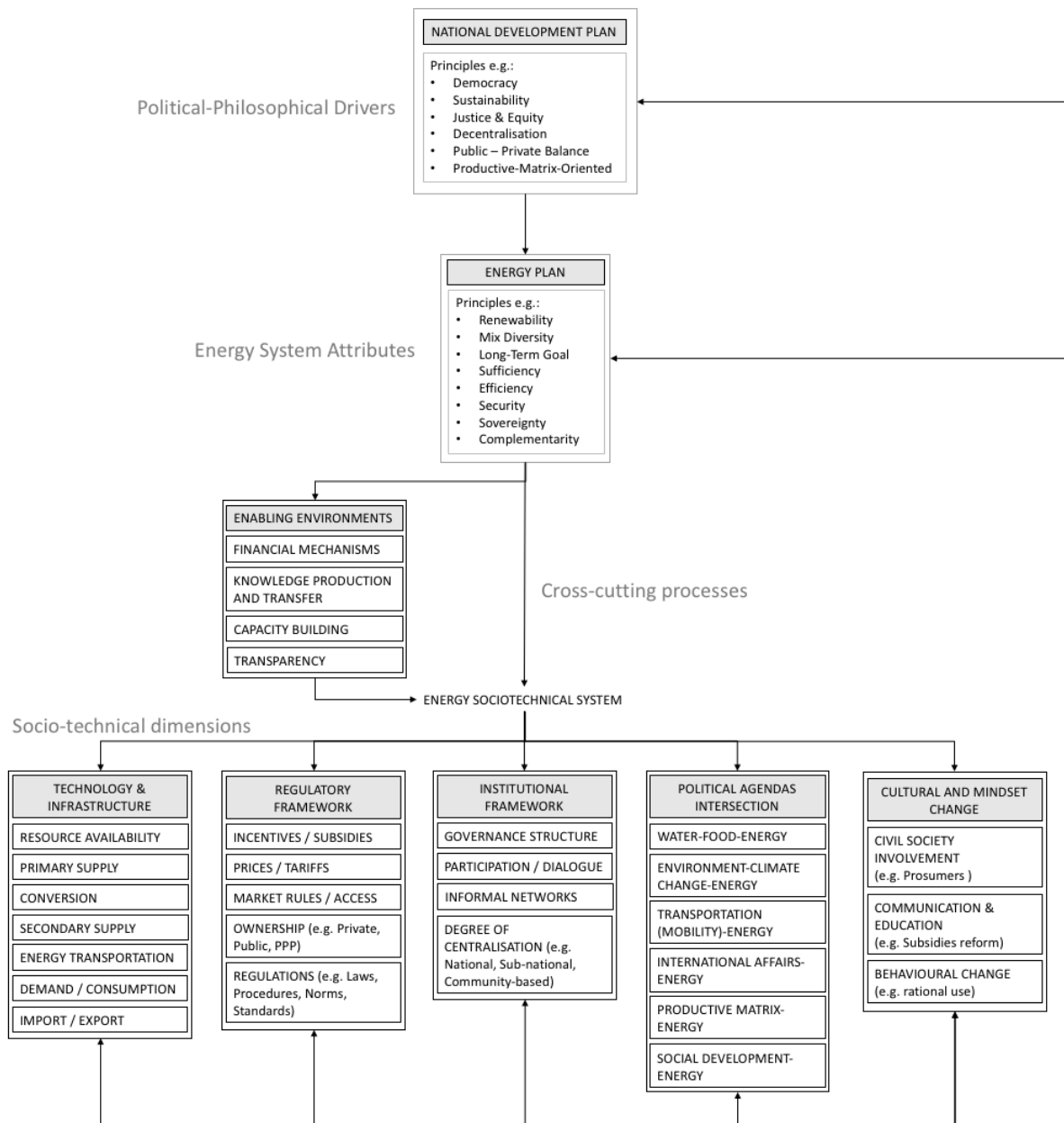


Figure 13: A framework for energy transition policy

5. Discussion

Experience with the transition arena in Ecuador raises a number of inter-related issues. These include the normativity of the transitions management, transdisciplinary sustainability science research and the advocated framework; their generalisability; and issues of democratic representation, including the role of civil society and other actors, such as lay publics. These issues are considered below.

Within a sociotechnical frame, alternative visions of the future are conceived of as selection pressures, while associated civic debate and NGO campaigns are conceived of as articulation pressures (Smith et al., 2005). Transition management arenas are premised on the view that formal institutions are not themselves capable of generating these types of pressure. That is, that they are not amenable to the types of thought, social and policy experiments – as well as widely cross-sectoral engagement - that taking account of system interconnections requires. Formal institutions have path dependencies that incline towards maintaining the status quo and formally instituted policy change often has implications for resource distribution; both features mitigate against change and experimentation. In short, those operating within and dependent on a relatively stable sociotechnical regime are unlikely to seek to destabilise it unless they see some purpose to doing so and it is often the need to respond to external pressures that provide this purpose and motivation.

In illiberal democracies, the stability of the status quo is strengthened by features such as state capture, authoritarianism and monopoly or oligopolistic control. Transition management seeks to intervene and disrupt the status quo in non-confrontational ways, though of course this may well limit its effectiveness in terms of policy change. Nonetheless, it seeks to build a wider policy legitimacy through relatively inclusive participation and hence perceived procedural legitimacy (Suchman, 1995). As a governance perspective, transition management views the

engagement of a wide variety of stakeholders in policy development as a necessary element in furthering sustainability through enhanced social learning (Kemp et al., 2007)(Upham et al., 2015).

The TTMA that is trialled here - and the underpinning, corresponding analytical framework that is advocated – both allow for the explicit definition of particular norms, but only to the extent that these are consistent with the premises of sociotechnical sustainability transitions (Geels and Schot, 2007) and transdisciplinary sustainability science research (Lang et al., 2012). Within these terms, the framework allows for the expression of different specific norms (e.g. regarding the ongoing use of fossil fuels with carbon capture or large-scale use of biomass and hydropower). As such, therefore, while it can be seen that the TTMA and the proposed analytical framework are somewhat normatively flexible and generalizable, it should be recognised that they do embody norms of liberal democracy.

Moreover, it is also recognized that there are alternative conceptions of sustainability and optimal or preferred sociotechnical routes to similar lower carbon goals. This raises the question of how the arena process and the framework might accommodate any irreconcilable clash of views within the group. Here, the development of visions deliberately took place in separate sectoral groups (government, business, academia and NGOs), where each sector had the task of developing a future scenario that would address the problems that they perceived as most relevant. These scenarios were then presented to the other sectors, in order to generate new perspectives, facilitate understanding and co-produce a synthesis scenario. This process ‘worked’ because the invited participants were known *a priori* to share compatible views on how the energy system in Ecuador should develop. This is an important success condition. If participants are unable to generate a consensual vision, then a number of variant visions may be required and this should not (in our view) be seen as problematic.

6. Conclusion and Policy Implications

A case for the value of blending aspects of transdisciplinary sustainability and transition management, to form a 'TTMA', is advocated, by which to justify and guide the engagement of multi-sector actors in the design of alternative energy futures in illiberal democracies. The rationale for these centres on the premise is that outputs from such processes may function as a source of pressure on the sociotechnical regime, should policy windows arise. Here such a TTMA is described and its application in Ecuador assessed, with the design being found effective in terms of generating a consensual vision and set of policy-related strategies. A framework for guiding future instances is set out accordingly.

At the same time, it is also clear that such proposals are no panacea for the interconnected political and energy system problems of countries such as Ecuador. Indeed, their location outside of formal institutions can be viewed as a weakness, with no direct input to formal policy processes. Moreover, consensus within such processes cannot always be presumed, especially as policy proposals become more specific. Nonetheless, the development of more than one vision and set of strategies within such contexts is feasible and can be allowed for. Overall, experience with energy-related TTMA outside of developed countries is still limited in extent and there is significant scope for further empirical and theoretical consideration of how well such concepts transfer to different political and political economic contexts.

While transition management experiments have been implemented in Europe and interest is growing in transdisciplinary science approaches, use of these rationales for informal energy planning processes in developing countries, where energy sector planning processes are autocratic or technocratic, state-driven-centralised or private-driven-centralised, reflecting the characteristics of illiberal democracies and state capture, has been less common. Nonetheless TTMA's arguably have potential

for application in Latin American and developing countries, where the conditions permit the parallel development of non-mainstream policy, awaiting policy windows for change. Indeed, the authors have undertaken a similar exercise in Peru, where the political context is governed by the private sector (state capture). The results were similar, though the scenarios and visions involved more small-scale renewables, multi-pole decentralized governance, distributed generation; transparency was also given a higher priority. There is also experience of participatory modelling and planning in Chile and Argentina, having been promoted by governments and involving civil society, business and academia (Ministerio de Energía, 2016)(Iniciativa Escenarios Energéticos Argentina 2035, 2015).

Overall, the originality of the study lies in two main contributions. The first is the combination of transdisciplinary research, transition management and multiple streams approach as a rationale; the second is the practical application, trial and evaluation of the approach in a developing country, specifically an illiberal democracy. It was found feasible to articulate a multi-stakeholder group in order to co-produce knowledge about a common problem, a preferable vision and strategies that are amenable to translation to policies. While a TTMA cannot of course guarantee policy implementation, with institutionalisation or adoption of TTMA output being subject to political and decision processes outside of its control, the TTMA at least offers a preparatory stage for transformation, helping to develop supportive knowledge-networks and alternative discourses, for windows of opportunity.

The implications of the above are primarily in the informal rather than formal policy sphere, given that transition management arenas are specifically intended to mitigate against the path dependencies or lock-ins of formal institutions. As stated, the objective of such arenas is to develop alternative or informal policy that is available for application when circumstances permit. The policy objectives and strategies developed through the arena reflect the principles of transition

management, which in turn reflect a systems perspective. Hence, they call for policy mixes that are consistent in the sense of being mutually reinforcing despite being applied in different sectors. They call for a more decentralised and liberalised energy system with multi-scale renewable energy supply.

Overall there is a strong theme of opening the energy system up to other possibilities than that current state monopolies permit, while at the same time avoiding simply creating private monopolies or oligopolies instead. These possibilities relate to technology types and scales, institutional frameworks and – importantly - governance arrangements. In an illiberal democracy, the latter is at the heart of the problem and informal policy arenas are an attempt to improve on a situation where too few interests are involved in policy shaping. Going forward, it remains to be seen to what extent Ecuadorian energy policy opens up in all senses.

7. Declarations

Ethics approval and consent to participate

Via an ethical protocol, the participants gave informed consent to the use of information generated in the forum process. Conditions of anonymity have been adhered to.

Consent for publication

There is no individually identifiable information in the paper.

Availability of Data and Materials

The study is semi-qualitative and conforms to the usual norm of maintaining confidentiality for those who took part, rather than hosting data publicly.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The lead author designed and undertook the research project, including establishing the theoretical framing. The second author made a substantive contribution in terms of discussion of ideas and language. The third author also added to the theoretical development of the paper.

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CHAPTER 4
THE PERUVIAN CASE

Building a Coalition with Depoliticized Sustainability Discourse: The Case of a Transdisciplinary Transition Management Arena in Peru

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Abstract

Transition management uses the depoliticized, rational discourse of systems terms, social learning and societal reflexivity. Transdisciplinary sustainability science research similarly uses the politically neutral terms of supporting the coproduction and integration of different types of knowledge. Yet both are clearly normative, resting on notions of participatory democracy and adopting environmental and social sustainability as explicit norms. Here we present the case of a transdisciplinary transition management arena in Peru, convened to develop a vision of a lower carbon, more decentralized and resilient national energy system. We show how the characteristics of the arena can help to foster the necessary conditions for empowerment and how these in turn both support – and are supported by - the ability of participants from different backgrounds generate shared problem statements, visions and strategies, building towards a coalition for change. While it remains to

be seen how politically influential such arenas can be in the medium and long term, we show that depoliticized, rational sustainability discourse nonetheless has a political role to play in helping to legitimize informal institutional efforts towards energy policy change.

Keywords

Peru; transdisciplinary transition arena; energy democracy visions; empowerment

1. Introduction

Transition Management (Kemp, Loorbach, & Rotmans, 2007) is premised on a co-evolutionary conception of socio-technical change, in which 'transition' is understood as shifts or system innovations between distinctive socio-technical configurations encompassing not only new technologies, but also corresponding changes in markets, user practices, policy and cultural discourses, as well as governing institutions (Loorbach & Rotmans, 2010). (Geels & Schot, 2010) characterize transitions as following: (1) co-evolution and multiple changes in socio-technical systems or configurations, (2) multi-actor interactions between social groups including firms, user groups, scientific communities, policy makers, social movements and special interest groups, (3) 'radical' change in terms of scope of change (not speed), and (4) long-term processes over 40-50-year periods.

Those seeking to implement transition management would examine the possibilities for change in terms of three types of governance activities - strategic, tactical and operational - which as a framework are intended to provide a structure for analysis (Kemp et al., 2007):

- Strategic level: processes of vision development, strategic discussions, long-term goal formulation, culture change etc.; this includes governance activities

related to long-term changes, which are not institutionalized in regular political cycles and have a time horizon of 30-50 years;

- Tactical level: processes of agenda building, negotiating, networking, coalition building, identification of 'barriers' etc.; this includes steering actions (planning and control, financial support and programs) and institutions (rules, regulations, organizations, networks, routines, infrastructure) related to the dominant sociotechnical regime and have a time horizon of 5-15 years;
- Operational level: processes of experimenting, project building, implementation of governance, and autonomous actions to achieve individual goals, etc.; this is the level of radical innovation, referring to activities with a time horizon of up to 5 years.

Despite the systems and managerial discourse, in practice transition management is political in the sense of seeking to intervene in the power to act. Hence Avelino and Rotmans (Avelino & Rotmans, 2009) argue that while instrumental, structuralist and discursive understandings of power differ, each has informative implications for how power is conceived in the context of transitions. Moreover, this is so even when transition management is intended to be consensual. Characteristically, transition management involves the engagement of civil society stakeholders in the meaningful engagement and co-construction of more sustainable futures (Hölscher, Wittmayer, Avelino, & Giezen, 2015). That is, the intention is that civil society may be empowered through the provision of 'experimental' fora or platforms that create new opportunity structures (Narayan-Parker, 2005), in which civil society actors can forge new agency-networks amongst themselves and also often with governmental actors (Frantzeskaki & Kabisch, 2016). These typically connect local, intermediary and state levels and investigate or even trial options that those that are legally mandated (Alsop, R., Bertelsen, M. F., & Holland, 2006).

Similarly, regarding facilitating conditions in transition management-like processes that include an open discussion format that enables sharing, the inclusivity of actors from multiple disciplines and with different expertise and experiences, and the legitimacy of the knowledge contributed to the co-production process, these are all consistent with a particular view of deliberative democracy that extends beyond representation and involves direct engagement (Dryzek, 1990), (Bohman, 1996), (Barber, 1984). Thus, the perspective of transition management is strongly linked to the discourse and practice of participation and sustainable development, which highlights the need for participatory approaches in view of factual and social complexity of sustainability challenges. Transition management has much in common with transdisciplinary (typically sustainability science) research, of which the same can be said.

As Patterson et al (2017) describe, transformations towards sustainability are deeply political (Scoones, Leach, & Newell, 2015)(Leach et al., 2012)(Meadowcroft, 2009)(Schellnhuber et al., 2011), because transformations are likely to have redistributive impacts, resulting in winners and losers (Meadowcroft, 2011)(Van den Bergh, Truffer, & Kallis, 2011). Normative sustainability goals require a political response (Schulz & Siriwardane, 2015) and such responses originate from particular political perspectives, worldviews and values, all of which condition ideas of what constitutes a desirable future (Hulme, 2009)(Stirling, 2011)(Stirling, 2014)(Patterson et al., 2017).

Given this, transdisciplinary formats are intended to encourage reflexivity as part of consensus building (Popa, Guillermin, & Dedeurwaerdere, 2015). That is, to support critical reflection on participants' values and orientation as well as the ability to adapt one's own positions and goals, thereby supporting and enabling capacities for purposive, collective action (Patterson et al., 2017). This in turn is theorized to

involve and develop the capacity to anticipate problems and integrate different types and sources of knowledge.

Transdisciplinary research has aims similar to those of transition management as well: to develop socially robust solutions for sustainable transitions via mutual learning, social reflexivity, empowerment and the building of social capital (Roland W Scholz, 2017). However, transdisciplinary research centres on the integration of the different types of knowledge and ways of knowing used by scientific researchers and practitioners. As such, transdisciplinary research emphasizes the role of scientific researchers and more generally of different types of knowledge, as “inducing processes of strategic (societal) transition when including certain stakeholder groups.” (Roland W Scholz & Tietje, 2002). The two perspectives also concur in their shared acknowledgement of knowledge and the generation of new knowledge as a particularly valuable form of social capital. The drive for this may arise, for example, from disappointment with formal public participation outcomes, leading to the initiation of informal grassroots participatory initiatives intended to intervene in planning-related decision making (Berman, 2018) and also – arguably more by implication than overtly - empower relatively marginalized actors. (Batliwala et al., 1995) defines empowerment as “a spiral, changing consciousness, identifying areas to target for change, planning strategies, acting for change, and analysing activities and outcomes”, perfectly aligning with the aims of transdisciplinary research.

While there is a wide range of definitions of transdisciplinarity, as Scholz and Steiner (2015) observe, in general transdisciplinary processes are expected to generate socially robust orientations that are science-based, state-of-the-art, socially accepted options of solutions cognizant of uncertainties and the incompleteness of different epistemics (Roland W Scholz & Steiner, 2015a).

Njoroge et al. and Steelman et al. (Njoroge et al., 2015)(Steeleman et al., 2015) address transdisciplinary sustainability research processes as practised in developing countries, advocating that the core aspects of transdisciplinarity (Klein et al., 2001)(R.W. Scholz et al., 2011) (Roland W Scholz, Lang, Wiek, Walter, & Stauffacher, 2006)(Klein et al. 2001; Scholz 2011; Scholz et al. 2006) are applied, namely that there is project co-leadership of the research process, with representatives from both practice and science participating in all subprojects and activities on an equal footing; and that representatives from all key stakeholder groups are included, for reasons of both including the necessary knowledge and obtaining the multiple perspectives of the various stakeholders necessary for socially robust responses.

Given the history of the development of the concept of transdisciplinarity, notably including the Zurich 2000 Conference (Klein et al., 2001), as said a key feature of transdisciplinarity is not simply that practitioners are invited to participate in research, but that there is a *co-definition of the goals* of the transdisciplinary research or process, the forms of which are ideally defined as involving co-leadership.

With this in mind, here we present the case of a transdisciplinary transition management arena in Peru, initiated as a transdisciplinary scientific project and convened to develop a vision of a lower carbon, more decentralized and resilient national energy system. The process focused primarily on the co-production of *knowledge*, while the initial co-definition of *goals* was only partially participatory, defined by a sub-group of participants. We describe and analyse how participants from different backgrounds generate shared problem statements, visions and strategies, building a coalition for change that motivated several participants to take joint political action immediately. Our main theoretical research question is: in what ways might transition management and transdisciplinary (sustainability science) research support political empowerment, despite its neutral political discourse? Our

main empirical research question is: what might a low carbon energy future for Peru look like, if a section of society broader than currently controls key aspects of energy policy were given more influence?

In terms of the structure of the paper, we begin with an overview of power in action, as applied to sociotechnical sustainability transitions processes by Avelino and Rotmans (2009). To this we connect concepts of *empowerment* by several authors working outside of sociotechnical transitions framing. It is the potential for at least the beginnings of empowerment that we attribute to (transdisciplinary) transition management arenas and that we explore empirically. To this end, we outline the nature of the Peruvian energy system and then describe the transdisciplinary transition management arena developed and applied to serve as a protective space for the development of new energy policy directions. We summarise its energy policy recommendations and describe its effectiveness as perceived by participants – which we interpret as evidence of at least the beginnings of empowerment. Finally, we reflect on the implications for transition management processes in situations that differ from the northern European conditions in which the idea and practice evolved.

2. Power, empowerment and the Peruvian energy transition context

Contemporary political theorists have argued that depoliticized discourses have been hegemonic over the last decades (Kenis, Bono, & Mathijs, 2016). For example in the environmental sphere, the discourses and calculation methods of carbon trading, emissions reduction from deforestation and degradation (REDD+), the Clean Development Mechanism, while all having their merits, arguably side-step value judgements relating to fungibility, sufficiency, individual voluntary responsibility and so on (e.g. (Swyngedouw, 2010)). Such measures arguably have a particular political-philosophical background (namely neo-liberal market economics) and thus support corresponding political structures, despite depoliticized discourse (ibid).

While sociotechnical transition management seeks a redirection of economies in sustainable directions, it too uses a language of systems that appears neutral. Cognizant of this tendency towards depoliticization, (Avelino & Rotmans, 2009) offer a framework for thinking about power in transition management. Accordingly the authors define power as the ability of actors to mobilize resources in order to achieve particular goals and that this requires resources that may be of many different types (Avelino & Rotmans, 2009). These resources may be used to create or discover resources (*innovative power*), perhaps by making something more visible (ibid). Alternatively, resources may be used destroy other resources (*destructive power*), through violence or other removal of the option to use (ibid). In addition, *constitutive power* is defined as the capacity to institute or stabilise a distribution of resources and *transformative power* as the ability to transform the distribution of resources. *Systemic power* is defined as the ‘combined’ capacity of actors to mobilize resources for the survival of a societal system, which may be a nation, sector, business etc. (ibid).

While Avelino and Rotmans (ibid) usefully characterise different types of power, the capacity to exercise this remains contingent on empowerment in the sense of a belief that meaningful action is possible (Ibrahim & Alkire, 2007). It is in this respect that transition management arenas may help (here, transdisciplinary arenas in the sense of academics working with practitioners), especially in contexts where civil society is weak and policy options that are alternatives to those currently institutionalised are particularly marginalised (Hölscher et al., 2015). Such conditions are typical of illiberal democracies (Noboa & Upham, 2018).

Here we define such empowerment as beginning with an enhanced perception of self-efficacy that comes about through the identification of conditions that enable the exercise of outer-directed power (Conger & Kanungo, 1988). In other words, the

beginning of a sense of empowerment requires that actors can see what needs to change and how that change may be affected. The stage beyond this is action-enabled empowerment, which Malhotra and Cross (2005) define as: “the enhancement of assets and capabilities of diverse individuals and groups to engage, influence, and hold accountable the institutions that affect them.” This is a more general statement of empowerment as operationalized by Avelino and Rotmans (2009). Figure 1 sets out a synthesis of the two stages of empowerment, bringing together the concepts of (Conger & Kanungo, 1988) and Avelino and Rotmans (2009).

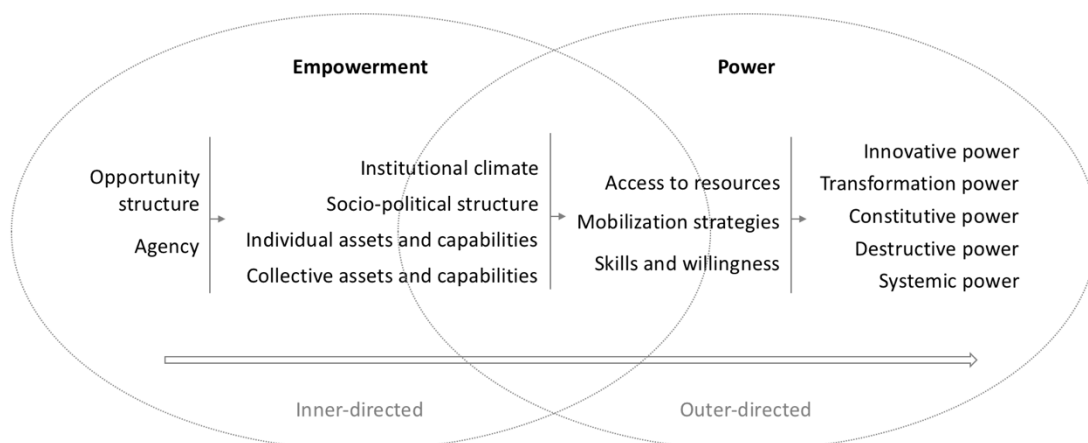


Figure 1. Empowering the exercise of power

In the terms of Avelino and Rotmans (2009), the Peruvian energy system is one of concentrated, stable systemic power, with constitutive power being held by a small number of actors. These are principally involved in oil and gas extraction, major recipients of foreign direct investment via transnational companies and also large-scale hydropower. In 2015, Peruvian demand for electricity was 48,251 GWh per year, of which 21,726 GWh was supplied by natural gas fired power stations and 23,711 GWh by large hydropower (IEA, 2015). The level of governmental interest in pursuing a low carbon economy might also be inferred from the length of time taken to approve (not implement) the Law 27345 that promotes efficient energy use,

namely seven years. The current National Energy plan for 2014-2025 should be implemented between 2018 and 2025 but has a severely reduced budget (Ríos Villacorta, 2016).

Regarding the climate policy context, the first National Climate Change Strategy (ENCC) came into force in 2003 and was revised in 2009 and 2014, when Peru hosted the COP20. The major objective of the ENCC is to reduce the adverse impact of the climate change by: (1) identifying the most vulnerable zones and/or sectors where adaptation programs need to be implemented; (2) controlling greenhouse gas emissions through programs that promote renewable energies and energy efficiency in all economic sectors. The ENCC contains 11 action strategies that propose measures for a more 'rational' management of greenhouse gas emissions, better management of forests for increased carbon sequestration, and distribution of knowledge and information about climate change (MINAM, 2014).

A major step towards a more sustainable oriented energy system was the adoption of the Law 2001 (Law 1002) in 2008. This was actualized in March 2011 by the Supreme Decree N° 012-2011-EM, of which Article 2 states that the Ministry of Energy and Mines (MINEM) should establish an objective percentage of Renewable Energy Resources (RER) and that this should be updated every five years. For the first five years a 5% target was established, despite RER, particularly wind energy, having far greater potential (Ríos Villacorta, 2016).

Article 5 establishes a priority of RER in the daily office of the Committee Responsible for the Economic Operation (COES SINAC) of the National Interconnected Electric System (SEIN) and an established price for RER. Article 7 specifies that the said guaranteed price should be evaluated through auctions where different projects should compete for quotations to inject energy into the National Interconnected Electric System. These auctions should be held at least every two

years by the Supervisory Body for Investment in Energy and Mining (OSINERGMIN), and the resulting prices valid for a period of 20 years. In 2016, eight years after the adoption of Law 2001, the elaboration and implementations of plans and programs for the investment into research and university programs concerning RER as called for in article 10 and 12 had hardly advanced (Ríos Villacorta, 2016).

Moreover, it is large scale hydropower that has been favoured for reaching RER targets. Peru's Ministry of Energy and Mines has commissioned tenders for 1100MW of hydroelectric power plants that should come on-line by 2018/2019. As a long run strategy, according to MEF (2011), the structure of the electricity by 2040 mix should be: 40% hydroelectricity, 40% natural gas, and 20% nonconventional renewable energy (NCRE) (Chavez-Rodriguez et al., 2018).

Against the policy backdrop of slow progress to RER targets and under-utilisation of other, particularly smaller scale and decentralized renewable energy options, our premise is that transdisciplinary transition arenas have the potential to play a role in catalysing system change, even if that role is modest in terms of any of the forms of power identified by (Avelino & Rotmans, 2009). The way in which we envisage such arenas exerting power is not so much through the direct exercise of creative, destructive and transformative power (Avelino & Rotmans, 2009), but, more plausibly, by helping to create the conditions for this. With a stable regime of centralised energy supply, such arenas are likely to be limited in their effectiveness, but nonetheless they do have the capacity to make marginalised voices more visible, a key feature of innovative power as defined above. Such arenas also help to create the coalitions and social capital that meaningful political engagement and action requires. With this in mind, in the next section we describe the rationale and nature of the arena developed and assessed here.

3. Material and methods

The overall research design is intended to support the experimental deployment and evaluation of a transdisciplinary transitions arena capable of producing less centralized, lower carbon energy policies for the Peruvian energy system. In using the term transdisciplinary transition management arena (TTMA), we acknowledge the variety of experiments that this term embraces (Caniglia et al, 2017). Evidence regarding the effectiveness of the arena is presented here from the perspectives of the participants, but using theoretically-derived criteria based in selected empowerment and power-related frameworks (Avelino & Rotmans, 2009) (Narayan-Parker, 2005)(Alsop, R., Bertelsen, M. F., & Holland, 2006). Mixed methods were used, specifically participant observation of the arena process, from which the appended policy and related information was derived; post-hoc questionnaires provided data on self-assessment of the process by the participants.

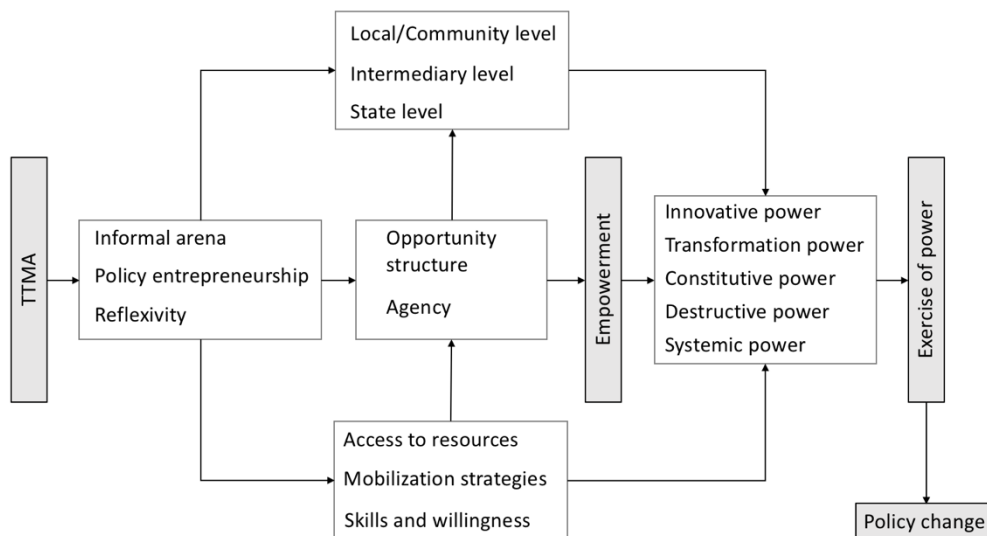


Figure 2. Linkages between empowerment and power-relations in Transdisciplinary Transition Management Arenas (TTMA)

Characterizing the process in terms of the transdisciplinary literature, while for (R.W. Scholz et al., 2011), modes of theory-practice collaboration in this case are close to action research as a result of the involvement of decision-makers, the latter were not in a position to make formal policy decisions. Rather the arena was intended as the first phase of a longer process; and, moreover, given the political context, the transdisciplinary process is politically highly marginal relative to formal institutions. It can be noted in this regard that the link between transition research as an activist science endeavour and post-positivist (Lewin, 1945) and the reflective scientist perspective of transdisciplinarity, with its interpretative approach and forward-looking, constructivist, reflective equilibrium between theory and practice, often involving formative scenario analysis (R.W. Scholz et al., 2011) is an analytic frame that supports multi-sectoral, formative preference processes (Dedeurwaerdere, 2018).

As such, the arena has been set up to provide a space for dialogue and the co-production of knowledge that seeks to support the transition processes involved the energy development model formulated under the National Planned and Determined Contribution (NDC) and its articulation within the new local and global context. As a cross-sectoral strategy, the process of developing the NDC provided a space for participation and dialogue in which stakeholders from academia, government, private sector, trade unions and civil society were invited to jointly construct alternative GHG emission scenarios and identify mitigation options and adaptation goals in the main sectors: agriculture, energy, forestry, industrial processes, transportation and waste, in order to meet the United Nations Framework Convention for Climate Change (UNFCCC) international commitment to submit its National Planned and Determined Contribution. Peru, as other UNFCCC member states, is in the process of reviewing and readjusting its NDC (NDCs of member countries are the basis of the Paris Agreement to enter into force in 2020),

associated with the national establishment of sectoral targets, policies and programs that promote low-carbon development in a competitive and climate-resilient manner.

Accordingly, 35 stakeholders from different sectors of society (government, business sector, civil society) with the potential to positively influence the implementation of the NDC in the energy sector were invited to participate in a scientifically-guided dialogue to collaboratively produce knowledge relating to the current problems of the energy sector, a preferable vision and possible strategies for enabling the implementation of the National Determined Contribution (NDC). The broad affiliations of the stakeholders are given in Table 1. They were selected on the basis of both spanning broad societal groups and being known to the lead researcher (who had a climate change policy role in the Ecuadorian government) as interested and motivated towards rethinking Peruvian energy policy. We make no claim as to the representativeness of the vision and strategies that the stakeholders produced, relative to their affiliated sectors. Rather it is the power implications of (transdisciplinary) transition management processes that are our primary focus.

As said, while transdisciplinary processes ideally involve co-design in all respects from their initiation, in this case, given the political context, it was not possible to involve high-level actors from the beginning. Within the workshop there was nonetheless room for negotiating content, topics and for developing policy proposals in directions that reflected the views of the participants.

Regarding the selection of participants, stakeholders were selected on the basis of being oriented towards norms of sustainability and renewable energy -in government, academia, NGOs, and business. An element of snowballing was involved and the invitation was issued by the NGO WWF, in coordination with the Ministry of Environment. The financial costs incurred by WWF in this process were covered. Stakeholders known to promote natural (fossil) gas were not invited. The

purpose was to provide a protected space for alternative, marginalized views of a low carbon future and the knowledge required for the foregoing was available via previous processes of engagement with the stakeholders. Regarding representativeness, the participants were not selected to represent all interests, but to compensate for marginalization and no claims are made here to representing all sections of society.

As such, the roles of the scientist (i.e. the lead authors as both analyst and practitioner) included methodological development of a participatory process, co-facilitation and epistemediator. The goal of the scientific process was to understand the feasibility of a participatory/transdisciplinary process to co-produce actionable knowledge in order to further stimulate collective action within an illiberal democratic context. The goal of practice was to articulate an alternative discourse and stimulate the creation of a supportive network for collective action towards promoting low-carbon development in the energy sector.

Table 1: Affiliations of the transdisciplinary transition arena participants

Affiliations	Number
State Representatives (Executive: Energy and Environmental Ministries)	5
Congress Representatives	2
Total Government	7
Companies, Industry Chambers and Business Associations	12
Total Business	12
Academia and Research Institutions	4
Total Academia	4
Local NGOs and Church Representatives	4
International NGOs Representatives	7
Total NGOs	11
Bilateral Cooperation	1

Total International Organisations	1
Total Stakeholders	35

3.1 Process design

The process followed a series of phases set out below. It should be noted that participants worked in groups that were mixed across affiliations, although this may not be practical in cases where there are strong differences of opinion.

3.1.1 Phase 1: Diagnosis of energy system problems

The first phase was problem definition as perceived by the participants, informed by official government documentation (new vision and updated plans) and analytical documentation generated in other sectors of society (academia, NGOs). This described the global and national trends in which the NDC was developed and how these may require a response in future. In addition, participants were asked to consider the evolution of the implementation of the NDC in the energy sector to date; the extent to which proposals for energy strategies have been translated into public policies; what circumstances have changed since the inception of NDC and the extent to which NDC objectives and strategies are compatible with the vision of the new government.

3.1.2 Phase 2: Back-casting

The production of a common vision and strategies was undertaken in a back-casting process, whereby participants derived strategies by which to achieve the vision that they developed. These were specifically framed around the actions required to achieve the goals of the NDC in the energy sector within the current national context, including new authorities, goals, financing mechanisms, regulatory and institutional

frameworks. The strategies represented the path or roadmap to follow, taking as their orientation the changes required in the elements, subsystems and dynamics, to achieve the desired restructuring of the energy system. The phase includes participatory-reflective processes, through which groups came to better understand the beliefs and interests of the stakeholders representing the different sectors of society.

The scenario process was a qualitative exercise in which participants expressed their concerns, beliefs, interests and preferences regarding a future vision of the energy system in Peru. The purpose was not to evaluate the outcome policy proposals or vision (e.g. via a multi-criteria tool). Rather, prioritization of elements was undertaken by the stakeholders through negotiation and discussion, in order to identify the key actions – in their view – required to achieve the joint vision (Roland W Scholz & Tietje, 2002)(Roland W Scholz & Tietje, 2002)(Wiek, Claudia, & Scholz, 2006).

The back-casting process had the following steps:

1. Developing a common understanding of the problem (via a “world café” design), with three questions given to guide this:
 - a) What are the most urgent problems that should be addressed in relation to NDC-Energy in Peru?
 - b) What are the challenges in accelerating their viability and compliance?
 - c) What has changed in the current circumstances (new government) that need to be taken into account?
2. Formulating the worst scenario (two multi-sectoral groups)
3. Formulating the preferred scenario (two multi-sectoral groups)
4. Integrating two preferred scenarios in one common vision (all together)
5. Defining strategies for achieving the common vision (all together)

As stated, the aim of organising a multi-stakeholder group for interaction and dialogue was to collectively answer questions about – and respond to- the slow implementation of NDC-Energy in Peru. The process was intended to promote an environment in which conflicts and differences were managed with "preferable" rather than "perfect" solutions. It was emphasized that the objective was to create a visualization that would guide social innovation, taking into consideration issues of polarization of perceptions, and indeed deliberately seeking the exposition and confrontation of opposing reasoning and arguments. This would enable identification of the ranges of tolerance and spaces of agreement, emphasizing the creativity and experimentation of a space of reflexive governance and joint decision making (Hernández, 2014). The process thus sought to deploy a learning cycle based on the reflections of the actors on the themes, on the specific context and on the process itself (Kerr & Tindale, 2004). The intended outcome was a group-level, shared understanding of the problems and their potential solutions (Thomas, McGarty, & Mavor, 2009), building capacity and coalitions in the process (Galinsky, Ku, & Wang, 2005).

3.1.3 Phase 3: Evaluation

The evaluation was undertaken with ex-post questionnaires consisting of qualitative and quantitative questions relating to four evaluative dimensions (outputs, outcomes, process, and inputs) (Luederitz et al., 2016). For brevity and practicality, evaluation was undertaken with a self-appraisal approach at the end of the intervention, to support reflection and learning from the process – i.e. a process of formative evaluation. (Roland W Scholz & Steiner, 2015b) (Walter, Helgenberger, Wiek, & Scholz, 2007)(Chebet et al., 2018). While self-evaluation has limitations, it can still serve the purposes above and also assist with any redesign that may be required for subsequent arenas. In fact although evaluation of transdisciplinary processes is vital,

the literature on this has historically been rather small (Stokols et al., 2003). One of the few (post hoc) quantitative evaluations is provided by Walter et al. (2007), who used a statistical mediation model to identify capacities developed. Miah et al. (2015) also identify a set of evaluation from the literature and provide a (nominally scaled) self-evaluation. (Vilsmaier et al., 2015) provide a qualitative evaluation of eight stakeholder engagement processes, using content analysis of interviews of participants. (Njoroge et al., 2015) develop and apply an analysis of variance-based assessment of the effects of the transdisciplinary process on the yield of smallholder farmers who participated in a transdisciplinary process (Roland W Scholz & Steiner, 2015a).

The terms of the evaluation reflect the above, combined premises of transdisciplinary sustainability science research and transition management, specifically regarding the extent to which such a process supports knowledge co-production and stakeholder involvement, building transformational leadership capacities and jointly contributing to the development of policy options for energy system change. All of this is held to relate to the first stage of empowerment, namely the engendering of a belief that meaningful action is possible.

Regarding the knowledge-related ambitions of transdisciplinary sustainability science research, we are therefore also interested in to what extent the types of knowledge involved in such an arena (Brandt et al., 2013) are generated. That is, *system knowledge* referring to the current state of a system and the key social and other factors involved and the capacity of the system to change (Hadorn, Bradley, Pohl, Rist, & Wiesmann, 2006); *Target Knowledge* referring to the more specific scope of action and problem-solving measures relating to natural constraints, social laws, norms and values within the system, as well as the interests of actors and their individual intentions (Jahn, 2008); and *Transformation Knowledge* referring to the practical implications that can be derived from target knowledge, in respect of

changes to existing habits, practices and institutional objectives (Hadorn et al., 2006).

Moreover, we ask to what extent the arena design supports reflexivity as a part of consensus building (Popa et al., 2015)? That is, to what extent does it support critical reflection on participants' values and orientation, as well as the ability to adapt one's own positions and goals, hence supporting and enabling capacities for purposive, collective action (Patterson et al., 2017)?

Finally, we ask to what extent the arena promotes trust and long-term collaboration among the participants (individual and institutional), resulting from common understandings of the problem, the identification of a shared values and the commitment to organise joint future actions. A key element of this is hypothesised in the transdisciplinary sustainability science research literature as relating to the development of a group identity that then supports a commitment to collective action.

In this respect, (Thomas et al., 2009) refer to the psycho-social normative alignment model of promoting ongoing commitment to collective action, via the crafting of a social identity based on norms for emotion, efficacy and action that contribute to a dynamic system of meaning and hence commitment to a cause. Similarly (Reicher, Spears, & Haslam, 2010) refer to social identity as shared and relational and as the product of a group's collective history and present. (Harris & Lyon, 2013) observe that trust among stakeholders is shown to be built by having information on others, prior experience of working together, norms of cooperation and sanctions exerted on those who might transgress norms of behaviour (Harris & Lyon, 2013).

In the next section we examine the performance of the arena in these terms, pursuing this further in the Discussion in relation to the implications for - and association with - the empowerment (Narayan-Parker, 2005)(Alsop, R., Bertelsen,

M. F., & Holland, 2006) and power-related issues that (Avelino & Rotmans, 2009) identify and that are arguably often elided in transition management processes. The evaluation has two elements. First, as stated, post-hoc questionnaires with 5-point Likert-scale based response options were used for self-evaluation by participants in terms of specific aspects of empowerment as set out above: these we characterise as *empowerment conditions*. Second, we map the outcomes and aspects of the transdisciplinary transition management arena process to the same empowerment conditions, to show more specifically how the arena supports empowerment.

In this way we are in effect exploring the ways in which the characteristics of transdisciplinary science and transition management processes concur with – share – the characteristics of empowering conditions. We are not arguing that these are sufficient or necessary conditions across all contexts: to make a claim of this strength, we would need multiple cases representing different types of socio-political context. Table 6 and 7 presents the policy outcomes from the arena in detail.

4. Results

4.1 Process evaluation by participants

The performance of the TTMA was evaluated in terms of the empowerment conditions of the TTMA. That is, in terms of the perceived value of: (i) the design of Informal Arena itself; (ii) the extent to which it supported Policy Entrepreneurship; and (iii) the value of the arena as a Reflexive space. As said, performance is indicated both via quantitative (Likert) response scales, which in aggregate enable the percentage of participants expressing agreement and disagreement to be observed, and in terms of the extent and form of the vision and policy recommendations resulting from the arena.

Table 2 describes the evaluative terms (indicators) that the empowerment conditions are conceived of as comprising. For the design of the Informal Arena, these relate to the perceived quality of: participation, facilitation, methodology, freedom of expression, inclusiveness and information inputs. For Policy Entrepreneurship, the evaluative terms comprise: perceived concurrence with participant’s expectations of transformation, aspirations, potential collective-actions, methodological suitability for aligning actors, sectoral transformative synergies and long-term cooperation capabilities. Finally, reflexive capacity of the arena was evaluated in terms of perceived: quality of the knowledge co-produced by the stakeholders in terms of relevance, ability to challenge the status quo, common understanding, clearness and rememberability, articulation of new perspectives, ability to anticipate futures and develop strategies.

Table 2: Empowerment conditions measurement indicators

Empowerment conditions	Measurement Indicator
Informal Arena design	A1. The selected participants were suitable for the participatory process
	A2. Facilitation of the process was satisfactory.
	A3. The methodology was useful for the participatory process' purposes.
	A4. Participants were able to express their ideas and opinions freely.
	A5. All ideas were considered in the discussion.
	A6. The inputs presented by the speakers were useful for the discussion.
Policy Entrepreneurship	B1. Participants agree that the Peruvian energy system requires a sustainable transformation
	B2. Participants have common (individual or institutional) aspirations regarding the future of the energy system in Peru

	B3. Participants have the potential to articulate joint actions for supporting a transformation
	B4. The participatory process' methodology was suitable for promoting the articulation of actors.
	B5. Active participation of all sectors is needed for the success of the implementation of transformation strategies
	B6. The appropriate level of inter-institutional involvement is a joint long-term cooperation strategy
Reflexivity	C1. The knowledge generated is relevant to current circumstances.
	C2. The knowledge generated contains ideas that question the status quo.
	C3. The knowledge generated helps to understand the processes of transformation.
	C4. The knowledge generated is clear and memberable.
	C5. The process enriched the understanding of the problem by including new perspectives.
	C6. The process facilitated the developing future scenarios and strategies

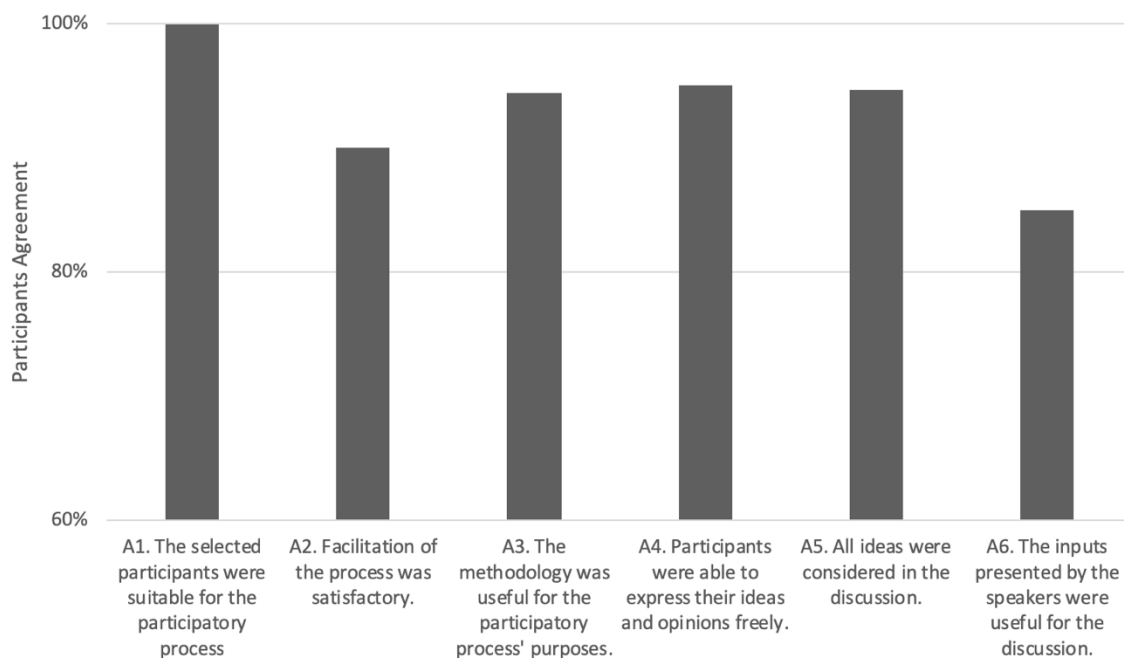


Figure 3: Perceptions of the informal arena design.

Figure 3 describes participant satisfaction with the arena design. The percentages relate to the participants as a whole and to their agreement with the statements A1, A2, A3, A4, A5, A6 in Table 2. Overall, participants agreed that the Informal Arena design was effective in terms of the range of participants, facilitation, methodology for exploring alternative energy policy, freedom of expression, inclusiveness and information input.

Table 3 shows the connections between the measurement indicators as applied to the Informal Arena design, with the concept of empowerment according to (Narayan-Parker, 2005), where the creation of an opportunity structure that influences institutional climate and social and political structures is vital for the empowerment of a community of actors acting as a protected space. Additionally, as (Alsop, R., Bertelsen, M. F., & Holland, 2006) emphasise, the opportunity structure conceptually connects, via empowerment, the local/professional community level with an intermediary level of agency.

Table 3: Linkages between informal arena process indicators and empowerment

Measurement Indicator	Opportunity Structure: Institutional Climate	Opportunity Structure: Social and Political Structure	Agency: Individual Assets and Capabilities	Agency: Collective Assets and Capabilities	Outcomes	Level of empowerment
A1. The selected participants were suitable for the participatory process	Marginalized actors were included in the participatory process	Space of interaction was specifically for a group of liked-minded marginalized actors	Participants were able to be proactive and open to others' perspectives	Participants represented all sectors of society: State, Civil Society, Academia and Business Sectors	Professional community development acting as a protected space	Local level / Intermediary level
A2. Facilitation of the process was satisfactory.	Participants demonstrated local organizational capacity	Facilitation mitigated competition and conflict	Facilitation understood the political power relations in advanced	Participatory process was effectively self-organized by participants based on agreed rules	Professional community development acting as a protected space	Local level
A3. The methodology was useful for the participatory process' purposes.	Participants demonstrated local organizational capacity	Methodology mitigated competition and conflict	Methodology was adapted to the local context considering political power relations among participants	Participatory process was effectively self-organized by participants based on agreed rules	Professional community development acting as a protected space	Local level
A4. Participants were able to express their ideas and opinions freely.	All ideas were considering when co-producing knowledge	Space of interaction was democratic and open	Participants trusted the others within the space of interaction	All participants had a voice	Professional community development acting as a protected space	Local level
A5. All ideas were considered in the discussion.	All ideas were considering when co-producing knowledge	Space of interaction was democratic and open	Participants trusted the others within the space of interaction	All participants had a voice	Professional community development acting as a protected space	Local level
A6. The inputs presented by the speakers were useful for the discussion.	Access to information was provided to all participants	n/a	Experts where invited to share their knowledge	n/a	Professional community development acting as a protected space	Local level / Intermediary level

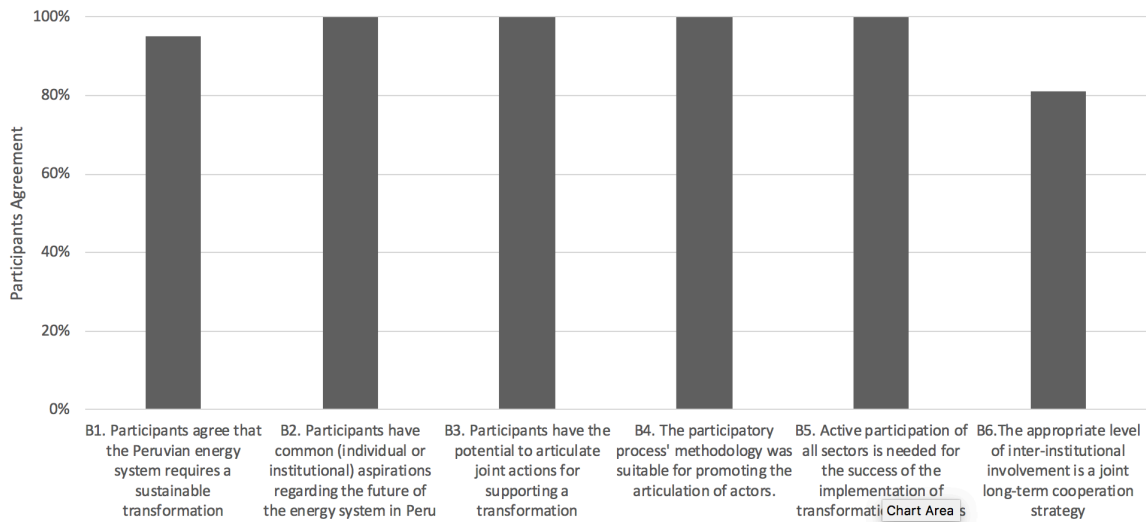


Figure 4: Perceptions of the extent to which the arena supports Policy Entrepreneurship.

Figure 4 reports participants' perceptions of the TTMA as supporting policy entrepreneurship (statements B1, B2, B3, B4, B5, B6). Overall, participants agreed that the arena supported the generation of common understanding about transformation, common aspirations, potential for collective action, the articulation of actors, interdependencies of sectors and the development of a long-term inter-institutional cooperation strategy.

Table 4 shows the linkages between the indicators of the Policy Entrepreneurship and empowerment (Narayan-Parker, 2005), where policy entrepreneurship is defined as the existence of an opportunity structure for influencing institutional and political structures, in combination with individual and collective assets and capabilities, resulting in entrepreneurial agency n (Alsop, R., Bertelsen, M. F., & Holland, 2006). Thus defined, Policy Entrepreneurship is conceived of as enabling synergies across structures and agency dynamizing intermediation between local and state level of intervention (ibid).

Table 4: Linkages between policy entrepreneurship indicators and empowerment

Measurement Indicator	Opportunity Structure: Institutional Climate	Opportunity Structure: Social and Political Structure	Agency: Individual Assets and Capabilities	Agency: Collective Assets and Capabilities	Outcomes	Level of empowerment
B1. Participants agree that the Peruvian energy system requires a sustainable transformation	Access to information was provided to all participants	Marginalized actors supporting sustainability were articulated to build alternative discourse	Participants were experienced professionals from the energy sector from different organizations	Participants build an identity based on shared values, beliefs and interests.	Network and coalition building for collective action	Intermediary level
B2. Participants have common (individual or institutional) aspirations regarding the future of the energy system in Peru	n/a	Articulation of actors stimulate the creation of an informal institution that represents a common vision of a professional community	Participants have individual values, beliefs and interests	Participants build a group identity based on shared values, beliefs and interests.	Network and coalition building for collective action	Intermediary level / State Level
B3. Participants have the potential to articulate joint actions for supporting a transformation	New information and knowledge was developed within the participatory process	Articulated participants increased their negotiations power in order to influence change	Stakeholders have the human and material resources to promote a long-term cooperation	Actor constellation developed a common voice, organizational structure, a group representation and identity	Network and coalition building for collective action	Intermediary level / State Level
B4. The participatory process' methodology was suitable for promoting the articulation of actors.	Participants were able to interact, dialogue and unify positions	Agreements were built on common interests	n/a	Participants build a group identity based on shared values, beliefs and interests.	Network and coalition building for collective action	Intermediary level

Measurement Indicator	Opportunity Structure: Institutional Climate	Opportunity Structure: Social and Political Structure	Agency: Individual Assets and Capabilities	Agency: Collective Assets and Capabilities	Outcomes	Level of empowerment
B5. Active participation of all sectors is needed for the success of the implementation of transformation strategies	Participants were able to interact, dialogue and unify positions	Articulation of actors stimulate the creation of an informal institution that represents a common vision of a professional community	Participants were able to be proactive and open to others' perspectives	Participants represented all sectors of society: State, Civil Society, Academia and Business Sectors	Network and coalition building for collective action	Intermediary level / State Level
B6. The appropriate level of inter-institutional involvement is a joint long-term cooperation strategy	Stakeholders are self-accountable for a joint long-term cooperation strategy	Actor constellation provides structure and purpose towards external competition and conflict readiness	Stakeholders have the human and material resources to promote a long-term cooperation	Actor constellation developed a common voice, organizational structure, a group representation and identity	Network and coalition building for collective action	Intermediary level / State Level

Table 4: Linkages between policy entrepreneurship indicators and empowerment (continuation)

Figure 5 reports participants' perceptions of the TTMA as relating to the processes of knowledge co-production/reflexivity. Overall, participants agreed that with statements C1, C2, C3, C4, C5, C6, namely that the process of reflexivity resulted in a high quality of knowledge in terms of the following criteria: relevance to the current circumstances, challenging status quo, understanding of the processes of transformation, clear and rememberable, articulation of perspectives and developing of future scenarios and strategies.

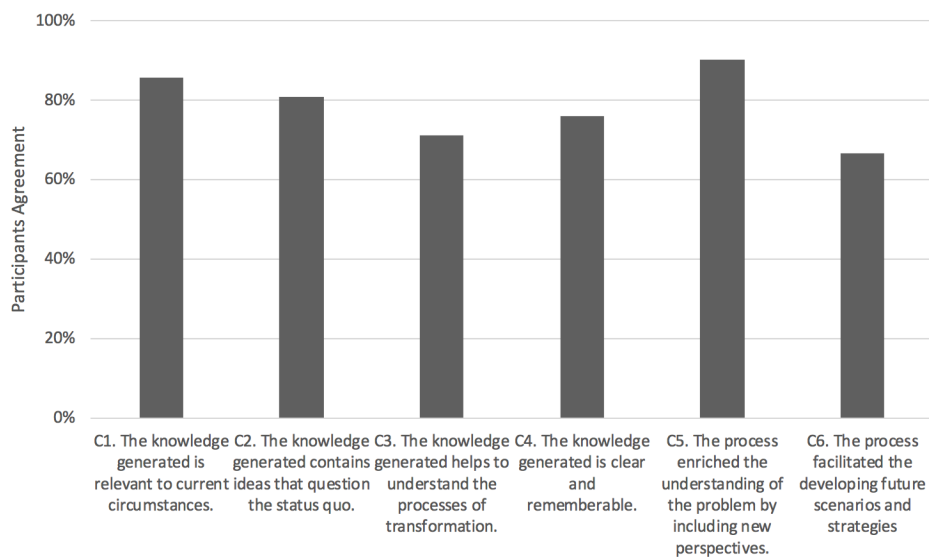


Figure 5: Perceptions of Reflexivity.

Table 5 shows the linkages between indicators of Reflexivity and empowerment (Narayan-Parker, 2005), whereby a process of the co-production of knowledge within a transdisciplinary space boosts individual and collective assets and capabilities and stimulates collective action, by articulating a shared alternative discourse that has the potential to be introduced at the level of national politics (Alsop, R., Bertelsen, M. F., & Holland, 2006).

Table 5: Linkages between reflexivity indicators and empowerment

Measurement Indicator	Opportunity Structure: Institutional Climate	Opportunity Structure: Social and Political Structure	Agency: Individual Assets and Capabilities	Agency: Collective Assets and Capabilities	Outcomes	Level of empowerment
C1. The knowledge generated is relevant to current circumstances.	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common understanding of the problem	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level
C2. The knowledge generated contains ideas that question the status quo.	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common understanding of the problem	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level / Intermediary level
C3. The knowledge generated helps to understand the processes of transformation.	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common vision and joint strategies co-produced	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level / Intermediary level
C4. The knowledge generated is clear and rememberable.	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common understanding of the problem	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level

Measurement Indicator	Opportunity Structure: Institutional Climate	Opportunity Structure: Social and Political Structure	Agency: Individual Assets and Capabilities	Agency: Collective Assets and Capabilities	Outcomes	Level of empowerment
C5. The process enriched the understanding of the problem by including new perspectives.	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common understanding of the problem	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level / Intermediary level
C6. The process facilitated the developing future scenarios and strategies	Actionable knowledge was co-produced within the participatory process	Process promoted socio-political activism based on a common vision and joint strategies co-produced	Participants contributed with ideas and perspectives to the collective production of actionable knowledge	Common alternative discourse about the future of the energy system was co-produced	Actionable knowledge co-production encompassing common understanding of the problem, common vision and strategies	Local level / Intermediary level

Table 5: Linkages between reflexivity indicators and empowerment (continuation)

Tables 6 and 7 summarize the substantive outcomes from the group in terms of strategic objectives and visions, as based on a recording via silent observers, who transcribed the dialogue of the forum process. The strategic objectives are mainly related to the need for: (a) networks for collaborative planning (planning governance); (b) financial mechanisms for investments and incentivizing the renewable energy sector; (c) collaborative knowledge production regarding regulatory frameworks; (d) the transparency of official information; (e) communication, education and training. The common vision emphasizes: (a) the decentralization and cross-sectoral participation in the planning and decision-making processes of the energy system (participatory governance); (b) high penetration of distributed generation based on solar, wind, biomass and geothermal (non-conventional renewable energies); and (c) a fundamental cultural change that enables continuous learning and transformation.

The system and target knowledge generated by the stakeholders described participants' perception of the energy system problems as they are now, followed by a preferable scenario comprising eight different components: interaction of the energy plan with the national developmental plan, energy planning processes and principles, enabling environments (financial mechanisms, knowledge transfer and capacity building), technology and infrastructure of the energy matrix, regulatory frameworks, institutional frameworks, agendas intersections, cultural and mindset change.

Additionally, transformation knowledge was generated regarding possible strategies for achieving the preferable scenario, categorized here in terms of nine types: Cross-sectoral collaborative energy planning, Educational Strategies for Sustainable Development, Financial mechanisms for sustainable development, Information transparency and accountability initiative, Institutional and professional capacities building programs, Knowledge Co-production Platforms, Regulatory framework development, Strategic Environmental Communication Campaign, Supportive Networks Articulation. The propositions were developed by the stakeholders within the session. They were categorized and organized in the session guided by the facilitation. The final propositions were circulated to the stakeholders after the meeting. The propositions served to develop a letter with policy recommendations directed to the ministry of energy and signed by the whole group. The group continued to network

with each other actively after the meeting and created communication channels among the participants.

Table 6: Enabling NDC Strategic Objectives proposed by the transdisciplinary transition management arena for Peru

Category	Strategic Objectives
Cross-sectoral collaborative energy planning	To consider renewable energy as a future export product linked to the productive matrix transformation under the National Development Plan
	To create learning spaces for participatory planning among stakeholders in order to have a common goal
	To create spaces for negotiation and dialogue among stakeholders in order to have a common vision
	To promote the electrification of the economy based on renewable energies as a National Strategy for Sustainability
	To enable the implementation of international commitments, cooperation and funding strategies developed for the Conference of the Parties 20 in Lima
Educational Strategies for Sustainable Development	To develop training courses for schools and universities
Financial mechanisms for sustainable development	To design and implement investment protection mechanisms in accordance to the development of renewable energy institutional and regulatory frameworks
	To attract more private international and national investors
	To incentivize renewables investments and divest oil & gas

	To incentivize private investing in renewable energy infrastructure
Information transparency and accountability initiative	To design and implement an information transparency and accountability initiatives for the energy sector
	To review Natural Gas exploitation and export contracts with operators and intermediaries in order to increase profit for the state and society
Institutional and professional capacities building programs	To strengthen institutional and professional capacities regarding analysis, design and implementation of Energy Sustainability, Renewable Energy and Energy Efficiency projects
	To design and implement professional capacity building and training programs about renewable energy
Knowledge Co-production Platforms	To empower civil society by creating knowledge co-production and dialogue spaces
	To create knowledge production and transfer platforms (Think Tanks, Platforms, Dialogues, Fora, Research Centres)
	To create think tanks and state-sponsored research centres to support energy planning and produce knowledge about renewable energies
	To support private technological innovation based on the development of star-ups, spin-offs and entrepreneurial initiatives
	To create awareness of the relevance of Renewable Energy use in the civil society through knowledge co-production and empowerment
	To design and implement alternative discourses to be appropriate by political organizations supporting sustainability

Regulatory framework development	To design and implement regulatory frameworks for the deployment of distributed generation at local governmental levels
	To design and implement regulatory frameworks in order to ensure the participation of renewable energy companies in the free and regulated market
	To design and implement regulatory frameworks to stimulate public-private partnerships
	To eliminate fossil-related incentives and promote transparent competition and access for renewable technologies
	To design and implement carbon taxes / pricing mechanisms
	To ensure participation of several actors via different mechanisms to invest on renewable energy projects
	To institutionalize revision and up-to-date mechanisms of the legal framework in order to improve the institutionality and alignment of actors: government, private sector, customer
	To design and implement regulatory frameworks in order to decentralize energy systems and provide market access and private-public partnerships
	To design and implement regulatory frameworks to ensure financial mechanisms for the subnational levels
Strategic Environmental Communication Campaign	To design and implement massive Sustainability and Renewable Energy communication campaigns
	To design and implement massive sustainable consumption communication campaigns

Supportive Networks Articulation	To organize and institutionalize cross-sectoral dialogues in order to co-produce knowledge, articulate stakeholders and generate robust alternative discourses
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Table 7: Perceived energy system problems and visions

Categories	Sub-categories	Problem	Vision
Planning	National Development Plan	National developmental plan is not connected to energy planning	To export renewable energy to neighbour countries based on enormous local potential
	Planning Goal / Horizon	Lack of long term goals	To have a common long-term goal about energy future
	Renewability	Electricity sector dependence on natural gas & oil	Electricity generated from 100 % renewable energies (solar, wind, biomass, geothermal) for the 100% of Peruvians by 2040
	Energy Planning	Lack of consensus about an energy future	To have a common vision about energy future
Governance	Subnational level participation	Lack of Local Government Participation	Participation of local governments in decision making - decentralization of decision-making
	Private sector participation	Renewable energy companies cannot participate in	Renewable energy companies are encouraged participate in the free and regulated market

		the free and regulated market	
	Cross-sectoral partnerships	Lack of cross-sectoral partnerships	Existence of articulated supportive networks for the development of the renewable energy sector
	Civil Society Empowerment	Lack of participation of civil society in decision-making	Participatory and democratic energy governance systems
Regulatory Frameworks	Incentives / Disincentives	Inappropriate incentives directed to fossil fuels	Barriers to renewable energy projects deployment are eliminated
		No Carbon Taxes	Carbon Taxes are working and supporting the low-carbon development strategies
		Lack of auctions for renewable electricity procurement	Several mechanisms to encourage the participation of new providers of energy
Access to the Market	No change or deterioration of legal framework		Dynamic and smart processes of continues revision and improvement of legal frameworks are implemented
Energy Prices / Tariffs	No clear energy prices and tariffs - externalities		Energy information about costs, prices and tariffs are transparent and accessible to the publics

		are no consider in the prices and tariffs	
Institutional Framework	Degree of centralisation	Centralized national system	Sub-national decentralised systems
	Sectoral Structure	Investment- inhibiting political framework	Political framework that fosters investments and international cooperation
	Informal Networks	Lack of dialogue processes among stakeholders	Stakeholders participate in dialogue platforms in order to support the innovation of the energy sector
Enabling environments	Financial Mechanisms	Lack of financial mechanisms	Budget for decentralised sub- national systems
		Lack of international investment	Increase direct international investments
		Investments are directed towards new oil and gas reserves exploration	Investments are redirected towards renewable energy sources exploration
		Lack of financial mechanisms	Political framework that fosters investments and international cooperation
	Knowledge Production and	Lack of Knowledge	Knowledge platforms and think tanks foster learning

	technology transfer	regarding Renewable energy	loops about renewable energy and stimulate sectoral innovation
		Lack of knowledge regarding renewable energy technologies – 100 % technological dependence from foreign countries	Peruvian firms develop and provide renewable energy technologies
	Capacity building	Lack of capacities concerning Sustainability, Renewable Energy and Energy Efficiency	Widespread knowhow about Sustainability, Renewable Energy and Energy Efficiency
Cultural Change	Education	Lack of education concerning Sustainability and Renewable Energy	Widespread knowledge about Sustainability and Renewable Energy
	Mind-set change	No political willingness to foster the development	Strong political willingness to foster the development of Renewable Energy

		of Renewable Energy	
		Lack of societal knowledge concerning Sustainability and Renewable Energy	Widespread knowledge about Sustainability and Renewable Energy
		Baseload capacity of renewable energy will stay unrecognized	Renewable energy will be considered as capable for baseload
	Consumer behaviour	Lack of education concerning sustainable consumption	Widespread knowledge about sustainable consumption
Technology and Infrastructure	Energy Supply	Low diversification: gas, oil and hydropower	High diversification of the energy matrix: including solar, wind and biomass
	Demand / Consumption	Use of imported oil derivatives for transportation and other sectors	Electrify the economy in order to make use of endogenous resources
	Import/export	Natural gas export prices	Natural gas prices are fair and benefiting Peruvian society -

		are not benefiting the national economy and Peruvian society - profits are capture by private intermediaries.	profits are funding the energy sustainability transition towards renewables
		Energy shortage – dependence of import	Excess supply –energy export
Agenda Intersection	Productive matrix International Affairs	Energy is not seen as an export product Plans, strategies and international commitments developed for the Conference of the Parties 20 in Lima under the UNFCCC are blocked by incumbents	Renewable energy is part of the productive matrix and an export product Plans, strategies and international commitments are enabled and funded by international financial mechanisms (Green Climate Fund) and private investors

5. Discussion

As described above, (Avelino & Rotmans, 2009) offer a framework for thinking about power in relation to transition management - and transition processes more generally. This framework refers to the power to innovate, including making issues more visible; the power to destroy or remove resources; the power to constitute, institute or stabilize a distribution of resources; and the power to transform the distribution of resources. Systemic power is defined as a combination of these capacities to act (ibid). To this we have added insights from empowerment-focused theorists (Narayan-Parker, 2005) and (Alsop, R., Bertelsen, M. F., & Holland, 2006), who offer frameworks for the analysis of empowerment in relation to the creation of structures of opportunity and policy entrepreneurial agency at different levels. We now consider the participants' evaluation of the arena in these terms: to what extent does the arena support the empowerment of a professional community in order to exercise any of the above mentioned different types of power?

Overall, we judge that the transdisciplinary transition arena process implemented in Peru contributed to stakeholder empowerment in several ways. The arena can be viewed as an opportunity for social learning by mobilizing *individual and collective assets and capabilities* (Narayan-Parker, 2005), whereby different sectors pooled and shared their knowledge for the collective goal of envisaging and ideally catalysing energy system transformation. This involved the creation of an informal support network that is intended to strengthen the negotiation position, collective action and policy influence of the wider renewable energy sector in Peru by influencing the *institutional climate and the socio-political structures at local, intermediary and state levels*(Narayan-Parker, 2005)(Alsop, R., Bertelsen, M. F., & Holland, 2006). Arguably these constitute a part of the *innovative* form of power that (Avelino & Rotmans, 2009) refer to as the "capacity of actors to create or discover new resources". These consist of social and intellectual capital, i.e. new knowledge (problem, visions and strategies) and enhanced potential to take collective action, including by sharing resources among institutions. In terms of *transformative power* (changing the distribution of resources), the participatory process redistributed knowledge to marginalized actors, such knowledge normally being centralized in oligopolies of which the Peruvian energy

sector is formed. In terms of *constitutive power*, the arena prepared ground for the informal institutionalization of a new network and the will to take collective action in future.

Of course this is far short of the *systemic power* (Avelino & Rotmans, 2009). The Peruvian energy system will not directly change in response to marginal actors developing alternative visions, policy objectives and strategic measures. The system has its own path dependencies, with cognitive and investment lock-ins and vested interests that favour large scale, centralized supply, with renewable energy supply primarily constituted by large hydropower. Nonetheless, initiatives such as those described here arguably offer a step towards change, with capacity building, mobilization of knowledge resources and network building. Of course, the challenge will be in converting this through to further policy influence. For now, the capacity for *destructive power* (Avelino & Rotmans, 2009), in the sense of path destabilization and creation, is not available to marginal actors – at least, not to any significant degree.

Overall, then, the main contribution of the transdisciplinary transition arena lies in contributing to the conditions necessary for empowerment of policy entrepreneurs, by stimulating the creation of an opportunity structure that has the potential to subsequently influence the contextual institutional climate and socio-political structures, catalysing assets and capabilities for inter-level agency (Narayan-Parker, 2005)(Alsop, R., Bertelsen, M. F., & Holland, 2006). The TTMA contributes to the exercise of power not directly, but by helping, in a limited way, to provide access to resources (including knowledge), mobilization strategies, skills and willingness, all of which constitute a 'meta-condition' for the exercise of power (Avelino & Rotmans, 2009). In this sense the arena can be understood as a political process that helps to ground rationally and knowledge-based empowerment for subsequent political activity. Its contribution is also psychological, helping to create meaning (purpose, vision) and self-determination (enhancing willingness to act) (Spreitzer, 1995), in addition to providing other forms of resource.

In short, in contrast to the discourse of (governance-oriented) transition management as a relatively depoliticized process intended to help societal exploration of new futures, the experimental transdisciplinary energy transition arena in Peru carves out

the power of a tailored transdisciplinary and transition management approach for building up a normative, cognitive and organizational basis for entering the power game within an illiberal political context. In many ways this is not so different to transition management and transdisciplinary sustainability science fora applied in liberal western democracies, except for the political context.

6. Conclusion

The Peruvian energy system is one of concentrated, stable systemic power, with that power being held by a small number of actors. Despite a National Climate Change Strategy and renewable energy targets, progress towards a lower carbon energy system is both slow and is following path dependencies, including large scale hydropower and natural gas related technologies.

Participants in a transdisciplinary transition management arena (Noboa and Upham, 2018) envisaged a future energy model in which 100% of energy supply is based on renewable energy. Despite a preference for expanding decentralized renewable energy supply, the participants envisaged that large hydro would provide some fraction of electricity in future due to the long life-cycle of hydro plants, while fossil natural gas should be gradually reduced to zero. The latter reflects the participants' view that natural gas exploitation in Peru benefits only a small group of people. At the same time, the natural gas business is also negatively impacting the rainforest ecosystem, mainly due to the access roads that later influence the colonization, urbanization, land use change and deforestation. The same problem has been seen by the Hydropower projects, which are mainly centralized, impacting Amazonian River Basin ecosystems and concentrating power and investments in few hands. In terms of the natural resources required for a 100% renewable future, Peru's deserts were viewed by participants as a large, currently non-exploited resource for solar power production, much as Chile has invested in Solar power in the Atacama Desert, becoming from net importer to potential leader in South America in a short period of time. It was also highlighted that Peru's long coastline and desert also have the potential to support substantial wind-power (International Renewable Energy Agency, 2014) and that the social co-benefits are potentially higher for these types of power supply (depending on the modes of implementation) than for fossil natural gas and large hydro, which are

associated with centralization of supply, management and ownership; corruption and environmental impact. The impacts of these latter forms of supply also include population displacement, potential lack of resilience in the face of changing, large scale water flow patterns, and corruption relating to the lack of royalties for those affected by resource exploitation and the lack of transparency regarding the state-private agreements for gas exploitation and trading (Ansar, Flyvbjerg, Budzier, & Lunn, 2014).

Here we have instituted and assessed a policy arena for marginalized actors. The arena draws on the ideas of transition management and transdisciplinary sustainability, while the assessment draws on concepts of power and empowerment. While the former approaches use the relatively depoliticized discourse of systems terms, knowledge coproduction and societal reflexivity, both are normative in their goals of sustainability goals and social inclusivity and have the potential to empower and hence lead to the exercise of power.

In the present case, participants collectively developed a vision of a lower carbon, more decentralized and hence resilient national energy system; they generated shared problem statements, visions and strategies, building a coalition for change; and they were broadly satisfied with a process that we show in theory and practice has begun to empower them. While it remains to be seen how influential such arenas are in the medium and long term, such depoliticized sustainability discourse nonetheless has role to play in helping to legitimize informal institutional efforts towards environmental policy change.

7. Declarations

7.1. Competing interests

The authors declare that they have no competing interests.

7.2. Ethics approval and consent to participate

Via an ethical protocol, the participants gave informed consent to the use of information generated in the forum process. Conditions of anonymity have been adhered to.

7.3. Consent for publication

There is no individually identifiable information in the paper.

7.4. Acknowledgements

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APPENDIX

Authors' Contributions

Overview of articles included in this cumulative Ph.D. thesis

(in accordance with the guideline for cumulative dissertations in Sustainability Science [January 2012], in the following termed “the guideline”)

Title of Ph.D. thesis: “Designing knowledge-action networks for supporting energy focused sociotechnical change in illiberal democracies: interfacing science, policy and transformation processes towards sustainability in Andean Countries”

Papers included:

- 1) Noboa, E., Upham, P., 2018. Energy policy and transdisciplinary transition management arenas in illiberal democracies: A conceptual framework. *Energy Res. Soc. Sci.* 46, 114–124. <https://doi.org/10.1016/J.ERSS.2018.07.014>
- 2) Noboa, E., Upham, P., Heinrichs, H., 2018. Collaborative energy visioning under conditions of illiberal democracy: results and recommendations from Ecuador. *Energy. Sustain. Soc.* 8, 31. <https://doi.org/10.1186/s13705-018-0173-0>
- 3) Noboa, E., Upham, P., Heinrichs, H., 2019. Building a Coalition with Depoliticized Sustainability Discourse: The Case of a Transdisciplinary Transition Management Arena in Peru. *J. Sustain. Dev.* Vol. 12.

Author's contributions to the articles and articles publication status (according to §16 of the guideline):

Article #	Short title	Specific contributions of all authors	Author status	Weighting factor	Publication status	Conference contributions
(1)	Energy policy and transdisciplinary transition management arenas in illiberal democracies	EN designed and undertook the research project, including establishing the theoretical framing. PU made a substantive contribution in terms of discussion of ideas and language.	First author with predominant contribution	1.0	Published in Energy Research & Social Science 46 (2018) 114–124 (Indexed - International Peer-Reviewed Scientific Journal)	Presented in NEST 2017 – 2 nd PhDs in Transitions Conference 2017 – Network of Early Career Researchers in Sustainability Transitions
(2)	Collaborative energy visioning under conditions of illiberal democracy	EN designed and undertook the research project, including establishing the theoretical framing. PU made a substantive contribution in terms of discussion of ideas and language. HH supervised the project and added	First author with predominant contribution	1.0	Published in Energy, Sustainability and Society (2018) 8:31 (Indexed - International Peer-Reviewed Scientific Journal)	Presented in IST 2017 – 8 th International Sustainability Transitions Conference Presented in ITD 2017 - International Transdisciplinarity Conference in 2017

		to the theoretical development of the paper.				
(3)	Building a Coalition with Depoliticized Sustainability Discourse	EN designed and undertook the research project, including establishing the theoretical framing. PU made a substantive contribution in terms of discussion of ideas and language. HH supervised the project and added to the theoretical development of the paper.	First author with predominant contribution	1.0	Published in Journal for Sustainable Development, Vol. 12, No. 1, February 2019 (Indexed - International Peer-Reviewed Scientific Journal)	Presented in NOLAN 2018 – 10 th Nordic Latin American Research Network Conference

Explanations

Specific contributions of all authors

EN - Eduardo Noboa

PU - Paul Upham

HH - Harald Heinrichs

Author status

According to §12b of the guideline:

- Single author = own contribution amounts to 100%.
- Co-author with predominant contribution = own contribution is greater than the individual share of all other co-authors and is at least 35%.
- Co-author with equal contribution = (1) own contribution is as high as the share of other co-authors, (2) no other co-author has a contribution higher than the own contribution, and (3) the own contribution is at least 25%.
- Co-author with important contribution = own contribution is at least 25%, but is insufficient to qualify as single authorship, predominant or equal contribution.
- Co-author with small contribution = own contribution is less than 20%.

Weighting factor

According to §14 of the guideline:

Single author	1.0
Co-author with predominant contribution	1.0
Co-author with equal contribution	1.0
Co-author with important contribution	0.5
Co-author with small contribution	0

Declaration (according to §16 of the guideline)

I avouch that all information given in this appendix is true in each instance and overall.

