Special Issue Distances

FUORI LUOGO

Journal of Sociology of Territory, Tourism, Technology

Guest Editors

Anna Maria Zaccaria
Maria Camilla Fraudatario

Editor in chief: Fabio Corbisiero
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YEAR VI - VOL. 15 - NUM. 2 - JUNE 2023
FedOA – Federico II University Press
ISSN (online) 2723 – 9608 – ISSN (print) 2532 – 750X

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This Special Issue of Fuori Luogo is made possible with the contribution of the Italian Association of Sociology
Section Sociology of the Environment and Territory

This issue is dedicated to the memory of Prof. Gabriele Qualizza, Università Ca' Foscari di Venezia

Summary

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FedOA - Federico II University Press
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Fedoa adopts and promotes specific guidelines on editorial responsibility, and follows COPE's Best Practice Guidelines for Journal Editors.
Authorization of the Court of Naples n. 59 of 20 December 2016.
Director: Carmine Urciuoli
ISSN 2723-9608 (online publication) ISSN 2532-750X (printed publication)

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Fuori Luogo is indexed in: DOAJ Directory of Open Access Journals - ACNP Catalogue code n. PT03461557 - Index Copernicus International ID 67296.

The journal is part of CRIS Coordinamento Riviste Italiane di Sociologia.

Fuori Luogo is included in the LOCKSS (Lots of Copies Keep Stuff Safe) network of the Public Knowledge Project (PKP PLN)

Ilaria Marotta, Dario Minervini e Ivano Scotti[1]

The Epistemic Distances in the Sustainable Energy Transmission Process[2]

1. Introduction

To face the COVID-19 socio-economic crisis, the European Union defined the Next Generation EU plan, a relevant investment fund addressing clean and smart recovery actions for a more stable, wealthy and sustainable EU society. According to the plan, the ecological transition and digitalisation process will characterise the investments in the energy sector to redefine the provisioning system. The idea is to produce energy sustainably (through renewables) and efficiently (with storage and smart redistribution systems), engaging new actors in the energy field (citizens, companies, local institutions, and experts) for a just transition that will leave no one behind. In this prefigured future, big energy companies and energy prosumers (individual and collective) will work side by side, exchanging resources (energy, money, information, services) through smart grids with expected common benefits.

Many actors are involved in the transition process with different roles in promoting changes in the energy system, complicating the "big picture". Actors can express diverse interpretations and expectations of the "desirable future" based on different epistemic cultures and values. Transition is intended as a designed and contextualized framework, enacted consistently with the internal rules and epistemologies informing the different domains pertaining to experts, professionals and academics, that contribute to define the sociotechnical energy imaginary. Transdisciplinary is often recalled as the way to connect the distances of knowing (and managing) reality and to give a concrete shape to policy programs and discourses on environmental sustainability, as well as the general aim of improving socio-economic well-being through an inclusive participation in decision-making.

Distances among different prefigurations of the transition can be retraced not only between different field of experts but also along the divide between experts and lay people. Indeed, a consistent part of the actors that participate in developing the transition, generally acknowledged as stakeholders, can be unrelated to an institutionalized filed of knowledge.

Through the main outcomes of the EU H2020 project ASSET, we propose to analyse the epistemic distances among actors involved in the transition process to understand how transdisciplinarity seems enacted. The research highlights the contradictions in the transition process in the case of the EU. Despite a widespread demand and initiatives for dialogue between STEM (science, technology, engineering and mathematics) and SSH (social sciences and humanities) disciplines, STEM retains a hegemonic position in the energy field with a traditional posture on the transition path. In this sense, the paper aims to promote consideration of the transdisciplinarity issues in the just transition. To do so, in the next paragraph, the concept of transdisciplinarity is questioned and connected with the energy issue. In the third section, we shortly report the research questions, the method and the consistency of our database. Research outcomes are detailed in paragraph four; in the conclusion section, we pose critical remarks on the epistemic distances in the sustainable energy transmission process.

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2 Received: 30/01/23. Revised: 25/05/23. Accepted: 01/06/23. Published: 30/06/23.

2. Transdisciplinarity Research and the Energy Transition

In the current socio-ecological crisis, complex and interrelated relations among human actors, objects, and natural entities appear evident; finding an effective solution for this issue is not possible without analysing separately the socio-material elements that act within it. To do so, we need to combine different disciplines, which clearly support the process toward the sustainable energy transition. The aim to develop a holistic understanding of this complexity has been pursued by important scholars such as Margaret Mead, Gregory Bateson, and Edgar Morin, to name a few. However, despite a broad debate, the framing of a connective epistemology still needs to be clearly established. Three different trajectories that compose the variety of disciplines can be mentioned.

First, "multidisciplinarity" recalls the cooperation between different scientific fields that still confirm their exclusive area of jurisdiction. In this case, the point is to differentiate among problematic claims about a specific issue. Second, "interdisciplinarity" is more about the linking and connection among different disciplines. Here the focus is to interplay different epistemic perspectives negotiating on a specific issue. The third case is the "transdisciplinarity", which represents an ambitious challenge consisting of a synchronic/coordinated understanding of the complex reality. It can be considered an ecological framing of the ontology, and, at the same time, a comprehensive epistemology based on the logic of inclusion, connection, reconstruction, and composition. Clearly, this posture distances itself from the modernist speculative/positivistic specialised and segmented division of scientific labour (Schroeder, 2022).

In the current socio-ecological crisis scenario, transdisciplinarity appears as a promising path forward. As Funtowicz and Ravetz (1993) showed, the separation and specialisation of scientific knowledge fail as "systems uncertainties" and "decision stakes" improve. Normal or applied science is the common way to address and fix problems; data are available, tools and techniques fit with the inquiries at stake, and decisions follow the ordinary "proof of evidence" approach, so science can "speak the truth to the power" (Collingridge, Reeve, 1986). However, when uncertainty increases, ordinary knowledge is not enough; something needs to be done in terms of problem framing before applying a specific protocol or claiming a state of facts. In this scenario, adaptation is the key, reshaping the old solutions, re-framing certainties while taking into account new risks, taking them into account. This is what Funtowicz and Ravetz call professional consultancy. Finally, the worst scenario (which is the current one) is characterised by high uncertainty, and the decision stakes are high, too. In this case, the urgency of the decision-making (policy) complicates the task of addressing, detecting, analysing, learning, and consolidating knowledge (science). The routinised science appears inadequate, and the adaptiveness of professionals is not enough. Here is where transdisciplinary research comes into action because what is needed to be managed is, first of all, the reconciliation of the facts and value nexus.

Where conclusive evidence-based demonstrations do not help manage and reduce the complexity, creative patterns for reconciling tensions and inconsistencies need to be explored. Transdisciplinary is not only a matter of deliberative scientific dialogue but also a remodulation of the relationship between experts, scientists and lay people. Transdisciplinarity recalls an extended idea of democracy, the method of knowing is political in itself, but this complicates the issue of the urgency of the decisions required. This short-circuit is quite straightforward and evident regarding the climate change "affair". Indeed, what is at stake is an "ecological subject" (Minervini, 2011), a heterogeneous aggregate of social and natural elements that needs to be unfolded, focusing on its relational and procedural dimensions that contribute to preserving or degrading the socio-natural balance. In a way, it challenged cognitive tools, producing an epistemological rift in the consolidated modern object-subject Cartesian dichotomy. For this, transdisciplinarity is close to the "ontology of becoming" promoted by Whitehead (1929), which postulates that knowledge experience involving object and subject precedes and affects the knowledge itself.

Similarly, some perspectives reframe analytical categories and conceptual metaphors to over-

come Cartesian reductionism, like notions of "co-production" (Jasanoff, 2004), "assemblage" (De Landa, 2006) or "actant" (Latour, 2005). Those concepts try to break free from both materialist and constructivist radicalism. The current socio-ecological crisis also leads to reformulating the nature-society relationship in political terms, and the question of "care" emerges as a significant ethical issue. As ecofeminism highlighted, care involves humans and non-humans in space (intra-generational justice) and time (intergenerational justice). This perspective imposes a rethinking of life on earth due to "odd kin" (Haraway, 2016; Tsing, 2015). In this sense, the well-being policy must consider the interconnections between everyday life's physical and social dimensions.

The "ecological subject" cannot be dispersed and fragmented into disciplinary fields. For example, to understand ecological innovations or the chance for alternative green life, some analyses (Shove *et al.*, 2013; Spaargaren *et al.*, 2011) propose to study how socio-materiality is embedded in everyday life, such as routines, consumption behaviour and lifestyles. Thus, disciplines (e.g. material sciences, sociology, urban planning) have to adapt to the study of the "new objects" and the researchers themselves, to some extent, have to cross knowledge fields accordingly to the post-normal approach mentioned before.

In energy research, transdisciplinarity is also a relevant topic (Grunwald, 2018; Heaslip, Fahy, 2018; Mallaband *et al.*, 2017; Sibilla, Kurul, 2020; Spreng, 2014). Energy across the natural science/social science interface and these two scientific cultures have to be intertwined to reach public purposes. For example, the sustainable energy transition process needs STEM to identify appropriate places to develop power facilities considering natural settings, technology efficiency, and plant affordability. SSH is useful in diverse ways because it can play a different role in studying the energy transition according to the analysis level: macro, meso or micro (Osti, 2019). SSH can recognise the socio-cultural values of local people affected by green projects and engage them in participatory development project steps. Some research report how green experts – who are strategic in promoting the green energy policy – seem to redefine their object of study, combining hard and soft skills (Minervini, Scotti, 2020) and practising transdisciplinarity in their work activities. Other research stresses how transdisciplinarity is useful for developing the energy community thanks to a constructive dialogue among "expert knowledge" (disciplines) and between 'lay/local knowledge' (local community) and researchers (Heaslip, Fahy, 2018; Thomas *et al.*, 2018).

Although the literature recognises the need to move toward a more collaborative approach in the energy field, studies highlight that fragmentation between disciplines remains a significant problem, and transdisciplinarity appears still as a goal than as practice (van Wees, 2022; Sibilla, Kurul, 2020). Moreover, scholars observe how exclusions of social sciences and humanities are reproduced in the energy research field (Baum, Bartkowski, 2020; Overland, Sovacool, 2020; Royston, Foulds, 2021). It also reduces the chance to consider how socio-technical imaginaries of the energy future emerge and are implemented as a result of conflict and mediation social process (Rudek, 2022; Sovacool, 2019). For this, the different positions, perspectives and epistemologies of the actors (individuals, civil society associations, companies, and institutions) involved in the transition need to be questioned. The inclusive, collaborative and deliberative approach featuring in the post-normal scenario overlaps with different epistemological distances enacting different ontologies (Carolan, 2004). People, observers, practitioners, scientists, and politicians can be more or less close to environmental facts. It depends on the complexity of the fact and the practical/direct experience of those involved in the facts. Carolan shows how the more complex and distant the environmental issues are, the more variable the ontological enactments of the same issues is (which are hybrid combinations of facts and values).

In short, the sustainable energy transition is a complex matter that affects (and is affected by) different experiences, practices and understandings. It implies conflicts and alliances, negations and confirmations of what is the energy transition itself. These ontologies are intrinsically political and real at the same time because they emerge from specific assemblages of heterogeneous institutions, discourses, knowledge, technologies, physical elements and so on (Law, Urry, 2004).

In this sense, the energy transition is not a linear process. Inquiring about the distance and proximity of the desirable energy future (policy/politic dimensions) for the main actors in the field and how they engage with transdisciplinarity to face the challenging complexity (knowledge/technical aspects) seems relevant to understand the possible green and just energy transition path.

3. Research Question and Methodology

EU policies aim to perform the energy transition as a participative, inclusive and sustainable process (Cameron *et al.*, 2020). To accomplish this goal, innovation processes must adopt the responsible research and innovation framework, including STEM and SSH disciplines (Wickson, Carew, 2014). In short, implementing the green energy transition has to consider socio-environmental effects and potential impacts, which implies a considerable complexity to manage. Despite indications, the way to implement the energy innovation is affected by actors' epistemic posture and what they intend for / enact transdisciplinarity.
Using some outcomes of project ASSET (funded by the EU Horizon program) carried out in 2020, we aim to retrace the actors' expectations on what kind of green energy innovation will be implemented and the combination of knowledge/competencies they consider relevant for the transition process[3]. Through a mixed-method approach, we collected information on the green professions and educational needs for the desirable transition by stakeholders at different stages of the energy project implementation. In this way, it was possible to detect how energy field actors consider transdisciplinarity and their epistemic distance from each other, affecting the implementation of the green energy transition process.
Specifically, we used a survey, in-deep interviews and two focus groups. We collected 140 questionnaires with a non-probabilistic sample that mainly reflects the relational circuits of the project partners. For this reason, the survey does not claim to apply our results on the whole sector. According to the multi-level perspective (Geels, 2002), we considered six stakeholder types to submit the questionnaire that represent the "energy regime" actors: market and costumers, industrial networks, policy and administration bodies, infrastructure managing authorities, cultural agencies, and science and technological actors. Those actors were detected in four European areas: continental, Mediterranean, Nordic, and West-European isles. According to the literature on the varieties of capitalism (Hall, 2008), those areas share similar institutional contexts. Even if this strategy guaranteed a sample heterogeneity (tab. 1), in the sample prevailed men (78), middle-aged people (42 years on average), subjects with a high level of education (85 with PhD, Master or similar), actors that work in private sector (36) or in public administration / authority (32), subjects involved in energy production (32) and manufacturing industry (27).

Tab. 1 - Sample of stakeholder for socio-economic and institutional contexts

	Continental	Mediterranean	Nordic	West-European isles	Total
Market and costumers	5	10	1	6	22
Industrial networks	7	9	2	2	20
Policy and administration bodies	6	10	1	4	21
Infrastructure managing authorities	7	11	7	7	32
Science and technological actors	10	19	8	1	38
Cultural agencies	1	6	-	-	7
Total	36	65	19	20	140

Source: research data.

3 ASSET (A holistic and Scalable Solution for research, innovation and Education in Energy Transition) was a research project funded by the Horizon 2020 Framework Programme of the European Union under Grant Agreement n. 837854. The consortium involved eleven partners from six European countries: Belgium, Denmark, Germany, Greece, Italy and Spain. The research was carried out between May 2019 and April 2021. The authors were part of the research team from the partner University of Naples Federico II (Italy).

The survey helped us to detect the features of the foreseeable energy future of our respondents and how competencies, knowledge, and social aspects they linked to the transition process. In this way, the actors' epistemologies emerged, along with the way with which transdisciplinary is defined.
In-deep open interviews were used to question 20 key informants (academics, market actors, policy and administrator subjects), energy field experts across some European countries: Italy, Greece, the UK, France, Belgium, and Sweden. Fist interviewees were identified by project partners, then informants were sampled with the snowball technique considering specific profiles to involve. This interview allowed us to reconstruct key features of the energy transition in terms of socio-technical practices and diachronic processes. A narrative / dialogical strategy was used for data production; it helped us to detect arguments emerging from the interviewed experts, not suppressing respondent arguments. The interview guideline included five main themes (energy transition and labour market; education, training, career; involvement in the energy transition filed; energy transition and ethics; respondent data). Informants guided researchers in the cultural and semiotic space of the energy transition, in particular dimensions of knowledge and competencies needed in the innovation process. Finally, two focus groups involving 10 stakeholders were implemented using in-depth open interviews. The aim of focus-groups was primarily to retrace the epistemology behind policy decisions and the social legitimation of energy transition.
Using the triangulation of the research pieces of evidence (Jick, 1979), this study revealed the epistemic distance among energy stakeholders and the role of transdisciplinarity in the process as they emerge in the study.

4. Research Findings

By integrating data, perspectives and the arguments collected during the research, here we report the alignment/disagreement among heterogeneous stakeholders involved in the green transition process on energy innovation. In particular, we consider four aspects: 1) the prefigured energy future, 2) the challenge to involve ordinary people and communities in the transformation path, 3) the knowledge and competencies deemed relevant to perform the transition, and 4) the gender issues, a controversial topic in energy field linked to social aspects, competencies and complexity. Those aspects help to show the different epistemic positions in the energy field and stakeholders' consideration of the need to integrate diversified disciplines and knowledge in green energy innovation.

4.1 The Sustainable Energy Future

Our sample shares a common image of the sustainable energy future that appears very close to the current dominant European energy imaginary in which prevails a green-collaborative industrial scheme (Engels *et al.*, 2020). In 5-10 years, small-scale distributed systems, like roof-integrated photovoltaic, will increase relevance in their country scenario (64.3%) in lieu of large facilities (28.6%), such as wind farms. Consequently, developing technologies are related to the management of a complex system (smart grids, 51.4%) and to ensuring a steady energy supply (storage systems, 43.6%). The energy future will seemingly be shaped by small-medium facilities owned by cooperatives or citizens that will operate in decentralized smart grids for symmetrical exchanges of energy, money and services (48.6% highly agrees). This innovation should mainly contribute to CO2 reduction and promote social share of "energy benefits", according to 57.9% and 55.0% of respondents.

To straighten out this green innovation, it seems crucial to engage University and public research centres and citizens. Respondents consider economic agents or institutional and regulatory actors only in the second instance (tab. 2). These data seem to confirm the idea that the energy transition is an innovation process that needs not only novel technological solutions but an active role of citizens in implementing the new scenario.

Tab. 2 – The first sector entities involved in the transition considered relevant in next 5-10 years. Maximum 2 answers per each sector.

Economic agents: manufacturing sector (e.g., wind turbine, PV, etc.)	49,3%
Institutional/regulatory actors: local administrations	45.0%
Research and educational sector: Universities and public research centres	78,6%
Civil society: citizens (single energy consumers)	65.0%

Source: research data.

Despite those data, in the interviews, the opinion emerges that citizens' participation is weak, but it is increasing. Emphasis is placed on promoting local communities by providing them with knowledge and competence on green behaviour, regulation/incentives and technological options. In short, citizens, as local community members, are part of the picture. However, they need new knowledge dissemination and communication tools to circulate positive narratives and good practices in promoting the transition process.

> «The issue of grassroots involvement is central because the only hope for the development of a democratic energy model is the involvement of the individuals [...]. All knowledge transfer is central to the choice of development model» (Managing director).

> «The energy transition is a decentralised process, and as such it involves the local area, and without a push from the local area it cannot be done. On the one hand, there are policies [...] that can make action viable in the [energy field]. And, on the other hand, there must clearly be the local sensitivity and willingness to do all this, even the possibility» (Policy adviser)

According to our data, stakeholders describe a socio-technical energy imaginary that will be digital, green and delocalized; citizens and local communities need to be involved in decision-making and technology adoption to realise this innovation. The "smart-green energy community" appears in the forthcoming energy scenario. This last aspect opens up crucial questions: in which way (epistemic posture) do different stakeholders see the citizens/communities' involvement? Moreover, what kind of knowledge (transdisciplinarity issue) do they think is relevant for this purpose? Coherently with the literature, data seems to report how those topics are described fairly evenly among actors involved in the transition process because of the emerging socio-technical energy imaginary that frames them. However, essential differences reveal the current transition scenarios' underlying social conflicts or tensions (Rabiej-Sienick *et al.*, 2022; Smith, 2016).

4.2 People and Community Engagement

To build the "smart-green energy community" scenario, ordinary people need to establish their effective and direct role in framing the socio-technical transition consistent with the local context by acquiring several competencies. This point is linked to the democracy issue in the transition process and multilevel energy governance. Intuitively, institutions and public agencies are responsible for setting cooperative initiatives with local actors to enhance a just and effective green transition. However, research suggests that narratives about multilevel governance and democratic arrangements overlap but are not connected enough. Stakeholders maintain spe-

cific and distant epistemic positions from each other, which seem related to their particular interests and purposes.
In the sample (tab. 3), actors directly involved in economic or technical sectors (for example, assembling industries, Universities and regulatory authorities) consider it essential to involve a wide range of stakeholders in co-defining transition strategies. However, the local/territorial level seems less important. In this case, an image of "corporate democracy" prevails, where ordinary people are close to clients, customers or user figures. Contrarily, respondents in policy bodies, environmental and third sector seem to stress the relevance, or the equal importance, of the local level in the energy transition. Ordinary people appear linked to "active citizenship" here. In these opposing considerations, we have two perspectives on people engagement as the transition path appears necessarily different.

Tab. 3 - Question 1: "How policies can contribute to strengthening a democratic energy transition process?"; question 2: "Do you agree or disagree with the following statements?".
Score 4 and 5 in percentage according to stakeholders' categories.

	Answer question 1: involving a wider range of stakeholders in the co-construction of actions and strategies	Answer question 2: local level should be more relevant in decision making about the energy strategies
Civil society (e.g., grassroots movements)	66.7%	66.7%
Consumptions (e.g., consumers organisations)	100.0%	100.0%
Educational agencies (e.g., Universities)	80.0%	70.0%
Energy production (e.g., energy suppliers)	72.4%	65.5%
Environmental sector (e.g., envir. agencies or associations)	75.0%	91.7%
Manufacturing industry (e.g., assembling industries)	74.0%	66.7%
Policy body (e.g., local administrations, Ministries)	80.0%	80.0%
Regulatory energy authorities (e.g., transmission operators)	100,0%	70.0%
Total	77.7%	72.0%

Source: research data.

In both cases, ordinary people need an empowerment process, but interviewees rarely expand on this issue. When respondents focus on this aspect, they report the role of citizen associations in animating the green innovation process in local communities. However, more relevant stress is on political institutions in defining the transition path. In particular, institutions must push for change in ordinary people and help them to learn appropriate competencies. In this way, citizens' involvement can increase energy and ecological awareness, promoting a stronger propensity to adopt new practices and participate in collective actions. The policy bodies (such as local administrations) require some new competencies and an innovation orientation to accomplish this task.

> «On the political level, there is a philosophy that says: "people are incapable of adapting to change", so we just must impose it. It would probably be right to impose it. Unfortunately, that's how it works. But there is obviously a need for a strong political force that leads to dramatization» (Professor of sociology).

> «Institutions must regain possession of the educational role, of informing people, first and foremost, because this illusion of "do-it-yourself" at the educational, informative level is an illusion. It is nice to think that you can have direct access to information, but you also need to have the culture, the training and the skills, the critical sense, the foresight, the awareness also to know how to filter from cyberspace» (Professor of chemical engineering).

The role of institutions appears pivotal because, in general, experts and market agents consider ordinary people's involvement and community participation necessary in implementing new energy arrangements, but they have a substantially subordinate position in the process. Smart solutions and experts have to support communities toward the best energy option that appears predetermined. In this case, competencies and knowledge emerging in the field (local technicians, local representatives) that could be relevant in a "participative green innovation" process seems not adequately recognised. For this, the integration of lay/local knowledge with the most legitimised and formalised skills profiles (academics, professionals) appears weak in the concrete undergoing the process.
As respondents report, institutions could connect different actors' specificities (interests, vocabularies, knowledge) to fill voids of a complex, multilevel and contradictory process. It regards the articulated role of connecting governance levels and composing interests at stake to manage societal dynamics through a holistic approach. Nevertheless, such approach is not easy to adopt because, as one of the respondents pointed out, political institutions have their organisational structure and action principles:

> «[...] the EU adopts the principle of competition, which means [...] the rules are applied uniformly as if all the players in the system had the same weight. This is an ideological distortion, if you like. [...] in practice the translation of European directives into national laws takes place through the national parliaments, and the ability of these parliaments to adequately represent minorities, even local instances, the instances of individual territories, and to represent them adequately and listen to them depends fundamentally on [...] the political architecture [...] of that country» (Advisory board).

4.3 Knowledge and Competencies

Consistent with the expected scenario, respondents report the knowledge and skills for professions needed to manage the energy transition. New skills are pivotal to governing the novel socio-technical complexity and the variety of actors involved in the "smart-green energy community" setting. The knowledge and skills necessary to facilitate a sustainable transition are transversal but slightly differ for specific actors (tab. 4). In general, on the one hand, hard skills related to digitalisation and data analysis seem necessary to integrate within the current energy field actors that can manage the technical side of smart-green innovation. On the other, soft skills, such as communication competencies, and adaptability/creativity, seem helpful in interfacing with communities and citizens to promote a collaborative and mindful transition. These skills appear essential to strengthen and support the cultural change we need for a sustainable transition. The requirement of an enhanced complex set of skills is also clarified by one of the stakeholders interviewed:

> «Engineering, sociological, and economic skills are needed because the topic is very broad and has an impact on various social, technological and economic spheres. The energy transition has been with us for more than 20 years, since liberalization began, at this moment it's involved a lot with new technologies. The skills needed are economic, technological and social as well as a well-developed knowledge of the regulation of this sector» (Researcher).

Nevertheless, some interesting nuances emerge on competencies if we consider specific respondents. For instance, market actors stress skills related to innovation in production processes or operational moments (software knowledge and big data analysis 72.4%, problem-solving 70.4% and decision-making 58.6%). At the same time, institutional subjects consider competencies helpful in governing the complexity (local context analysis 70.0%, adaptability 80%). Civil society, instead, emphasizes aspects that could contribute to participation and access to knowledge in co-defining the efforts required by the energy transition considering local con-

text analysis 66.7%, communication 70.0%, awareness of territorial context and intermediation 50.0%).

Tab. 4 - Considering the sector in which you are directly involved, which hard and soft skills should be trained in the near future to foster the energy transition? Maximum 4 answer for each.

Hard skills		*Soft skills*	
Software knowledge and Big Data analysis	62.1%	Communication skills	50.7%
Digital skills	54.3%	Adaptability/creativity	50.7%
Local context and paths analysis (Network Analysis)	52.1%	Decision-making	48.6%
Management	39.3%	Problem-solving	47.9%
Machine operation	28.6%	Team-working	43.6%
Logistics	21.4%	Networking/lobbying	32.1%
Languages knowledge	19.3%	Awareness of territorial contexts and intermediation	29.3%
Accounting	9.3%	Learn to learn	20.0%

Source: research data.

Data indicate that energy transition needs professional figures that integrate different disciplines and approaches to implement the green transition, able to connect STEM and SSH. In line with this, respondents think that these topics should be included in educational and training courses because the energy transition is a socio-technical innovation process. At the same time, respondents report that disciplines like "economic and management" and "engineering and technology" are those that need a priority reorganization to answer to the current energy challenges (respectively, 60.7% and 67.9% of the sample). It seems that energy managers and engineers are pivotal professional figures who embody the transition process. These traditional expert profiles need to enlarge and enrich their knowledge and skills because their ordinary disciplinary fields are insufficient.
In the focus-group sessions, a participant reported that these figures are relevant and need to be constantly updated because the energy field constantly changes, and new challenges emerge.

> «The people I deal with daily are managers who generally do not have technical profiles, but they have been in the energy sector for a long time, so they gradually acquired technical skills. [...] I don›t necessarily have to do engineering studies to enter the sector, but I have to do a training course. Training, so transversal. [...] We are constantly recruiting human resources and following the evolution of the sector [...] both technologically and in terms of services. [...] we create employment opportunities and new professionalism. These are people who have technical expertise in plant maintenance on the one hand, and managerial, economic, and managerial skills within the company on the other» (Employee of an energy company).

Data research suggests that new knowledge and skills are critical for engineers and economists concerning not only novel smart-green technologies but also territorial participation and local actors' involvement. However, other professional figures emerge as relevant in forging relationships with local authorities and links with territorial societies to promote green innovation and distribute energy benefits. These "new" (and renewed) profiles should acquire interpersonal skills to recognise social needs, rights, and communication competencies to establish a collaborative environment to balance local stakeholders' interests with market actors' purposes. In this sense, an interviewee reports the "community planner" in the energy transition.

> «[...] the figure of the community planner, a syncretic figure that combines the urban planner, the territorialist, the sociologist, that combines all these skills put together can certainly make a difference, including the legal skills» (PhD researcher).

An uncritical general imaginary of the energy transition is therefore beginning to emerge, based on the same static conception of skills. This is mainly grounded in the dominant and positive image of this process and its subordination to the market.
Another case of new profiles is the "project developer", which respondents qualified precisely. This expert necessarily masters technical disciplines, but it should encompass both humanities and social science in their curriculum more than other figures. Accordingly, this expert's main competencies are related to communication, networking and decision-making (tab. 5). Our respondents and interviewees recall the necessity to combine scientific and social disciplines specifically for profiles directly in contact with local communities or citizens. Nevertheless, project developers can be qualified as market actors that work mainly for companies, and then intermediations with local actors/contexts are addressed by companies' purposes. On the contrary, experts like community planners seem close to institutional purposes to regulate competing interests to achieve the collective good. We can trace this difference in the role of educational agencies. The sample indicates Universities (43.6%) and energy companies (33.6%) – as on-the-job training or internal training – places where new skills have to be developed and spread. Social issues are pivotal for both, but the aspects on which Universities and companies should focus are diverse. For example, universities should consider environmental and ethical aspects in developing green novelties. It recalls the role of the public collective in preserving common goods. On the contrary, energy companies should focus on management and gender issues, which govern contingencies.
Data suggests that connecting disciplines in the energy transition takes work. In the survey, we decided to ask about a well-known "interdisciplinarity" concept as a proxy for transdisciplinarity one.

Tab. 5 - Disciplines and skills that characterize the "ideal job profile" for project developer in the renewables and energy efficiency sector.

Disciplines	Energy project developers	Average of other profiles
Arts and humanities	5.7%	2.6%
Engineering and technology	59.3%	87.2%
Social sciences and management	29.3%	6.2%
Soft skills		
Communication	20.7%	8.6%
Decision-making	26.4%	13.8%
Networking/lobbying	7.9%	3.3%
Hard skills		
Languages knowledge	9.3%	5.5%
Management	41.4%	15.4%
Network analysis	15.7%	7.1%

Source: research data.

On a scale of 1 (not at all) to 5 (definitively), we asked respondents if they thought interdisciplinarity was an important issue; around 81.5% said that it is relevant (4 and 5 scores). Nevertheless, they also indicate that acquiring and practising interdisciplinarity competencies is difficult, respectively 57.9% and 66.4%. According to some interviewees, these difficulties are related to the absence of figures able to define conditions in managing dialogue and coordination toward transition purposes. In this sense, stakeholders still maintain an epistemic distance, and transdisciplinarity is not easily reachable.

> «I strongly think that we must not lose the depth of our own disciplinary knowledge, of the method, and we must instead work more on the connection between figures with different backgrounds, who must build up a capacity for scientific and project-related relations, etc» (Professor of chemical engineering).
> «There is a lack of transversal experience, where people from different fields can communicate with

each other. Getting social scientists and engineers to communicate is not easy! It would be important to create people who facilitate these meetings, who can effectively organise a meeting between different groups of stakeholders, so that a constructive atmosphere can emerge. A major limitation is precisely that of creating opposition. A useful figure would therefore be represented by these facilitators, who are not people that have to promote a project but are people who have to promote dialogue between different interests, therefore without espousing an a priori thesis» (Researcher).

What has been reconstructed so far leads us to believe that, as far as the distribution of expertise is concerned, the view of the respondents appears predominantly flat. It refers to an uncritical imaginary of the energy transition, entrenched mainly on the dominant and positive images of this process and its subordination to the market. This, according to writers, may depend on two factors: the first refers to the education of the respondents themselves, who are already involved in the transition scenario. The second issue, on the other hand, depends on the fact that the very vision of the energy future that is dominant among stakeholders is built on a common imaginary that bases its foundation on the status quo and current dominant interests. In this scenario, therefore, the (few) differences underscore an epistemic distance between SSH and STEM disciplines.

4.4 Gender and Energy Issues

Gender issues are another relevant topic in the energy transition that helps us observe the epistemic and transdisciplinary issues. In our sample, women involved in the energy sector have a higher educational level (77.0% have a PhD, Master or similar) compared to men (59.0%), but, at the same time, a lower job position; women that report being "top manager" or "manager with high responsibilities" are 25% versus 38.5% of men. This gender gap seems related to the different educational backgrounds: 57.5% of women indicated "engineering and technology", while men were 62.8%. Women prevail in "social science and humanities" disciplines (30% versus 9%) while men in "economics and management" ones (15.4% versus 2.5%). Data also show how STEM is an increasingly dominant discipline in the energy (and the energy transition) sector, and SSH are growing (tab. 6), particularly for younger respondents. A specialization process in the field appears to reduce the relevance of "economic and management" competencies. At the same time, engineer profiles consolidate positions and gain new skills, as stressed in the last section. SSH significantly increased, but respondents with degrees in SSH, mainly women (54.5%), are not in high job positions, despite it being reported in the previous section that SSH disciplines offer knowledge and skills useful to promote processes of public involvement and persuasive actions for the green innovation process. It shows a peculiar epistemic dominance in the field.

Tab. 6 – Respondents for disciplines, gender and age.

	Women		Men		Total	
	≥ 40 yrs. old	< 40 yrs. old	≥ 40 yrs. old	< 40 yrs. old	≥ 40 yrs. old	< 40 yrs. old
Economics and management	5.6%	0.0%	23.7%	7.5%	15.2%	5.4%
Engineering and technology	55.6%	59.1%	60.5%	65.0%	56.1%	63.5%
Natural sciences	5.6%	4.5%	2.6%	10.0%	4.5%	6.8%
Social sciences and humanities	27.8%	31.8%	5.3%	12.5%	10.6%	20.3%
Other or not indicated	5.6%	4.5%	7.9%	5.0%	13.6%	4.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: research data.

Respondent women are around a third of the sample, but they propose a slightly diverse opinion on the sustainable energy transition process. Women think that green energy innovation should

involve subjects linked with (or able to connect) local context, such as citizens (68%), end users (50%), plant developers (35%) and grassroots movements (18%). On this, men suggest an essential role for actors related to the industries and administrations, like university and research centres (86%), manufacturing sectors (51%) and local political bodies (51%). Moreover, even though the most urgent priorities in the energy transition are slightly different for women and men, women prevail in aspects related to the environment and social dimensions (CO2 reduction, 63%; job opportunities, 43%; reduction of impact on the landscape, 43%), while men consider priority economic and regulatory ones (more socially share energy production, 58%; a simplified regulatory model, 49%; improving the security of energy supply, 35%). Differences insist even on the aspects that should be stressed in the educational path to support the green transition. For both women and men, "university and public research centres" and "energy companies" (in the on-job learning process) are the main places to develop competencies to achieve the transition. Nevertheless, women focus more on socio-environmental aspects, while men focus on technical and environmental ones (tab. 7).

Tab. 7 – Aspects that should be focused on University and energy companies to support the transition. Score 4 and 5 in percentage by gender.

	University		Energy companies	
	Women	Men	Woman	Men
Environmental aspects	87.5%	75.6%	85.0%	71.8%
Ethical issues	70.0%	60.2%	75.0%	66.7%
Gender aspects	47.5%	42.3%	55.0%	37.2%
Management issues	77.5%	74.40%	77.5%	70.5%
Social aspects	90.0%	65.4%	82.5%	69.2%
Technical/engineering issues	82.5%	84.6%	77.5%	83.3%

Source: research data.

For both, gender and ethical issues are minority elements to focus on, albeit women stress ethical and gender issues in the case of companies; supposedly, they report difficulties in the private sector to emerge as valuable skilled employees. Our respondents seem to record gender gaps that recall what is known in the literature as horizontal and vertical forms of occupational gender segregation (Valentini, 1997), as to say gender stereotypes influence the choice of educational/training paths and employment sectors to target (horizontal segregation); top positions are primarily a men prerogative (vertical segregation).

> «Women always must show that we are intelligent, but not so much. [...] We have developed powerful chameleon skills [...], it is not enough for us women to know how to do things; we also need [...] to think when it is appropriate to propose something and when not, when to take a step forward or backwards. [...] Do you know how many times in the early days, about ten years ago or even more, that I was travelling around Europe, the energy tables were all male? 80% of the time, it was just me. In that context, they had a good-natured attitude toward me; I was «the only girl and young person» there. I did not have any influence role» (Director of Department of territorial government).

In sum, the presence of women in the energy field and the increasing relevance of SSH (evident in the case of younger respondents) appears to be an essential chance to determine a transdisciplinary dynamic in the sector promoting a more inclusive transition process. However, in the interviews and focus groups, subjects suggest that a slow change is taking place, particularly in the renewable sector. Nevertheless, the presence of women in the energy field continues to be minor, although their skills and attitudes are considered worthy of the transition process.

> «As far as the presence of women is concerned, I would definitely say a minority, let›s say 30%. I have a female boss, but at her level, she is one of the few, and I do not think there are any other women above her, so I would say there is still a strong gender gap (I.18, Nuclear Physicist).

«Energy is a very masculine field because it is always linked to technical education, and culturally technical education is something men have access to, all STEM subjects. That is still the situation today, but it is slowly evolving» (Member of renewables company).
«I see a prevalence of men, but with a gender disparity also linked to age. If I think of a group of people under 35/40, it is probably a draw. Men are more or less the same number as women. Perhaps because they are also new professional figures, women can enter more easily. However, if you go up in age, they are primarily men» (Project manager of an environmental association).

Gender issue, as a problematic analytical dimension, poses the question of how to promote transdisciplinarity and reduce epistemic distances among stakeholders in the energy field. Although interviewees mentioned a gradual increase in the presence of women in the innovative renewable sectors, many gaps persist in terms of employment, management and pay. In addition, research findings show that policy-makers consider women more as beneficiaries (passive role) than innovation agents (active role) and female employees are involved in administrative offices and mid-management positions. The public debate seems to converge on requesting a "gender-balanced" energy transition. However, our respondents are timid about this issue, and gender is not reported as relevant. The absence of emphasis specifically on this issue confirms the stereotyped polarisation between men and women on competencies that also seems to show the implicit division of epistemology postures that dialogue with difficulties.

5. Conclusion

In this paper, we propose an analysis of how energy transition develops itself along different conceptions of reality, and how it creates reality itself, both in theory and in practice. Transdisciplinarity is considered a way to manage the epistemic distances among actors and, at the same time, to face high levels of complexity and uncertainty of eco-innovation. The "desirable" futures emerge as inherently political visions that embody social values enacted in situated energy practices. In other words, it represents a sociotechnical imaginary, a collectively held, institutionally stabilized, and publicly performed vision of a good energy future.
In this context, the participative and just transition, as principle, is insistently claimed as one of the pivotal points of the EU path to a decarbonized society, but significant insights seems to emerge from the analysis of ASSET research dataset.
The epistemic differences in the sustainable energy transition are commonly considered a barrier to green innovation and, at the same time, "lay knowledge" is claimed relevant as well as the involvement of citizens, local communities, and women. However, the fragmentation among specialized knowledges affects the concerns of the respondents, which seem to depict the disciplinary dialogue more as a vague wish than as an actual practice. Training and education institutions are introducing timid transdisciplinary working/learning method (Yeung *et al.*, 2021).
Professionals who embody technical and engineering skills are aware that an efficient and sustainable energy transition needs to be consistent with an ecology of values, attitudes, and knowledge that may not fit with the "dominant" (neoliberal) culture of sustainability. So, mediation management and cooperative building are tasks that need to be organized with the professional profile also of those that are in charge to take care of the economic sustainability of green investments (Minervini, Scotti, 2020).
Data shows that professional re-skilling can be designed within a general scheme fostering not only a sort of disciplinary hybridization, but also the abilities to collect, interpret and be responsive to the requests from those local communities involved in experiences of energy transition.
If the composition of STEM and SSH sensitivities seems to be a convergence point of discussion from the respondents, at the same time research results seems to denounce a lack of actual connections and practices. Actually, a STEM oriented approach prevails in the energy field, and

despite the declared relevance of SSH, they are quite side-lined. Social scientists and experts from humanities participate with ambiguous roles, too often as facilitators for black-boxed innovations more than for a participatory and inclusive decision making process.
In short, energy still remains an engineering-lead field and the rhetoric about transdisciplinarity is characterised by a sort of depoliticization leading to an abstract/generic idea of connection of plural epistemologies, without a problematization of its actual translation in actual practices (with all the related contradictions, criticalities, challenges). The vague claim to transdisciplinary overlaps with a confirmation of a prescriptive image of the transition in financial and technological terms. The common awareness of epistemic distances doesn't lead to the reconfiguration of the big pictures but, paradoxically, seems to be confirmative of the status quo. In the same way, conflicts, power asymmetries and social exclusion could be reproduced in the new energy future despite the "smart-green energy community" recalling energy democracy concepts (Stephens, 2019).
Research findings reasonably lead to suggest that institutions can improve their commitment to develop non-rhetorical and practice-based transdisciplinary paths for the eco-transition. In the case of the EU, the Just Transition Mechanism (JTM) is devoted to reaching climate neutrality by 2050, ensuring that no one will be left behind in the green innovation process. The JTM offers funds to avoid that this transition could negatively affect industries, workers, and communities. In addition, territorial just transition plans finance social-territorial initiatives facilitating employment opportunities in new sectors, offering re-skilling opportunities, investing in fighting energy poverty and promoting access to energy. Nevertheless, European policies are not radical enough to put in question the "ontology" of energy transition itself, confirming an ecological modernization of the field and assembling more or less adaptive governance arrangements, the economization of ecology, and technological innovation.

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