Bringing geopolitics to energy transition research

Angélique Palle

Bringing geopolitics to energy transition research – postprint version

Angélique Palle, Institute for Strategic Research (IRSEM, Paris) / UMR Prodig (research associate)
Keywords: energy transition, research agenda, power, justice, geopolitics

Published as: Palle, A. (2021). Bringing geopolitics to energy transition research. *Energy Research & Social Science*, *81*, 102233. https://doi.org/10.1016/j.erss.2021.102233

Abstract:

This perspective aims at a geopolitical conceptual and empirical contribution to research questions on power in energy transition research, coming from the history of energy and Sustainability Transitions Studies. It aims at answering the call that has been made for the development of approaches that take power dynamics between actors into account, by authors coming from Sustainability Transitions Studies.

This article suggests a geopolitical approach of power relations, at and of the different scales of energy transitions – understood as a change of energy resource could open a complementary and more spatial vision on this issue based on the main concepts of representations, territoriality, and resource development.

This conceptual proposition is then developed over two empirical examples. The first one is France's energy governance system, which is just stepping out of its precedent energy transition towards nuclear energy. It explores the effects of the ongoing sustainable transition on the structure of the political landscape and of the energy sector using the concepts of resource development control and appropriation. The second one on EU energy transition policy highlights the importance of representations, a key concept in geopolitics, whose analysis facilitates the understanding of actors' strategies.

1. Introduction

This paper's aim is to bring both a geographical-geopolitical and conceptual-empirical outlook to research questions on power and justice in energy and climate research. This contribution stands at the intersection of the History of Energy [1–2] and the Sustainability Transitions Studies [3–4], analysed through geographic and geopolitical lenses.

1.1 Recent calls for power and spatial analysis in STS

Recent calls have been made in Sustainability Transitions Studies for the development of approaches that would take power dynamics between actors into account [3–5–7]. This call has arised from the fact that the young field of Sustainability Transitions Studies has tended, so far, to focus on the driving forces and hindering factors of the governance processes of transitions, rather than on analysing their impacts. The political and epistemic critique of the Sustainability Transitions Studies has thus underlined a conceptual shortfall of the field [8]. Indeed power relations between the different actors involved in the transition process and the exclusion dynamics or shifts of power that they bring [9–10] lack proper questioning. This has left open important and untheorized topics such as conflict between actors, political discourse or domination and power relations [11]. Though more recent work has been carried out on power dynamics [7–12–14] it mostly deals with how existing power dynamics affect transition, on resistance processes put in place by incumbents, and how they help or prevent the

diffusion of innovation. On the other hand, what transition processes do to power dynamics in return, how they change existing power relations between old and new actors or between actors acting at different levels, still lacks analysis.

1.2 How the geopolitics of energy could contribute to the Sustainability Transition Studies agenda

The answers and research agenda proposed in *Energy Research in Social Sciences* address these issues of power and justice with a focus placed on "inequities of race, income, gender, and other demographic attributes, and the oppression of marginalized people and communities" [4]. This perspective proposes a geopolitical approach of power relations as well as the different spatial scales of transition. It could in turn open a complementary vision on this issue while contributing to answering the calls for spatial analyses of the transitions. Power is classically understood as the ability to act or make other actors act according to your goals and strategies. Through the multiscale analysis of actors' representations and strategies over territories, geopolitics brings up issues such as : the modification of power relations between incumbents based on transition dynamics, or the emerging conflicts between actors due to opposing representations of what a sustainable transition should be. In geopolitics power relations are not necessarily a given fact but a socio-political and economic construction which can be actively shaped. The geopolitical perspective would thus help to overcome 1. a passive perspective of describing "injustices" and transition hindering power relations 2. while shifting focus on larger multiscale power dynamics, on territorial entities thus seeing beyond social groups.

Starting from a conceptual perspective this paper first aims at explaining how geopolitical concepts and methods could apply to STS's analysis of power in transitions. It then proposes to apply these concepts and research prospects to empirical examples. The case-study of the French energy governance system shows how the current dynamics of sustainable transition are conflicting with the existing system inherited from a recent transition to nuclear electricity. The existing nuclear regime hinders the current transition dynamics going for more sustainability. The case-study explores the effects of the ongoing sustainable transition on the structure of the political landscape and of the energy sector

The example of the European Union presents a focus on the conflicting representations of the ongoing sustainable transitions, leading to question of choosing the "the right scale and level" for a European transition policy. For example, groups of citizens sometimes see the transition process as local empowerment based on local projects that conflict with European institutions' or national governments' transition strategy to develop large national or transnational infrastructures [15].

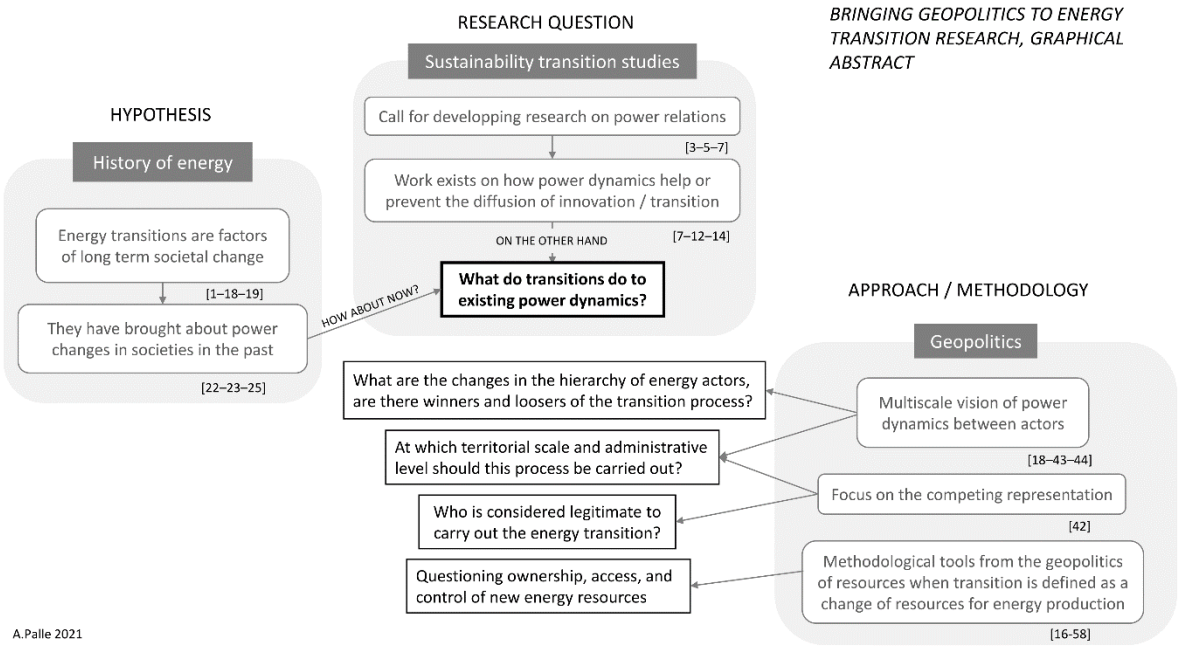

Figure 1 Bringing geopolitics to energy transition research, Graphical abstract

2. Research approach and methodology

The research approach for this paper has been an inductive and iterative one, with several iterations from theoretical literature to empirical cases. The author comes from the fields of geography and geopolitics[1] and joined the STS field later in her career. This paper conveys the first results of this process of integrating geopolitical approaches into the STS field.

2.1 Empirical data

The French school of geopolitics values field research and engagement with the actors themselves. The main findings of this paper thus come from a series of field studies on and with energy actors, These were carried out in France and in the EU from 2012 to 2021. These fieldworks, interviews and participative observations are listed in an annex, they encompass local and regional authorities, local networks of citizens, national regulators and governments, European bodies, and industrial actors. The French school of geopolitics is specifically attentive to discourse production and to the representations conveyed by different actors [16–17]. Naturally the various documentation and discourse produced by these actors though their communication on projects, policies, partnerships, etc., has provided additional research material.

The two case studies presented in this paper (France and the EU) are based on this empirical material.

2.2 Literature and theoretical approach

This paper touches upon three research fields and wishes to achieve interdisciplinary dialogue between them. First of all, the History of energy transitions provides the foundation of the argument which elaborates on the hypothesis that energy transitions are vectors of long-term societal changes [1–18–19]. The second approach comes from geopolitics and its French radical school [16–17–20], it is used here as an attempt to contribute to the understanding of the power changes that occur in the European energy transition. The main goal of this paper is to contribute to a conceptual dialogue between these two fields and the Sustainability Transition Studies field, which has been one of the

[1] Both fields are linked in France as geopolitics is academically taught as a sub-discipline of geography.

leading areas of research on energy transitions in social sciences for the last decade, and which is currently engaging with power issues in transition [7–12–21–3–4].

3. From energy transition to societal change, questioning power changes in energy transition processes

Energy plays a central role as a strategic resource fuelling how societies produce, exchange and live. Contributions to the field of Energy History over the last decades have highlighted the central role played by transitions in long-term social changes. Debeir, Deleage and Hemery's *In the servitude of power* [22] presents an early example of work linking energy transition to structural societal and political change in a linear perspective over long term periods covering most of human history, thus bringing up the question of power changes. Richard Adams' work [23–25] is also an early attempt at linking together energy and power dynamics in the same framework. Picking up on their work, a long tradition of historical analyses, mostly linear models of change from one energy system to another, presents energy as a critical factor in social change, [1–18–26–32], sometimes even "the critical factor" [19]. Without necessarily sticking to the idea of linear synchronous transitions of energy and social systems, as the 20th and 21st century's evolutions in energy sources have been rather incremental[33], this line of historic work raises a set of research questions that could be asked about the ongoing sustainability transitions.

To assume that a change in energy systems also means a structural change in societal systems raises a more global question, that of the effects that sustainable transitions (which are not limited to energy) have and will have on our societies at many levels. Focusing on power issues, many of these historic works explain how a change in energy sources and means of production have deeply modified pre-existent power relations. Debeir, Deleage and Hemery [22] explain how the change from watermills to windmills by the end of the Middle Ages in Europe contributed to a redefinition of social hierarchy because water was owned by the lord while wind was free for the commoner to exploit, thus contributing to the appropriation of the means of production by a rising bourgeoisie.

Many examples could be adjoined to this one, questioning if and how the ongoing sustainability transitions are bringing similar changes to our societies' power balances. Power relations that could be linked, for example, to the reappropriation by local actors or citizen groups of means of energy production, to the impact of autonomous energy management methods, to the willingness of certain territories (either urban or rural ones) to adopt an autonomous transition policy at their own level or to join networks of international actors who can challenge or compete with the policies implemented at the national level.

4. Applying geopolitics to energy transition research

4.1 Why bring a geopolitical perspective into energy transition research?

The political dimension of transition processes has largely been explored through governance approaches that first focused on building cooperation and consensus among actors [37]. The "unacceptability" of certain major infrastructure projects and the opposition observed, particularly that of local actors, to transition processes decided and planned at the national level [38] called into question this obviousness of consensus. The eminently political nature of transition processes is now defended by numerous works that deconstruct both extremities of the spectrum which describe either the "neutral" nature of the technologies used or their deterministic nature of reinforcing socio-spatial inequalities [9–39–42]. These approaches, which are mostly socio-technical, mainly address the transition process through its infrastructures (production infrastructures, transmission and distribution networks). This paper proposes to adopt a geopolitical prism that views the transition process as a change in resources. Beyond the political dimension of this transition, it allows one to

analyse the transition process in terms of the power relations between actors at different levels but also between the levels themselves [18–43–44].

4.2 Mapping geopolitics, a short introduction to the field

The field of geopolitics is composed of different branches of research whose interests and objects are partly determined by the other disciplines geopolitics has been associated with. Two main lines of research exist, for a full mapping of the field see [42]. The first one, sometimes called neoclassical geopolitics is close to international relations. It is a conservative realist approach mostly focusing on States. The second one, sometimes also called critical geopolitics is close to political geography. It mostly develops a critical approach to foreign policy practices and works on discourse and representations. In this second line, the French school of geopolitics has a particular approach because it advocates for a multiscale perspective giving great importance to local dynamics and putting less emphasis on foreign policy [43–17–20]. It has close relations with the Foucauldian perspective with which it dialogued when the field was structured in the 1970s [44–45].

The paper addresses the concept of geopolitics in the critical and French sense of the term, as the study of power relations between a diversity of actors over a territory (that is not necessarily a State). These relations are built around actors' representations and interests, and around territorial appropriation [17–42–46–47]. Based on this definition, following subsections of this paper explore the main concepts of geopolitics that could be used in STS analysis.

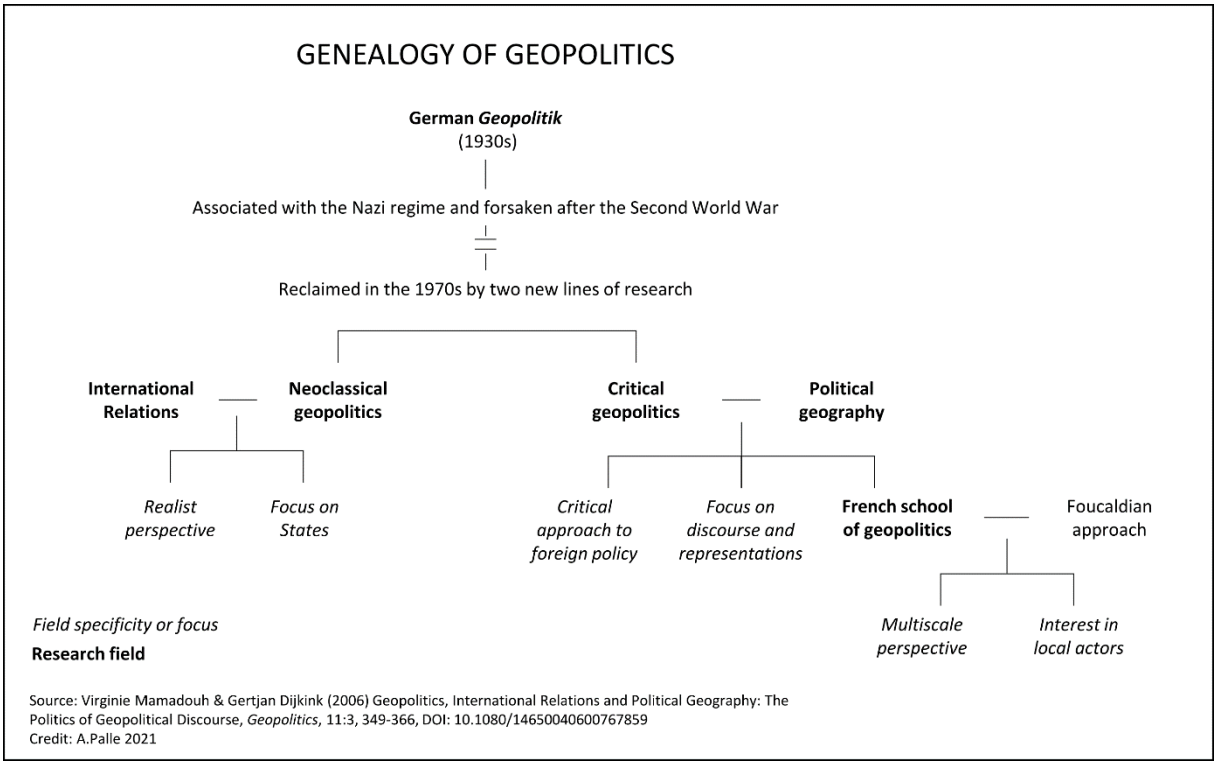

Figure 2 Genealogy of geopolitics

4.3 Using geopolitical concepts in STS: Actors, representations, and projects

Critical geopolitical analysis gives strong importance to discourses, representations and narratives developed by the actors [42] both as means of powers and as gateways to understanding their territorial strategies. The French line of research thus explores the notion of a "geopolitical project" [20] that links the representations that an actor has of itself, of other actors (as competitors, collaborators, hostile, or neutral agents) and of their respective goals, with the strategy this same actor

puts in place to achieve his goals. At an international level, concerning States, these geopolitical projects can often be analysed through foreign policies. At other scales of analysis, actors' official and unofficial discourse, their means of communication and the analysis of their positioning within a specific territorial context shed light on their geopolitical project for the territory. A project such as a specific project of energy infrastructure or an energy transition strategy in a municipality.

Based on the analysis of these territorial strategies and representations, the geopolitical lens then maps the power relations and the power balances between the identified actors of the territory [17–46]. Depending on the case study this can be particularly complex, for example a power line project will mean considering the project bearer, the local and regional authorities, some local groups of citizens concerned by the project, the national regulatory landscape, and the European one if the project is financed or supported by a European body. Conversely, mapping the geopolitics of the European energy transition requires understanding the positioning of hundreds of actors and might open a subfield of research in itself.

In our case, the geopolitical mapping of energy transition in the European Union is interesting as a dynamic process. The point is not so much to get a snapshot of power relations in the EU energy sector at a given time than to A. understand ongoing dynamics of power changes that can be analysed through the discourses, narratives and representations of these actors, old and new; and B. map these changes in a system of relations that integrates case studies in a global framework.

4.4 Power and territoriality as a key approach

Geopolitics being the study of power relations between a variety of actors over a territory, the concept of territoriality is especially important to the geopolitical analysis. It is a shared concept with other fields, mostly geography but also political science or international relations.

The concept of territory makes links between spatial, political and social structures at different scales. Two main lines of research pertaining to territory exist currently. The Anglo-Saxon one stems from the work of R. Sack [48–49] and is inspired by E. W. Soja [50] who considers territoriality as a socio-spatial strategy. The French-speaking line is connected to the work of C. Raffestin [51–52] inspired by both M. Foucault and J. Gottmann's theories on territoriality as a product of representation and power relations [45–53]. These two approaches have developed independently and with few connections between them [54], but they share a focus on power and social relations.

The Anglo-American approach aims at exploring the "spatial strategies that actors use to achieve social and political ends" [55]. It is a pragmatic approach on territorial projects led by different actors and a conceptual framework driven by a Modern European vision of controlled space [56]. On the other hand, the French-speaking line takes a more conceptual relational approach of the different individuals and social groups seeking an increase of their possible autonomy, whilst also taking into account the resources of the system [16].

The compatibility and potential for fruitful dialogue between these two approaches of territory as a conceptual framework for the relations between power and space has been highlighted in the last decade [40–55]. Together they could provide a key approach to the analysis of energy transition impacts on the links between spatial, political and social structures. The concepts of territory and territoriality also take into account the diversity of scales and actors. This answers one of the critiques according to which the geographical approach is too focused on local aspects. Teis Hansen and Lars Coenen thus write that "a well-known weakness of many geographical analyses is that they celebrate the particular and focus on highly idiosyncratic case stories or specific places. It is therefore a challenge for spatial analyses of Sustainability Transitions to identify and formulate insights with theoretical purchase beyond the narrow domain of geography" [57]. Using the theoretical framework of

territoriality to explore the question of energy transition impacts could answer this critique and integrate case studies on power dynamics into global conceptual contributions.

4.5 Energy as a resource, bringing STS power questioning into energy geopolitics

Besides other aspects (e.g. technology change or socio-political changes) an energy transition can be considered as a change of the resources used to provide energy. Approaching energy transitions through the prism of resource use, as a change of sources and production vectors or energy converters, allows the use of analytical grids belonging to the geopolitics of resources. All while raising questions about the political and societal changes brought about by transition processes.
"A resource is the product of a relation. As such, there are no such things as natural resources, there are only natural materials"[16] states Claude Raffestin, one of the forbearers of French geopolitics who dedicated a section of his book *For a geography of power* (*Pour une géographie du pouvoir*) to resources. As such, geopolitics analyse resources through the process of "resource development" ("mise en ressource" in French, literally "putting into resource") that considers the different processes put in place by actors to transform raw materials into resources. This resource development involves access strategies (who gets to access the resource), control of distribution and circulations (control of routes, supply lines, production and distribution infrastructures) and appropriation (who owns the resource and its production system) [58]. Considering energy transition as a change of energy resource is therefore already a way of questionning the power dynamics of energy transition. In this definition an energy system encompasses the different elements used for the transformation of the raw material into a usable resource, and designed by actors to ensure access, control, circulation or appropriation of the resource.

There is a long tradition of energy analysis in the field of geopolitics, with a main focus on international issues related to carbon and fissile sources of energy. Concerns about the changes brought about by the emergence of transitional renewable energy sources are recent (less than 10 years)[59]. Most of this work is being conducted on an international scale. Contributions address either the changes in global balances linked to the adoption of new technologies, e.g. the issue of patents[60]; or the impacts of the energy and environmental changes on international relations [61]; or the new dependencies on the supply of resources needed for this transition (rare earths, lithium, iron, aluminum, etc.) [62].

On the other hand, there is little work on the geopolitics of this energy transition at local, regional, national and macro-regional scales. While in the neighbouring field of resource geopolitics, these questions are addressed. Bringing STS and their power questioning over energy transition into the classical geopolitics of energy would open fruitful areas of interdisciplinary work. The proposed lens is that of the appropriation and ownership of resources and their modes of production [58], through their territorialisation. Territorialisation is understood here as the articulation and exercise of the social and political powers of actors in a space [52–63–64] and as the formation of political and identity representations [55–65]. This prism of appropriation and ownership through territorialisation could be used to explore power relations in transitions.

5. Applying geopolitical reasoning to empirical examples of sustainable energy transitions: the case studies of the French energy governance system and the European Union.

The following sections present two empirical examples of energy transition through the geopolitical framework presented in section 4. The first one on the French energy governance system with an example of the Island of Sein, explores how the energy transition challenges incumbent actors' positions of power. The European Union case study explores the representations the actors of the

energy transition have of what this transition is, and should be. It analyses how these representations play a role in the definition of legitimate governance for the European energy transition.

The research methodology relies on qualitative actors' interviews, analysis of public discourse of these actors, observatory participation fieldwork as a policy expert or team member (European Committee of Regions, European Network of Transmission System Operators for Electricity), and quantitative analysis of public surveys carried out by the EU (Eurobarometer) or by the French State ("Grand Débat") among their respective populations.

5.1 The French example presents a conflict between current dynamics of sustainable transition and the existing system inherited from a recent transition to nuclear electricity.

France is just stepping out of its last energy transition towards nuclear energy (1955-1990). In about 40 years the country moved from 0% to 80% of its electricity being provided by nuclear resources relying on large utilities backed by centralized State policies. The new emerging paradigm with the ongoing transition towards renewables is shaking most of the power balances inherited from the nuclear system at local regional and national levels, bringing in new actors and redefining power positions.

From the first experimental reactors at Marcoule, construction of which began in 1955, to the 1990s, when the share of nuclear electricity stabilized in the mix around three-quarters of the electricity production, France has achieved in less than 40 years one of the fastest and most important energy transitions in European history [66]. In order to lead this transition, French governments have relied on massive political and financial State investment. They also relied on and favoured the birth of major centralized industrial and research players such as the *Commissariat à l'énergie atomique* (CEA) and the firms it gave birth to (Cogema, Framatome, Technicatome, later becoming Areva then Orano) or *Electricité de France,* a State-owned monopoly on electricity supply, until the European Union's integration started opening the energy markets to competition in 1996 [67].

The current transition dynamic, based on the use of renewable energies, began ten years after the end of this electrical transition to nuclear power. It is therefore taking place in a context with several interesting specificities. First, France has a previous experience of not only a rapid transition, a 40 year time step comparable to that targeted by the European Union for its current transition, but of a successful one too in the sense that this transition policy was actually implemented and led to an effective transition. Second, the actors in this transition, whether individuals, institutions, companies or local authorities, are for the most part still active or influential in the energy sector and in French society. The previous transition to nuclear power has given rise to the emergence or strengthening of powerful actors on the national scene, whether they are large industrial groups such as EDF, engineering corporations and schools (Ecole Polytechnique, Ecole des Mines, Ecole des Ponts), or research institutions such as the CEA [67]. The transition process currently underway towards renewable energies is therefore particularly interesting to study in the light of these legacies. This is because some of its dynamics (decentralization of resource production, local or individual production, etc.) are at odds with the logic of the previous transition to nuclear power, this forecasts effects on the power relations between actors. It gives rise to conflictual situations between the actors of the nuclear transition, that are still very powerful in the country's energy and political landscape, and the actors of the sustainable transition.

An example is the case of the Island of Sein. The sources for this example are an exploratory fieldwork in 2019 at the Positive Energy Territory Days (TEPOS), which was followed by an interview (26.11.2020) with a renewable developer involved in the project and the association, finally backed up with press coverage of this project [68–69]. The Island is not connected to the national network and is currently

powered by 3 oil-fired power plants, the extra cost for the island per year compared to the national price of electricity is 450,000 euros. This extra cost is financed through a national tax, the contribution to the public electricity service, which is managed by the long-standing player and former State monopoly EDF who supplies the Island's energy. In 2011 part of the island's population set up a project to transition towards renewable sources of wind energy "Ile de Sein Energie". This project was backed up by an association of 70 inhabitants and sympathizers which represented 25% of the island's voters. They asked for a reinvestment of the yearly subsidies of 450,000 euros covering the extra energy cost of the island to finance its energy autonomy through renewables. They faced both the opposition of EDF and of the mayor and the town council. It brought the project to a halt and led to severe local political consequences. The project bearers lost their seats at the next election in 2014 in a context of local tensions over the project [68]. At the national level, the project has been sent up to the Prime Minister and the association is seeking support from the Parliament. At a European level, the association also met with the Energy Directorate of the European Commission in order to raise political support outside of the national arena. Four years later, in 2018, EDF presented its own renewable project of wind turbines for the island which was attacked in court by four of the island's inhabitants before getting licenced by the administrative court [69].

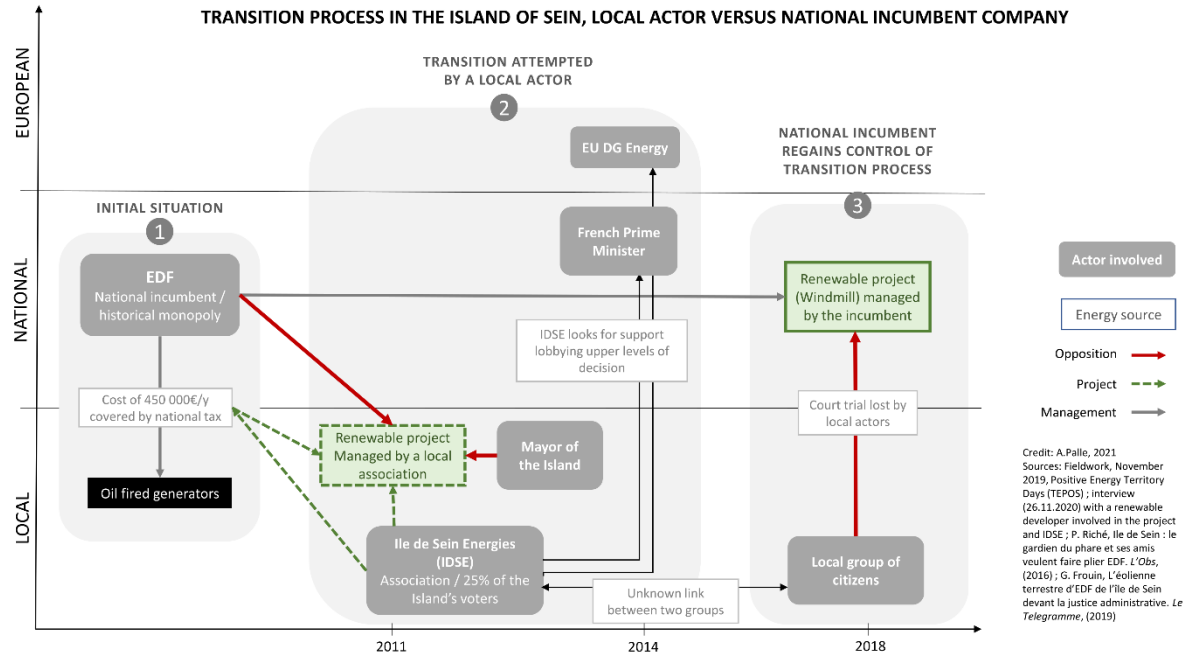

Figure 3 Transition process in the Island of Sein, local actor versus national incumbent company

This exploratory example mostly focuses on energy resource ownership control and appropriation. It shows how sustainable transitions both trigger and are subject to power games between a diversity of actors (incumbents, utilities, governments, groups of citizens, small developing firms, etc.) at different levels over resource control and appropriation.

5.2 From European energy policy to local representations of the energy transition. From conflicting representations of the ongoing sustainable transitions to territorial power games: choosing "the right scale and level" for an energy transition policy

While the French example explored the effects of the ongoing sustainable transition on the structure of the energy sector and the political landscape, these examples explore competing representations of the transition in the context of the European Union in France and Greece. The main point here is

that transition changes existing power balances between actors which opens opportunities for a change in domination patterns.

Representations that actors have of themselves and others, of a territory, a resource or a process are a key factor for geopolitics. Their analysis leads to the understanding of these actors' strategies and can translate into rivalries over territory or resource appropriation [46–52]. In our case, these representations are important to understand power issues and conflict over transition processes. Some recent work carried out on representations shows that "issues raised by citizens link sustainability issues to societal transition" [70], which also means that these representations of the ongoing transitions also involves wider concerns related to societal change and the future of society in general.

This paper considers that the EU case study raises the question of the representations of this transition among the different actors. The main point argued is that many power conflicts over energy and climate policies in the EU come from opposed representations of the relevant or legitimate scale at which they should be carried out [15].

We can start here from the observation of the coexistence of different territorial visions of the energy transition carried in the EU by a plurality of actors. These visions are deployed at different scales and according to different temporalities. If the stated objective is a common one (a change in energy source towards sustainable ones), its territorial implementation by the different actors in the energy sector gives rise to divergent visions, which are sometimes the source of disagreement. Certain actors developing a national or European vision (States, large public or private groups, or European institutions, etc.) seek "acceptability" by the populations of the technical, economic, fiscal or more broadly societal solutions that they propose at their scales without necessarily taking into account or conceiving the "public" or "consumers" as actors of this transition [71]. Some groups of these consumers such as citizens, municipalities or city networks see the transition dynamic as a means of empowerment. The influence policy of the C40 cities network or of the European Committee of Regions are examples of this trend. They actors can also seek autonomy from a national production, like the rural "positive energy territories" in France, or the reappropriation of a territory vis-à-vis the historical actors of the energy sector like the Ile de Sein vis-à-vis EDF developed in the previous section.

This diversity of visions on what this transition is, means or should be for the different actors and territories, all grouped together under the idea of sustainable transition, makes the transition process a particularly political issue, giving rise to oppositions. The previous case study on the Island of Sein showed a competition between the historical state monopoly and emerging local players over network management and energy production ownership and appropriation, in other contexts the opposition can be much more structural with at stake the very conception of what a sustainable transition means.

The most striking examples might be observed among the local oppositions to the building of energy infrastructures dedicated to sustainable energy sources. For example, in Crete, both the Greek government and the EU backed the development of wind farms on the island that aimed at coping with growing demand while progressively replacing the old fossil fuel power plants. The plan was also to export part of the electricity produced to the mainland by building an interconnection partially financed by the EU. This sustainable policy designed at a National and European level faced strong opposition from local populations who perceived it as an exogenous policy aiming at depriving them from their traditional pastoral lands and that would also harm the touristic potential of the island by destroying the landscapes [15]. In other areas the opposition can arise between on the one hand a centralised conception of the transition that implies large infrastructures of either production, like wind or solar farms, interconnection, such as new power lines to cope with the network instability

created by the intermittent production of renewables, or surplus exports, and on the other hand a decentralised conception of transitions that would imply very local and sometimes individual production appropriated and managed by local actors. When these competing conceptions of the transition collide over a specific project of infrastructure, both sides often use the same discourse presenting themselves as the responsible party protecting the climate and the environment while criticizing the other side for its short-sightedness or its misunderstanding of what a sustainable transition implies [15–72].

These competing representations over what an energy transition process is and should be, for territorial entities such as a municipality, a State or the EU, and the conflicts between actors they create raise several questions for research on sustainable transition. In a context of competing visions where sustainable transition dynamics imply societal structural changes, the first question is that of legitimacy; who are the legitimate actors to decide on a transition vision for a territory? In a European context that seeks to apply the principle of subsidiarity, that is to say decision-making as close to the citizen as possible decided "by reason of the scale and effects of the proposed action" [73], this question of legitimacy specifically pertains to the level of decision making. In the case of competing actors at different levels of decision making (local, regional, national, macro-regional, European), which level is legitimate to decide on and enforce a transition process? These questions, which must highlight the conflict between different levels in the dynamics of European energy transition, also contribute to the ongoing debate on the latter's democratic character.

6. Research prospects and questions stemming from a geopolitical and spatial perspective on STS

These perspectives on possible future research agendas for Sustainability Transition Studies concerning power issues open a set of research questions. This paper suggests prospects that will need to be enriched or confirmed by further conceptual and empirical research.

Analysing transition representations

A study of the representations that the actors of the energy sector in the EU have, of what a sustainable energy transition is and should be, is essential to a geopolitical analysis of power relations changes occurring in the European energy transition process. Through this representation analysis, specific questions are of particular interest: Who is considered legitimate to carry out the energy transition? At which territorial scale and administrative level should this process be carried out?

Evaluating resource access, control and ownership

Current carbon and nuclear energy sources and their converters to transform them into usable energy are appropriated by specific and perhaps different types of actors with characteristics and particular geopolitical influences (States, utilities, but also some cities, group of landowners, etc.). Which are the actors who own the sustainable transition energy resources and their converters? Do the owners differ between the resources and the converters ? How is this ownership structure of energy sources evolving with sustainable transitions and with what consequences for power relations among actors? Are there winners and losers in this process? For example, what happens in terms of the balance of power in a specific territory if and when collectives of citizens try to replace big utilities? When a new energy producer emerges? Or when the patterns between producing and consuming areas are changed?

On energy hegemony and power relations between actors old and new

Who are the dominant actors in the sustainable transitions and at which scale are they acting? Are these actors changing over the course of an energy transition? Is the structure of their relations different from the previous energy system of resource development (e.g. bigger number of actors, or

actors involved that did not take part in energy governance in the previous energy system)? What are the implications for power relations between the traditional actors in charge of energy production, management or policy? And between these historic actors of the energy sector and the new actors engaging with energy through the transition process? For example, are cities stepping over State prerogatives in terms of policy making? How is this accepted by State policymakers?

Questioning the spatial reality of power changes in energy transitions

How are these power changes spread across space? Are there specific spatial differences? For example, are transition processes in terms of power relations in urban areas more smooth than in their rural counterparts? How are power relations affected by specific national or regional administration and governance culture (e.g France's centralized governance culture versus other decentralized cultures like Germany)? How are they affected by the different representations that actors have of what a sustainable transition is and implies?

7. Conclusive remarks

In a research context where sustainable transitions are mostly analysed through the prism of economy, innovation spread or international relations, a geopolitical approach in the broader sense of the term that goes beyond international relations to encompass power relations at all scales seems relevant for various reasons. First because besides international relations, it takes into account the game changers and sometimes troublemakers of the existing energy system that are local actors, who see the sustainable energy transition as an empowerment opportunity. Second because it brings together the representations that actors have of this ongoing transition, their strategies and how they territorialize them. This results in a new perspective on the determinants of innovation spread and more broadly on the reasons why a transition process may occur or develop in certain areas or contexts and not in others.

The geopolitical framework provides concepts and methods of analysis that can contribute to answering the issue of power in transitions developed by Sustainability Transition Studies. Questioning and comparing the diversity of the representations that actors have of this transition process leads to a better understanding of their competing strategies often showcased in clashes over infrastructure projects. The geopolitical concept and understanding of resource and the system of appropriation, control and exploitation built around it offers a particularly interesting lens for analysing power relations in sustainable energy transitions.

The empirical examples of the French energy governance system challenged by transition dynamics and the opposition to the European union's energy policy present pilot approaches of the types of analysis geopolitics could bring to energy transition research. In order to better understand the relation between power changes and sustainable energy transitions, some steps still need to be taken such as: the analysis of energy transition representations, of energy transition resource access and control, and of their spatial reality. Sustainability Transition Studies should adopt a broader geographic approach exploring other areas outside the European union.

List of field studies

All the field studies mentioned below are not specifically referred to in the paper, they all contributed to an iterative process with geopolitical theory that resulted in the proposals made in this contribution.

- 2012 (April to June): participating observer at the European Parliament

- 2013: interviews with the European Commission, the European Union's Joint Research Centre - Institute of Energy and Transport, and the French and British regulators

- 2014 (February to July): participating observer at the European networks of electricity and gas transmission system operators, ENTSO-E and ENTSO-G

- 2017: online survey of electricity network modellers

- 2019: interviews with local actors of the energy transition in France, members of the Positive Energy Territories movement, TEPOS

- 2020-2021: participating observer at the European Committee of the Regions (environment commission)

Bibliography

1. V. Smil, *Energy In World History* (Routledge, 2019).
2. V. Smil, *Energy Transitions: History, Requirements, Prospects* (ABC-CLIO, 2010).
3. J. Köhler, F. W. Geels, F. Kern, J. Markard, E. Onsongo, A. Wieczorek, F. Alkemade, F. Avelino, A. Bergek, F. Boons, L. Fünfschilling, D. Hess, G. Holtz, S. Hyysalo, K. Jenkins, P. Kivimaa, M. Martiskainen, A. McMeekin, M. S. Mühlemeier, B. Nykvist, B. Pel, R. Raven, H. Rohracher, B. Sandén, J. Schot, B. Sovacool, B. Turnheim, D. Welch, & P. Wells, An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, **31** (2019) 1–32. https://doi.org/10.1016/j.eist.2019.01.004.
4. B. K. Sovacool, D. J. Hess, S. Amir, F. W. Geels, R. Hirsh, L. Rodriguez Medina, C. Miller, C. Alvial Palavicino, R. Phadke, M. Ryghaug, J. Schot, A. Silvast, J. Stephens, A. Stirling, B. Turnheim, E. van der Vleuten, H. van Lente, & S. Yearley, Sociotechnical agendas: Reviewing future directions for energy and climate research. *Energy Research & Social Science*, **70** (2020) 101617. https://doi.org/10.1016/j.erss.2020.101617.
5. B. K. Sovacool, *Global Energy Justice: Problems, Principles, And Practices* (Cambridge: Cambridge University Press, 2014).
6. P. Newell & D. Mulvaney, The political economy of the 'just transition': The political economy of the 'just transition.' *The Geographical Journal*, **179** (2013) 132–140. https://doi.org/10.1111/geoj.12008.
7. F. Avelino & J. Rotmans, Power in Transition: An Interdisciplinary Framework to Study Power in Relation to Structural Change. *European Journal of Social Theory*, **12** (2009) 543–569. https://doi.org/10.1177/1368431009349830.
8. R. Audet, The double hermeneutic of sustainability transitions. *Environmental Innovation and Societal Transitions*, **11** (2014) 46–49. https://doi.org/10.1016/j.eist.2014.02.001.
9. E. Shove & G. Walker, Caution! Transitions Ahead: Politics, Practice, and Sustainable Transition Management. *Environment and Planning A: Economy and Space*, **39** (2007) 763–770. https://doi.org/10.1068/a39310.
10. J. M. Wittmayer & N. Schäpke, Action, research and participation: roles of researchers in sustainability transitions. *Sustainability Science*, **9** (2014) 483–496. https://doi.org/10.1007/s11625-014-0258-4.
11. J. Meadowcroft, Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, **1** (2011) 70–75. https://doi.org/10.1016/j.eist.2011.02.003.
12. F. W. Geels, Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Culture & Society*, **31** (2014) 21–40. https://doi.org/10.1177/0263276414531627.

13. J. T. Murphy, Human geography and socio-technical transition studies: Promising intersections. *Environmental Innovation and Societal Transitions*, **17** (2015) 73–91. https://doi.org/10.1016/j.eist.2015.03.002.
14. D. Rosenbloom, The Politics of Decarbonization Pathways: Responses, Conflicts, and the Transition to a Low-Carbon Energy Future, Text, Carleton University, 2019.
15. L. Durand, A. Oiry, & A. Palle, La mise en politique de la transition énergétique : la durabilité à l'épreuve des conflits de temporalités. *Temporalités*, **28** (2018).
16. C. Raffestin, R. Brunet, & C. Kobler, *Pour une géographie du pouvoir* (Paris, France: Librairies techniques, 1980).
17. Y. Lacoste, Geography, Geopolitics, and Geographical Reasoning. *Herodote*, **No 146-147** (2012) 14–44.
18. A. Malm, *Fossil Capital : The Rise of Steam Power and the Roots of Global Warming* (Verso, 2016).
19. P. S. Ciccantell, Alternatives to Energy Imperialism: Energy and Rising Economies. *Journal of Energy History/Revue d'Histoire de l'Énergie*, (2020).
20. P. Subra, *Géopolitique locale: Territoires, acteurs, conflits* (Armand Colin, 2016).
21. T. Haas, Struggles in European Union energy politics: A gramscian perspective on power in energy transitions. *Energy Research & Social Science*, **48** (2019) 66–74. https://doi.org/10.1016/j.erss.2018.09.011.
22. J.-C. Debeir, J.-P. Deléage, & D. Hémery, *In the servitude of power: energy and civilisation through the ages* (London ; Atlantic Highlands, N.J., USA: Zed Books, 1991).
23. R. Adams, *Energy and Structure: A Theory of Social Power* (University of Texas Press, 1975).
24. R. Adams, *Paradoxical Harvest: Energy and Explanation in British History, 1870-1914* (CUP Archive, 1982).
25. R. Adams, *The Eighth Day: Social Evolution as the Self-Organization of Energy* (University of Texas Press, 1988).
26. Daniel. Yergin, *The prize: the epic quest for oil, money, and power / Daniel Yergin.* (New York ; London: Simon & Schuster, 1991).
27. M. T. Klare, *Resource Wars: The New Landscape of Global Conflict* (Henry Holt and Company, 2001).
28. B. Podobnik, *Global energy shifts: fostering sustainability in a turbulent age* (Philadelphia, PA: Temple University Press, 2006).
29. V. Smil, *Energy in Nature and Society: General Energetics of Complex Systems* (MIT Press, 2008).
30. E. A. Wrigley, *Energy and the English Industrial Revolution* (Cambridge ; New York: Cambridge University Press, 2010).
31. T. Mitchell, *Carbon Democracy: Political Power in the Age of Oil*, 2nd Revised edition edition (London: Verso Books, 2013).
32. R. Rhodes, *Energy: A Human History* (Simon and Schuster, 2018).
33. P. K. Gellert & P. S. Ciccantell, Coal's Persistence in the Capitalist World-EconomyAgainst Teleology in Energy "Transition" Narratives. *Sociology of Development*, **6** (2020) 194–221. https://doi.org/10.1525/sod.2020.6.2.194.
34. S. Jaglin, Urban Energy Policies and the Governance of Multilevel Issues in Cape Town. *Urban Studies*, **51** (2014) 1394–1414. https://doi.org/10.1177/0042098013500091.
35. A. Nadaï & D. van der Horst, Wind power planning, landscapes and publics. *Land Use Policy*, **27** (2010) 181–184. https://doi.org/10.1016/j.landusepol.2009.09.009.
36. J. Meadowcroft, What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, **42** (2009) 323. https://doi.org/10.1007/s11077-009-9097-z.
37. T. Moss, Socio-technical Change and the Politics of Urban Infrastructure: Managing Energy in Berlin between Dictatorship and Democracy: *Urban Studies*, (2013). https://doi.org/10.1177/0042098013500086.
38. O. Coutard, *The Governance of Large Technical Systems* (Routledge, 2002).

39. O. Coutard & S. Guy, STS and the City: Politics and Practices of Hope. *Science, Technology, & Human Values*, **32** (2007) 713–734. https://doi.org/10.1177/0162243907303600.
40. F. R. Klauser, Thinking through Territoriality: Introducing Claude Raffestin to Anglophone Sociospatial Theory. *Environment and Planning D: Society and Space*, **30** (2012) 106–120. https://doi.org/10.1068/d20711.
41. M. Redon, G. Magrin, E. Chauvin, L. Perrier Bruslé, & E. Lavie, *Ressources mondialisées. Essais de géographie politique* (Sorbonne (Editions de la), 2015).
42. V. Mamadouh & G. Dijkink, Geopolitics, International Relations and Political Geography: The Politics of Geopolitical Discourse. *Geopolitics*, **11** (2006) 349–366. https://doi.org/10.1080/14650040600767859.
43. Y. (dir.) Lacoste, *Dictionnaire de géopolitique* (Paris, France: Flammarion, 1993).
44. M. Foucault, Questions à Michel Foucault sur la géographie. *Hérodote: Revue de géographie et de géopolitique*, (1976) 71–85.
45. J. W. Crampton & S. Elden, *Space, Knowledge and Power: Foucault and Geography* (Ashgate Publishing, Ltd., 2007).
46. Y. Lacoste, Rivalries for territory. *Geopolitics*, **5** (2000) 120–158. https://doi.org/10.1080/14650040008407683.
47. G. Ó. Tuathail, The critical reading/writing of geopolitics: Re-reading/writing Wittfogel, Bowman and Lacoste. *Progress in Human Geography*, **18** (1994) 313–332. https://doi.org/10.1177/030913259401800303.
48. R. D. Sack, Human Territoriality: A Theory. *Annals of the Association of American Geographers*, **73** (1983) 55–74.
49. R. D. Sack, *Human territoriality, its theory and history*, Cambridge Studies in Historical Geography (Cambridge, 1986).
50. E. W. Soja, *The political organization of space* (Washington: Association of American Geographers, Commission on College Geography, 1971).
51. C. Raffestin, Repères pour une théorie de la territorialité humaine. *FLUX Cahiers scientifiques internationaux Réseaux et Territoires*, **3** (1987) 2–22. https://doi.org/10.3406/flux.1987.1053.
52. C. Raffestin, Space, Territory, and Territoriality. *Environment and Planning D: Society and Space*, **30** (2012) 121–141. https://doi.org/10.1068/d21311.
53. J. Gottmann, *The significance of territory* (University Press of Virginia, 1973).
54. J. J. Fall, Lost geographers: power games and the circulation of ideas within Francophone political geographies. *Progress in Human Geography*, **31** (2007) 195–216. https://doi.org/10.1177/0309132507075369.
55. A. B. Murphy, Entente Territorial: Sack and Raffestin on Territoriality. *Environment and Planning D: Society and Space*, **30** (2012) 159–172. https://doi.org/10.1068/d4911.
56. S. Elden, Land, terrain, territory. *Progress in Human Geography*, **34** (2010) 799–817. https://doi.org/10.1177/0309132510362603.
57. T. Hansen & L. Coenen, The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions*, **17** (2015) 92–109. https://doi.org/10.1016/j.eist.2014.11.001.
58. M. Labban, *Space, Oil and Capital* (Routledge, 2008).
59. M. O'Sullivan, I. Overland, & D. Sandalow, The Geopolitics of Renewable Energy. *Harvard Kennedy School, Faculty Research Working Paper*, (2017).
60. C. Bonnet, S. Carcanague, E. Hache, G. S. Seck, & M. Simoën, *The nexus between climate negotiations and low-carbon innovation: a geopolitics of renewable energy patents* (University of Paris Nanterre, EconomiX, 2018).
61. J.-M. Chevalier & P. Geoffron, eds., *The new energy crisis: climate, economics and geopolitics* (Palgrave Macmillan, 2013).
62. E. Hache, G. S. Seck, M. Simoen, C. Bonnet, & S. Carcanague, Critical raw materials and transportation sector electrification: A detailed bottom-up analysis in world transport. *Applied Energy*, **240** (2019) 6–25. https://doi.org/10.1016/j.apenergy.2019.02.057.

63. G. Bridge, S. Bouzarovski, M. Bradshaw, & N. Eyre, Geographies of energy transition: Space, place and the low-carbon economy. *Energy Policy*, **53** (2013) 331–340. https://doi.org/10.1016/j.enpol.2012.10.066.
64. N. Brenner, B. Jessop, M. Jones, & G. Macleod, *State / Space: A Reader* (John Wiley & Sons, 2008).
65. G. Bridge, Resource geographies 1: Making carbon economies, old and new. *Progress in Human Geography*, (2010). https://doi.org/10.1177/0309132510385524.
66. A. Grubler, The costs of the French nuclear scale-up: A case of negative learning by doing. *Energy Policy*, **38** (2010) 5174–5188. https://doi.org/10.1016/j.enpol.2010.05.003.
67. W. Brucher, Énergie et centralisme en France ; l'exemple de l'électricité nucléaire. *Revue Géographique de l'Est*, **34** (1994) 45–60. https://doi.org/10.3406/rgest.1994.2270.
68. P. Riché, Ile de Sein : le gardien du phare et ses amis veulent faire plier EDF. *L'Obs*, (2016).
69. G. Frouin, L'éolienne terrestre d'EDF de l'île de Sein devant la justice administrative. *Le Telegramme*, (2019).
70. K. Matschoss, P. Repo, & P. Timonen, Embedding European citizen visions in sustainability transition: Comparative analysis across 30 European countries. *Futures*, **112** (2019) 102437. https://doi.org/10.1016/j.futures.2019.102437.
71. M. Cotton & P. Devine-Wright, Making electricity networks "visible": Industry actor representations of "publics" and public engagement in infrastructure planning. *Public Understanding of Science*, **21** (2012) 17–35. https://doi.org/10.1177/0963662510362658.
72. A. Oiry, La transition énergétique sous tension ? Contestations des énergies marines renouvelables et stratégies d'acceptabilité sur la façade atlantique française, 2017.
73. TEU, Art 5(3), *Consolidated version of the Treaty on European Union - TITLE I: COMMON PROVISIONS - Article 5 (ex Article 5 TEC)* (OPOCE, 2008).
74. J.-B. Racine & C. Raffestin, Des réponses aux questions de Michel Foucault. *Hérodote: Revue de géographie et de géopolitique*, (1977) 15–19.