UNPACKING THE GOVERNANCE OF ENERGY TRANSITION. A CONCEPTUAL FRAMEWORK.

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Abstract

There is a deep relationship between energy transition and the governance of contemporary societies. However, while existing governance literature has gone a long way to accommodate complex and heterogeneous problems, it has so far fallen short of entirely dealing with the human, social and cultural challenges that this topic incurs. In particular, the deep relationship between energy transition and political dynamics at large has important connections to social, cultural and personal issues that remain underattended in theories of energy transition governance. As a matter of fact, in more or less direct ways, any event moving in the direction of energy transition requires sophisticated levels of coordination among the many actors involved in governance, and mobilizing a wide range of interests that are likely to produce conflicts, tension and resistance. Building on the interim results of the MILESECURE-2050 FP7 project, the authors reflects upon constitutive elements of energy transition regimes, i.e. more or less stable clusters of individual and collective actors, institutional or not, that can develop plans of action, activate social norms and standards and mobilize resources to encourage, manage, anticipate or direct the dynamics associated with energy transition. Theseelements are presented against existing, more abstract and generic approaches to governance of complex problems, in order to position them as potential operationalisations. Overall, the proposed contribution aims to derive general principles for the governance of Energy transition and Energy security, using both empirical material and existing scholarship on governance of complex problems.

Keywords

Governance, low-carbon transition, energy security

1 Introduction

This contribution aims at a problematisation of the governance of energy transition and the multiple challenges surrounding the latter. It does so by putting together a conceptual framework that integrates multiple modes of governance into an organized toolbox, from which some of those may be selected and mobilized jointly towards a successful governance of energy transition. In particular, it shows how the clustering of modes of governance may help devising strategies to attain energy security as well as an increased use of renewable energy sources, while at the same time stimulating a much stronger mobilization of the general audience with its social-cultural capital that most often still remains elusive to grasp and address.

In the following sections, we first present our understanding of energy transition, as developed within the activities of the MILESECURE-2050 FP7 project[3]. Then, we discuss in more detail how

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[3] The present paper is indeed based on the interim results of the FP7 Project MILESECURE-2050: Multidimensional Impact of the Low-carbon European Strategy on Energy Security, and Socio-Economic Dimension up to 2050 perspective (www.milesecure2050.eu). Overall aim of the project is to understand and overcome the political, economical and behavioral traits and trends that led Europe to its difficulties in reducing fossil fuel consumption, and in diversifying its energy balance at rates which guarantee European energy security in the next years (more specifically at the horizon 2050), reduce the threat of climate change, and diminish the risk of an energy gap in the coming decades. The MILESECURE-2050 consortium is led by Politecnico di Torino (Italy), and composed by ten project partners: Instytut Energetyki IEn (Poland) EnergSys (Poland);

complexity arises in energy transition and how this complexity stretches beyond the epistemological ambiguities that have been observed already in policy studies. The third section focuses on how approaches to governance of complex problems still offer some ground work for dealing with these particular issues. More specifically, we offer an inventory of modes of governance that bring out qualities of specific modes that serve the mobilization of citizens in different ways. In the penultimate section, a brief outlook will be given of how such governance could work in practice. Finally, a conclusive section rounds off the contribution, reflecting onthe possible implication that the propose discussion may have for further research in both the fields of energy transition and governance.

2 Socializing energy transition: knowledge, politics and the 'human factor'

Energy transition is the result of a set of complex, heterogeneous, long-term and reflexive processes. Governance studies have produced sophisticated perspectives on the societal management of such processes. These have addressed challenges such as value pluralism, uncertainty, contested expertise, and the changing role of the state (Enroth 2014, Bressers and Kuks 2003, Florini and Sovacool 2009, Guston 2013, Termeer et al. 2013). Yet, the resulting governance frameworks are not per se apt to address the issues that come about when energy security and low-carbontransition are implemented in a social context, and in particular the mobilization of citizens who are the ones supposed to enact the eventual changes.

In this contribution, energy transition is understood at a conceptual level as a set of structural changes in the energy system, with the aim of both achieving energy security as well as of moving towards an increased use of renewable energy sources.This usage is adopted from the conceptual framework developed in the context of the MILESECURE2050 FP7 project. As the changes constituting energy transition concern the structure of the energy system, they are highly consequential: subsystems may become obsolete as they become poorly aligned with new system standards (they become 'reverse salients', see Hughes 1987). Insofar as incumbents depend on these particular subsystems, their competitive position will change. This is one important reason for changes to breed resistance.

Changes also protrude into the private life of citizens: modern life is inextricably connected to energy consumption, and effectuating changes in private lives requires a high degree of willingness for it to happen in the first place. The connection between changes in the energy system and the lives of citizens are manifold. The most radical change seems to be that the role of citizenschanges from mere energy consumers to potential energy producers, since their small scale photovoltaic (PV) installations and the energy buffer offered by the accumulator of their electric car will at times have a surplus rather than a shortage of energy. Moreover, in a less radical sense, citizens' approach to energy consumption is required to change: either as a consequence of legal enforcement, of economic conditionality mechanisms, or by means of 'fun' applications that render energy frugality a competition, decisions on when to use energy and how much will change. This 'human factor' (cf. Caiati et al. 2014) of energy transitions is in the centre court of this paper.

While important challenges in the governance of energy transition still stand, governance studies have already gone a long way in dealing with complexities in a more generic sense. In particular, attention has been paid to the mobilization of science and expertise to abate policy problems. The traditional notion of scientific knowledge and evidence informing political decision making in a neutral way, as 'speaking truth to power', has long been refuted (Brown 2009). The most important arguments are that it would be naïve to believe that scientists and experts do not have political interests or at least a particular, value-ladenperspective, and it would be equally naïve to believe that politicians have no

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ENEA (Italy); Laboratorio di Scienze della Cittadinanza LSC (Italy); Maastricht University MUSTS(The Netherlands); The University of Salford USAL (United Kingdom); Paris-Lodron Universitat Salzburg – PLUS (Austria); EU Joint Research Centre JRC (EU); Ecologic Institute (Germany); Société de Mathématiques Appliqués et de Sciences Humaines – SMASH (France)

access to knowledge without help (Brown 2009, Palmer 2012, Adams et al. 2011). Additionally, the whole idea of science informing political power from a neutral ground presumes that such political power is available in a single site such that it is receptive to the sayings of science.This is clearly a questionable presumption to the backdrop of modern, democratic societies.

A first move in the direction of a more sophisticated connection between knowledge production and decision making has been the introduction of the very notion of 'governance'. For one thing, it holds a refutation of the presumption that politics in clearly defined and limited sites, and instead presumes that power is distributed over many formal and informal institutions throughout society (Barben et al. 2006, Rip 2010, Peters 2004). This entails that decisions are made at numerous places. Also, with this vastly expanded space (compared to conventional notions of politics) in which governance takes place, both the range and heterogeneity of relevant bodies of knowledge proliferate. Not least, it becomes to include the knowledge otherwise confined to private life just explained[4].

Yet, it has been observed that even in its distributed and democratized forms, explicated notions of governance and the way these notions mobilize knowledge still seem to be modelled after scientific ideals of qualified knowledge. That is to say, the more knowledge resembles in content and method the kinds of knowledge produced by (chiefly natural) sciences, the higher its chances to find entrance to governance decisions (Schomberg 2011). Knowledge production aimed at informing governance and modelled this way may make highly valuable contributions to governance, but it is hard to see how it deals with the issue of enrolling citizens.

In addition to the enrolment of citizens, also the problems themselves with which governance is confronted, sometimes resist the simple structure of scientifically informing politics and then taking a decision. In identifying such complex problems, one categorization has been influential. Uncertainty can occur on two dimensions. On the one hand, there can be uncertainty with respect to the facts. In this case, expertise could be consulted so as to reduce this uncertainty. On the other hand, uncertainty can be situated at the normative level, if there is no clear position on which value should be realized. In that case, political and moral debate could possibly be conducted to come closer to a consensus. If neither dimension is particularly ambiguous, we could speak of 'puzzles': these problems are sufficiently structured and can be approached as implementation problems of which the solution is principally within reach. Quite the contrary, especially difficult or 'wicked' problems occur if uncertainty exists on both dimensions.[5] In that case, normative uncertainty renders controversial or ambiguous what kind of expertise should be enrolled, and the factual uncertainty renders unclear what the political debate should be conducted about(Hoppe 2002, Ezrahi 1980). These problems are unstructured, and resist strategies that approach them as puzzles.

[4] For a further discussion of the relation between knowledge and power, check the 'Territorial knowledge channels' framework developed by Adams et al. 2011 Adams, N., Cotella, G. and Nunes, R. J., 2011. Territorial knowledge channels in a multi-jurisdictional policy environment: a theoretical framework. *In:* Adams, N., Cotella, G. and Nunes, R. J. eds. *Territorial development, cohesion and spatial planning. Knowledge and policy development in an Enlarged EU.* London Routeledge.

[5] Prior definitions of wicked problems Rittel, H. W. J. and Webber, M. M. 1973. Dilemmas in a General Theory of Planning. *Policy Sciences,* 4, 155-169, Termeer, C., Dewulf, A. and Breeman, G. 2013. Governance of Wicked Climate Adaptation Problems. 27-39. use different specifications, but the overall characteristics of the current class of problems are much alike.

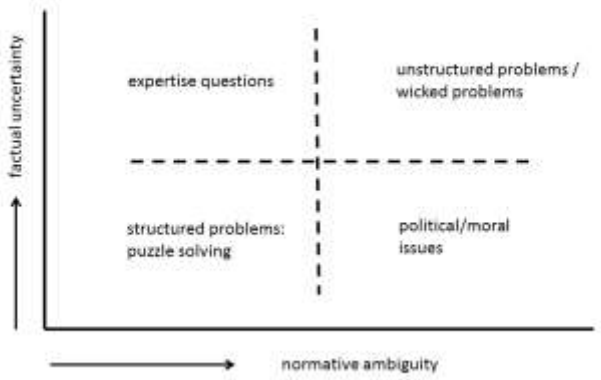

Figure 1: the structure of policy problems (modified from Hoppe and Hisschemöller 1996)

In the upper right quadrant of Figure 1, many problems have been identified over the past decades that are subject to strong controversy and contestation while uncertainties cannot as yet be reduced by scientific research. This is often the case of uncertainties linked to energy security and transition, where the weakness of scientific evidence over long-term issues such as peak oil and climate change impacts hampers the reconciliation of opposite political positionson various matters. For such problems, new modes of knowledge-intensive governance have been devised. On the one hand, it is certainly valuable to bring in many different perspectives, including the perspectives of citizens who are in the end important actors in the effectuation of transitions. On the other hand, as will be developed at length in this paper, to actually transform their positions and mobilize them is entirely another kettle of fish.

Many of the challenges that concern energy transition can be classified along theaforementioned epistemological lines. However, some difficulties remain anomalous in face of this classification. Notably, the fact that energy transition renders the private lives of citizens part of the object space of governance raises ambiguities that are not simply resolved by either conducting further debate, nor by conducting further research. After such epistemic endeavours, considerable ambiguity remains. Most importantly, considerable effort is still to be spent on actually mobilizing citizens, on committing them in the transformations needed. This is not an epistemic affair, but a matter of empowerment, enrolment, activation, and engagement. These dimensions defy the classification of problemsin terms of normative and empirical uncertainty, andremain anomalous, because the classification is chiefly epistemic.In order to shed some light on the matter, the following sectiondiscusses first in more detail how the complexity that arises in energy transition stretches beyond the epistemological ambiguities that have already been observed in policy studies.

3 The complexity of energy security and energytransition

Thus, energy transition derives complexity from three kinds of sources. First, energy transition is complex because of the heterogeneity of relevant values. This concerns both conflation of notions of energy security with notions of sustainability, and a broader range of social goods such as freedom of movement, security of subsistence, and the exercise of democratic rights. These may each entail different and conflicting demands for the energy infrastructure. This is the aforementioned normative ambiguity. Second, energy transition is complex because of factual uncertainties. It is as yet unknown what kind of energy technologies will be successful in the future, how energy needs will exactly be shaped, etc. Also, the influence of carbon emission on climate change remains swayed by large margins of uncertainty, which determines part of the urgency of energy transition. This is the factual uncertainty mentioned earlier. The third kind of complexity is of an entirely different nature though:

the difficulty of societal mobilization. It is different because it is not a knowledge-driven problem in the sense that it can be solved by either moral-political or techno-scientific intellectual effort. It needs something to be 'done'.

An example of a difficulty brought about by a failure in efficiently enrolling citizens in a specific initiative, that is difficult to solve by merely acquiring additional knowledge, could run as follows.It could happen that producers of consumer appliances that have some sustainable energy aspects have wrongly estimated the impact of a particular technology on the private life. They have devised a new laundry machine that directly communicates with real-time energy markets, and takes its own decision as to when the laundry is to be done. It strikes a balance between determining the cheapest moment and meeting some basic level of convenience. However, making use of the machine requires that people may have to wait up to 48 hours until their laundry is finished. Even though this was considered a reasonable 'operational cost' by the developers, it turns out in practice that people after a short while start overruling the energy trading mechanism and tell the machine to do the laundry immediately after loading.

This example tells that the designers had wrongly assumed that people will simply reschedule their laundry during the week, if this yields a financial benefit. To some extent, of course, this is exactly a knowledge deficit in the sense mentioned before. Methods of bringing in user perspectives into the innovation process could indeed help prevent part of such misfits between everyday life practices and novel technologies.The introduction of such new technologies can be supported by roping in relevant expertise and by allowing the public involved to generate relevant perspectives on how things are likely to operate when implemented in the social practices they know so well. But it is hard to see how such perspectives relate to actually 'doing' the work of enrolment – getting citizens to 'do' something – and engagement – getting citizens to care about something and voice their concerns.

It was already pointed out above that transitions involve a reprioritization of values that each on their own have a legitimate claim to realization; that is to say: even if we know what the goods are that deserve our pursuit, we clearly cannot pursue them all at the same time (Caiati et al. 2014). In a governance perspective, such value conflicts would be delegated to the domain of political debate (of whatever sort), in which consensus can be tried to achieve. However, in the case of the laundry machine with sensitivity for the energy market, it is unclear what kind of political question is to be put on the agenda, and in which sort of political or ethical forum. The value prioritization is in the first place a private affair, and it requires specific mechanisms to connect in any democratically legitimate way between such public and private spheres. Such connections can be technologically mediated (Marres 2009), but this in itself not a direct resolution of the problems of enrolment and engagement (for the implementation of those technical connections would themselves face exactly the same challenges of engagement and enrolment).

An additional complexity derives from the reflexivity of the entire system that, in turn, generates additional uncertainty. In other words: we don't know how the future system will behave, since we cannot be entirely sure what system we will build for the future.This is especially true for transitions with their upheaving changes: given the fundamental levels at which changes take place, we are gradually *de facto* building a new sociotechnical system, which means that it is not entirely known how the future system will behave. This holds *a fortiori* for the human factor. In practice, this means that we cannot easily predict the exact social situation in which future technologies will be embedded. This is not only about social and institutional arrangements, but also about the whole axiological scale of private moral concerns, habits and life-style related norms, political ideologies, etc.

This reflexivity holds for all the uncertainties mentioned so far, which adds to the difficulty of challenges being not clearly of an epistemic kind. In general, the reflexivity of transitions and their management has been recognized, and taken to call for an iterative and learning way of management (Kemp and Loorbach 2006, Stirling 2014, Rotmans and Kemp 2008). At the same time, it has been argued that hitherto, important normative questions have been neglected, including the question of

how to 'live' under sustainable transitions, and how the inclusion of this private sphere can be shaped in any democratically sensible way (Shove and Walker 2007).

In the following section, we will explain how governance theory has approached complex problems. The complexity is of a different kind there, and we will thus show how these approaches offer a misfit with the problems of transitions. These misfits will then in the next section be explored proactively, reflecting on how different modes of governance can be mobilized in a way that fills in part of the lacunae.

4 Governance of complex problems

The intricate balance between maintaining (central) public control over matters or delegating decision and policy making powers and competences toagents distributed at the different territorial scales and in and outside the public sectors has long been recognized and captured through the concept of 'governance'. Where the traditional notion of 'government' referred to the control exercised from within a polity's institutions, 'governance' generalizes this control and also includes all the forms of control that take place outside those formal institutions. Thus, forms of citizen participation, production and mobilization of expertise, and self-organization within professional and commercial sectors, to name only some, come to be recognized as important elements not only of the management of a society, but of the evolution of the various institutional mechanisms that shape the latter.

However, the meaning of governance is not univocal and evolved through timein many different, more or less normative understandings. In its broadest, more neutral sense, governance includes all structuring that has consequences and legitimacy (cf. Rip 2010). In a general way, governance is presented as a bottom-up alternative to top-down modes of command and control, that complements the latter without replacing them by any mean (Barben et al. 2006).Some authors often presents it as adding democratic quality to governing a society (Le Gales 2002), while others contest these claims as uncritical, by opposing the blurred features of legitimacy and accountability that the new governance beyond the state often brings along with it (Smismans 2006, Swyngedouw 2000, Swyngedouw 2005).

Whatever conception of governance we adopt, it is likely for there to be problems that are too difficult to resolve. As explained above, Hoppe (2002) has identified two dimensions along which problems can be 'difficult': their normative and factual ambiguities, respectively (see also Hoppe and Hisschemöller 1996). These two dimensions together determine the degree of 'structure' of problems, or the extent to which they can be approached as puzzles to be solved. If problems score high on both axes, they are unstructured, which means they cannot be approached as puzzles. They are likely to be wicked problems: the definition of the problem itself may be ambiguous, there is no clear point at which the problem can be seen as solved, there is no test-site in which a manageable version of the problem can be tried to solve, there are no clearly good or bad answers, etc. (Rittel and Webber 1973).

An approach such as *post-normal science* (PNS, Funtowicz and Ravetz 1993) has prescribed how such wicked problems necessitate the expansion of practices of knowledge production beyond traditional forms of expertise. This 'extended peer community' needs to include a broad range of stakeholders, which are needed to bring a sufficiently wide range of perspectives to bear on a particular problem. While this approach, together with many other approaches to governance of complex problems, has accomplished a democratization of some sort, it has not explicitly engaged with the 'engagement' part of dealing with energy issues.

It is vital to recognize that both the axiological and empirical dimensions of wicked problems are epistemic:[6] they relate to particular forms of knowledge about the world. Even though the distinction

[6] 'Epistemic' is used here as referring to 'knowledge', in particular knowledge of any sort. Thus, it includes normative knowledge. This is different than how Funtowicz and Ravetz Funtowicz, S. O. and Ravetz, J. R. 1993. Science for the post-normal age. *Futures,* 25(7), 739-755. use it. They oppose 'epistemic' with 'axiological',

between these two realms seems fundamental, the categorization is incomplete as, as problems are not always possible to reduce to a knowledge deficit (whether axiological or empirical). Also the PNS approach is ultimately directed at the expansion of knowledge. But knowledgeis only part of what makes this class of problems complex. Complexities of geopolitics and marketsare neither reduced by expertise nor by debate. Also, as Guston (2013) has noted, seeking resolution within a mere epistemic realm would arrogating to (social) scientists the ability to determine what is good, as they will always be in a prioritized position when it comes to adducing knowledge.

True enough, inclusion understood as the inclusion of a sufficiently broad range of perspectives on a problem, what could be called *epistemic inclusion*, is important both from the perspective of democratizing decisions and from the perspective of capacitating actors to cope with complex problems. An approach such as PNS is indeed in principle open to any sort of knowledge, including the human aspects of energy transitions. But exactly because of this fundamental openness, the approach is less capable of identifying problems that are outside the epistemic realm. Also, not all sorts of knowledge can be expected to be equally able to 'speak truth to power' and get their particular truth over the footlight. As Adams et al. (2011) pointed out, when aiming at influencing policy and decision making through the production of knowledge, individuals are more likely to be successful when clustering more or less formally in knowledge communities (may their nature be epistemic, linked to a specific practice or set of values).

At a more philosophical level it can be argued that governance as an alternative to government offers a reversal of the primacy, from a top-down central government to a bottom-up approach (Van Zeijl-Rozema et al. 2008). This changes the subject of governance – who does it – but it does not significantly alter the *object* of governance – what needs to be governed. This is, though, exactly what becomes destabilized in the context of energy transition. Perhaps, additional insight on the modes through which governance actually operates may contribute to unravel the conundrum, and this is what the following paragraph tries to do.

5 How governance operates: modes and regimes

We speak of governance as all those activities that are consequential for how life in the polity is organized. Straightforward examples of modes of governance are political debate, public debate, the installation of market incentives, public education, and self-regulation of professional groups.In a general way, governance is presented as a generalized alternative to classical notions politics and government, which is able to accommodate more of what actually matters in the management of a society. It thus has an inherent promise of democratization, even though Smismans (2006) as convincingly argued that such promises are often made too uncritically.

Classifications of modes of (conventional understandings of) governance have been suggested along various dimensions. As Treib et al. (2005) review, modes of governance can be classified to their degree of coercion, the degree of openness of implementation of decisions, the presence of sanctions, their involvement of actors, their dependence on market mechanisms, and some more. Such classifications are typically one-dimensional and, due to their nature, often sacrifice complexity to the altar of clarity. In this light, it may be worth to put together, on the basis of existing studies, a classification of modes of governance along two dimensions instead: the level of inclusion, and the level of coercion.

The first dimension captures the extent to which modes of governance are socio-spatially distributed and mobilize agency of a broad variety of actors. This *level of inclusion* is low if only institutional and political actors matter, and high if the general audience and market players etc. matter as well. Political debate in parliament is a fairly exclusive, centralized affair. So are taxes, since there is only one authority that executes them. In contrast, grass-root initiatives, interest groups, and public information

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where the latter is exactly the realm of values. Thus, epistemic uncertainty with them is only empirical uncertainty.

are much more distributed and inclusive. They are accessible to many or all citizens, and their execution or effectuation is importantly done by many. This dimension conflates several aspects of what may, in certain conceptualisations, count as 'democratic'. It includes the enrolment of citizens in effectuation of a policy. It includes citizens' access to the institutions where the policy is created and implemented. It includes the extent to which something pertains to all members of society. And it includes the degree to which things are physically distributed and pervaded through society. Thus, this distribution is comparably intuitive, and leaves intact some underlying heterogeneities and ambiguities. However, a further analytic specification of the concept is not needed for the argument of this paper.

The second dimension captures the extent to which propositions are open to negotiation, or instead have closed down and become inevitable. This *level of coercion* is high if things are settled and/or institutionalized and decisions are binding, and low if they are still debated and contested, and decisions dependent on voluntary action. Political debate, conducted within the confines of political institutions that eventually produce laws and other authoritative policies is ultimately capable of coercively taking decisions. In contrast, public debate as such is not. It may generate new ideas and perspective, it may generate support for a particular case, and it may in the end breed acceptance for laws to be adopted, but in itself it is not able to issue binding rules. Yet, the fact that public debate can have important consequences for how life in the polity is organized, makes that it clearly belongs to the sphere of governance.

Following distinctions along these two lines, a collection of modes of governance – by no means meant to be complete – can be arranged in Figure 2.

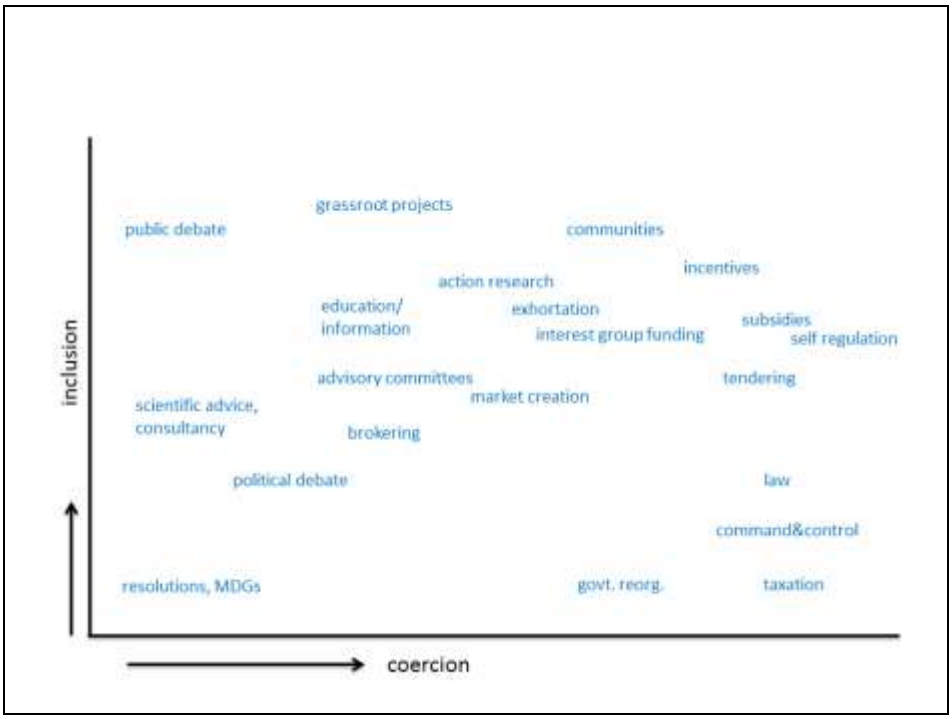

Figure 2: A two-dimensional classification of conventional modes of governance (original)

The combination of these two dimensions produces a field in which the complete range of modes of governance can be charted. At the same time, the field carries a gradient towards both engagement and enrolment of the general public. This is a democratic enrichment, and one that offers more substantial specification than the naïve hopes debunked by Smismans (2006). As will become clear onwards, this classification explicitly engages with the agency of individual actors and how this is arranged, whereas existing approaches often see agency as a systemic feature (Lockwood et al. 2013).

However, in modern, technological life, choices between technological options can be very consequential and binding for the citizens living with them. Therefore, notions of governance should importantly include all those decisions that are consolidated into the techno-scientific infrastructures upon which we live our lives. This holds maybe even more strongly when it comes to energy security and transition towards a low-carbon society, processes that are very much influenced by variable linked to technology. In this light, it is worth to include in the classification more technology-based forms of governance, as the setting of standards, the implementation of infrastructures, the installation of research and development incentives, but also the mere development of new technologies and the abolition of obsolete ones. Thus, innovation and technological design are important forms of governance, even if they are not typically reckoned as such in governance studies.

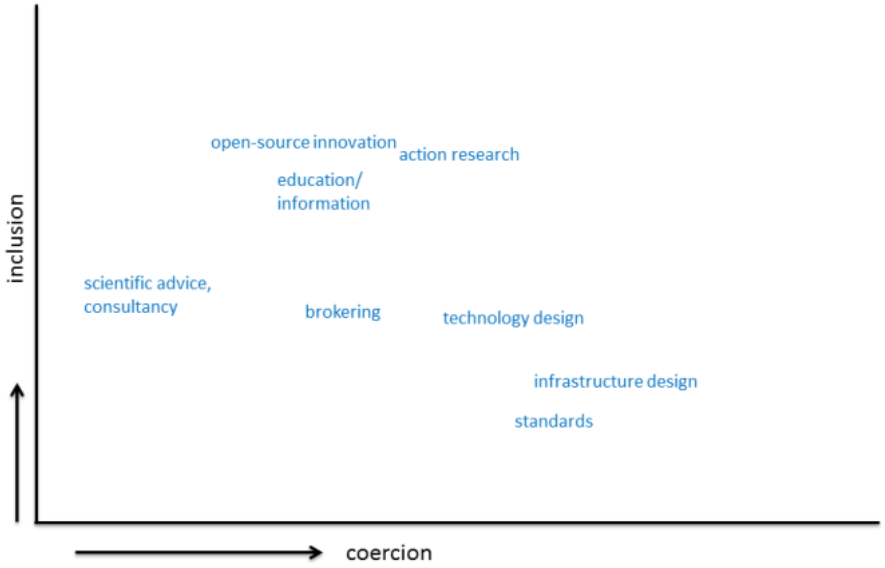

Figure 3: Techno-scientific modes of governance (original)

Principally, governance is about making decisions, the effects of which are imposed on society at large. This is not only done through formal, binding decisions, but also through breeding particular commitments and voluntary behaviour. This entails that the field of modes of governance harbours a general gradient towards the upper right corner. In the end, decisions should produce an impact on everyone (or at least on a high share of the chosen target), and decisiveness requires that the openness to negotiation is ultimately reduced.

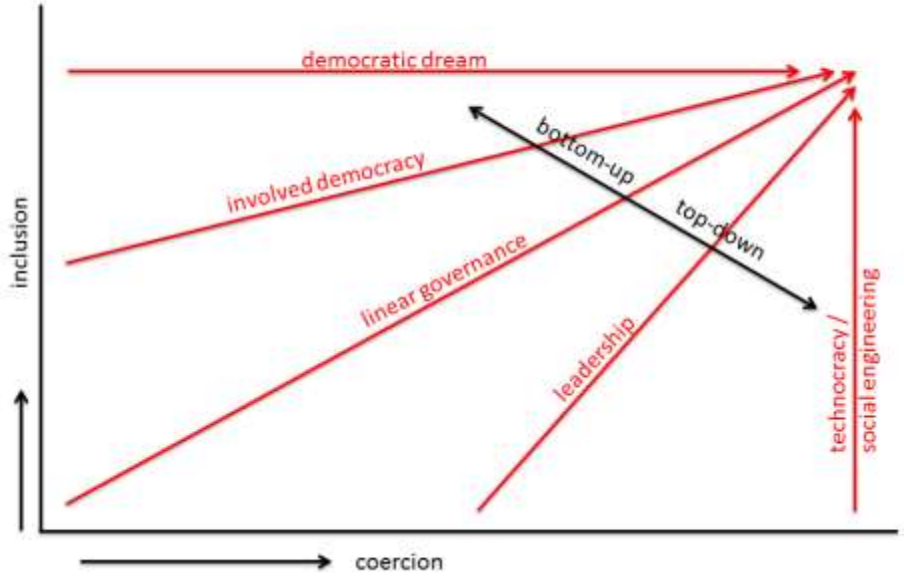

Figure 4: Regimes as gradients in the field of governance (original)

Given this gradient, different 'governance regimes' can be discerned,and represented as stylized trajectories through the field of modes of governance (figure 4).The three trajectories at the centre seem most legitimate and realistic. The most straightforward form of governance, termed 'linear governance' here, starts from a political situation, increasingly enrols and engages more parties so as to include more distributed forms of agency, and eventually ends up in a situation where a policy is well-developed, and generally accepted and applied. What we have termed 'leadership' and 'involved democracy' principally do the same, yet they importantly differ in their starting position. Leadership starts from a position that is stronger on authority while building participation from scratch, whereas involved democracy starts from a position that is stronger on involvement but has no a-priori authority. The extremes of 'democratic dream' and 'technocracy', while theoretically possible, are left out of the following analysis, because they are unrealistic or morally undesirable, respectively.

While the above subdivision of policy problems into the classes of political/moral issues, expertise questions, puzzles, and wicked or unstructured problems remained largely epistemic, the classification of modes and regimes of governance as exposed above adds to this the dimension of process: how issues are circulated, how actors show agency, how actors are positioned in power relations, and how outcomes are never merely determined by knowledge positions. Only through this expansion of the scope can it be possible for the human factor in energy transitions to be incorporated and mobilized. The trajectories towards the upper right corner of the inventory of modes of governance show exactly the enrolment of forces outside institutional politics, and moreover in a way that pays tribute to the fact that such processes are more than an epistemic affair. As a matter of fact, the presented trajectories, but also the many other trajectories that may be drawn in the diagram as linking various modes of governance towards the reach of a specific achievement, when carefully thought, may actually provide a preliminary representation of the involvementof more or less stable clusters of individual and collective actors, institutional or not, that jointly develop plans of action, activate social norms and standards and mobilize resources to encourage, manage, anticipate or direct the dynamics associated with energy transition.

At this point, the important question can be raised of why developments typically start somewhere in the lower left quadrant: with a small degree of participation and a small degree of enforcement. One simple answer is that sustainable transition is an imperative, and institutional politics is a good place to

start implementing such an imperative. A more complex answer is that even if considerable support of the programme exists outside institutional politics, and even if the actual initiative for sustainable transition is taken elsewhere than in parliaments, then still coordination of some sort is needed. For sustainable ideas to be implemented, it is necessary to pass them through political institutions to make sure they become authoritative. De facto, institutional politics will thus always be involved, and pivotal at that.

6 Governing energy transition

As empirical work in the MILESECURE2050 project shows (Caiati et al. 2014), the enrolment and engagement of citizens is most important throughout the whole trajectory of a transition. The empirical material consists of pilot-scale projects. While most of them show characteristics of radical innovation, they are too much limited in scale to count as systemic changes (even though at the level of local perception, they may appear so). Nevertheless, the material clearly shows the value of the gradient-field grouping of the modes of governance. First, it serves as a heuristic to increase our understanding of energy transition and how their governance unfolds. Second, it provides advice on how such governance could be arranged, provided that indeed the gradient as explicated is appreciated.

First, using the framework as a heuristic, the following becomes clear. On the one hand, the empirical material seems to suggest that transition succeeds best if social dimensions are mobilized first, then to be followed by technical and economic arrangements. However, such a conclusion would suggest that the whole transition starts somewhere in the upper half of the field. This is unlikely from the perspective of the field itself, and indeed it should be expected that transitions in reality do not start from scratch. They are typically prepared 'backstage' in policy rooms, political forums, or even spontaneously in public debate. The gradient field suggests that some more centralized form of governance is required upstream, so as to provide some stability and legitimacy to the very direction of the transition. While the gradient field is merely speculative (i.e. based on conceptual ideas, not meant to constitute an empirical or ontological claim), it offers a perfect heuristic reason to look for such more centralized modes of governance. And indeed, at closer look, such modes of governance are actually found in the empirical material. For example (p. 99) [7], it is observed across a variety of case studies that think tanks often play a role in preparing the activation.

Second, the framework seems to make sense as a tentative guideline for selecting relevant modes of governance. For instance, it is observed in many pilots that acceptance of lifestyle changes (p. 46) strongly depends on cultural backgrounds, and how valuations of specific forms of behaviour are made. In many situations, owning a car has a value beyond the mere economic. Owning a car is also about status, comfort, and about a seemingly self-evident conception of 'normal'. Similarly, changing behaviour in heating, for example if an innovative system uses lower reference temperatures than conventional heating systems, is difficult if the whole perception of what a proper reference temperature is, and how this perception is to be changed, are not taken into account. The regimes that were identified in the gradient-field already show which modes of governance are likely to be mobilized if we want those social-cultural aspects to be changed. If an informed guess is made that trading the car for public transit is likely to meet resistance, then it might be naïve to hope for strong participative governance in the initial phase. Instead, the 'leadership' regime might be the trajectory of choice, building on modes such as infrastructure and technology design and the creation of markets. Conversely, if it is expected for any substantial reason that revision of heating behaviour will meet with great initial public support, the 'involved democracy' regime is likely to be successful. This means that scientific advice can easily be consulted, to be followed by public information campaigns and incentives – to mention of course only a few of the many available options.

7 Conclusions

[7] Page numbers in this section refer to the MILESECURE2050 deliverable by Caiati et al. (2014).

The gradient field of modes of governance helps operationalizing the idea that the solution of complex problems requires that multiple perspectives are brought to bear on the very problem. In particular, to existing approaches to complex problems, which engage with epistemic lacunae of normative and empirical nature, it adds sensitivity towards diverse ways of mobilizing and engaging citizens.

Through the three regimes of leadership, linear governance and involved democracy it offers three ways of giving a particular direction to transitions. Clearly, these three regimes are only stylized trajectories, and in practice there is no limitation on the combination of modes of governance. Yet they offer, as shown in the examples in the previous section, some guidance on which modes are likely to be effective. Regardless of the exact choice of modes, the trajectories also reflect that building legitimacy is at least as important as is building engagement. Such legitimacy is built in the left half of the field, and requires argumentation of why a particular transition is needed. This point is vital: as earlier critique has pointed out, many approaches to transition take too easily for granted that the direction of transitions will be a good or benevolent one (Shove and Walker 2007). The current approach highlights what it takes to add democratic legitimacy to such directions. That is why the lower left corner of the field plays an important role in any evolution of a transition.

It is to be hoped that this approach, of arranging modes of governance in the field spanned by the level of inclusion and the level of coercion, can be developed further. Given that the regimes move in the upper right direction, which is a direction of increasing legitimacy, one follow-up question would be how each mode of governance contributes to the further production of legitimacy. A second line of research would be a more substantive specification than could be given here of how modes of governance actively contribute to the engagement and enrolment of citizens. Currently, in fact only a match is made between such levels of engagement and the seemingly appropriate mode of governance, but this requires more specification.

Finally, this production of engagement and legitimacy must be connected more explicitly to the ideas of learning that are central to existing approaches to transition (see sections 2 and 3), which in turn are strongly connected to the notion that transitions, as are contemporary societies at large, are highly reflexive processes. Feedback loops render the prediction of future behaviour of systems (whether technical or social) unpredictable. The production of engagement and legitimacy are themselves interventions in the sociotechnical system, and reflexive at that. The current contribution helps mobilizing learning processes to deal with this reflexivity.

Acknowledgements

The authors would like to express their gratitude to all the partners of the transnational consortium that is responsible for thedevelopment of the FP7 Project MILESECURE-2050. Moreover, additional gratitude goes to the colleagues of Maastricht University and Politecnico di Torino involved in the project, namely Wiebe Bijker, Tsjalling Swierstra, Patrizia Lombardi, Jacopo Toniolo and Federica Borio, for the continuous proactive collaboration during the research work.

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