Futures 140 (2022) 102959

Contents lists available at ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

Time for transition – Temporal structures in energy governance in contemporary Poland☆

Aleksandra Wagner [a,*], Krzysztof C. Matuszek [b]

[a] Institute of Sociology, Jagiellonian University, Grodzka 52, Kraków, Poland
[b] Jesuit University Ignatianum in Krakow, Institute of Political and Administrative Sciences, Poland

ARTICLE INFO

Keywords:
Temporal structures
Luhmann's theory
Future horizons
Energy transition
Energy
Temporalities

ABSTRACT

The institutions of the European Union place a clear emphasis on the importance of energy transition. However, the speed and scope of actions aiming at achieving climate neutrality of economies varies in the different member states. Poland, with an economy based on coal and a particular emphasis on the demands of energy security, appears to be especially sluggish in this respect, despite external and internal pressure from diverse stakeholders expecting particular decisions. The subject literature to date has analysed the structural – economic, political and historical-cultural – difficulties of phasing out coal. This article gives further attention to the causes by analysing the temporality of energy policy, a rarely analysed subject in the literature. It examines various temporal structures in functional systems, questioning how politics, science, economics and social movements designate the future horizons, which concepts of time influence their observations of the environments and how they affect the relationships of expectations and decisions. The discordance of temporal structures generates sources of uncertainty and induces an autoimmunological reaction of the system.

1. Introduction

Poland is a coal-based economy. The share of this raw material (black and brown coal) in the production of electric energy remains at a level of 70% (PSE, 2020). Despite the growing support for energy transition in opinion polls (Eurobarometr 2019; CBOS, 2018), successive governments have questioned the direction of this transition, opposing the ambitious plans of European climate policy, which aims to achieve climate neutrality by 2050. Poland's lack of a clear energy policy is one of the most common charges made by various stakeholders against the country's authorities. Despite the financial and institutional support offered by the European Commission for fair transition based on a socialised restructuring process, this process is a slow one, based rather on regional government and local initiatives than planned, long-term government actions.

Various reasons are cited for Poland's resistance to abandoning coal. Historical factors result from the country's political transformation and a long-lasting struggle with the technological and economic backwardness of the communist era (Henning, 2019) and bad experiences with the restructuring of past years (Zientara, 2009). There are also structural factors: the dysfunctional links between

☆ Time for Transition – Temporal Structures in Energy Governance in Contemporary Poland "Quantum physics tells us that no matter how thorough our observation of the present, the(unobserved) past, like the future, is indefinite and exists only as a spectrum of possibilities."–Stephen Hawking.

* Corresponding author.
E-mail addresses: Aleksandra.wagner@uj.edu.pl (A. Wagner), krzysztof.matuszek@ignatianum.edu.pl (K.C. Matuszek).

https://doi.org/10.1016/j.futures.2022.102959
Received 26 February 2021; Received in revised form 4 September 2021; Accepted 6 May 2022
Available online 13 May 2022

the main energy companies and the state (Gadowska, 2002), the strength of miners' trade unions (Brauers & Oei, 2020; Zientara, 2009), imposing their group interest on the rest of society, an influential coal lobby, and vertical consolidation in the energy sector (energy production and distribution). The phase-out of coal and resultant major political-economic transformation leads to fears about unemployment in coal regions, pauperisation of society, but also dependence on external suppliers. Particularly highlighted here is the risk of transactions with Russia, which treats export of raw materials as a tool of foreign policy and expansion of its sphere of influence (Larsson, 2006; Lough, 2011). On the other hand, Poland's failure to provide a specific timeline for coal phase-out, and declaration in its last energy strategy document[1] that the basis of security is optimum exploitation of its own resources, including coal, raises concerns among companies about competitiveness on European markets (e.g. in the case of introduction of additional fees for use of coal for their production).

In addition to these multidimensional factors determining the mechanism of guaranteeing energy security and protection of the existing interests and creation of "lock-ins" into coal dependence (Brauers, Oei 2020), we would like to address an additional dimension – that of time. Recent years have seen an increased emphasis and reflections on the temporal dimension of energy policies, engaging the concept of future visions (Delina & Sovacool, 2018; Marquardt & Delina, 2019; Sovacool, 2019; Sovacool et al., 2020; Osička et al., 2020; Skjøsvold & Ryghaug 2020), the dynamic and speed of transition (Geels & Schot, 2010; Sovacool & Geels, 2016; Sovacool 2016), and sociotechnical imaginaries (Jasanoff & Kim, 2015; Smith & Tidwell 2016; Tidwell & Tidwell, 2018; Delina, 2018). There are, however, few analyses of its temporality referring to sociological theory (Pantzar & Shove 2010; Sovaccol 2016; Ruzzenenti & Wagner, 2018), even if modern sociology has recognised the significance of time and temporality for society (Luhmann, 1976; Maines, 1987; Lewis & Weigert 1981; Hassard J, 1990; Nowotny 1992; Adam, 1998, 2004; Abbot, 2001). Important sociological contributions to the study of the temporality of energy transition have been made with a focus on everyday practice and discourse (Sovacool, 2016) or the significance of future visions for policy shaping (Brugger et al., 2021).

The specific focus of this paper is not the rhetorical function of discursive representation of the future or covering the temporality of the energy sector in Poland in full, but demonstrating how temporal structures are produced in particular functional systems: the economy, politics and science, as well as the third sector (the ecological movement). The article also aims to demonstrate how time is relevant for reality perceived through these systems, without necessarily being relevant from the perspective of other systems. Another analytical category are decisions that, taken within these systems, can cause uncertainty related to their possible consequences. Those consequences are also temporally constructed, which, as we argue, allow the system to deal with uncertainty.

Analysis embedded in the neo-functional system approach allows us to consider these two main categories – time and decision – in terms of system operations, separated from the individual actors' intentionality.

2. Society without a privileged observer

Our theoretical starting point is the hypothesis about the functional differentiation of modern society, which we borrow from Niklas Luhmann. The concept of a function in this context describes the relationship of a given social system with society as a system encompassing all communications. This non-hierarchical form of differentiation denotes the lack of a privileged observer. Various systems (the economy, politics, law, science, education, religion) have a monopoly on fulfilling an important social function. They are autopoietic communications systems using diverse concepts and distinctions, and in this sense observations are made. Each system observes the environment, including the natural environment, in its own way, and to each of them it remains predominantly invisible and indifferent. The "eyes" and "ears" of functional systems react extremely selectively to changes in the environment, before processing them into information using intra-systemic categories. In the ecological context, Luhmann calls these reactions "resonance" (in other contexts he uses the concept of irritation), to illustrate that the system can be vibrated or shaken up only within its own frequency. As a result, there is indeed no single natural environment, e.g. the one described by natural sciences, but each functional system constructs its own environment (Luhmann, [1986] 1989: 15–21).

Time appears here as a crucial dimension. Each system, by generating appropriate structures (memory and expectations), constitutes its own eigen time (*Eigenzeit*), thereby adapting the speed of operations to internal circumstances and in this respect distancing itself from its surroundings (Luhmann, 1997: 83). According to Tada, who draws from Luhmann: "Today's society should be characterized by endless differentiations based on the autonomy and closure of systems, and the time concept is resurrected in sociological theory to explain this situation" (Tada, 2018: 7). We argue that temporalisation of social system is a mechanism of reducing complexity:

"By organizing eigen time, a self-referential system can reduce the world's enormous complexity (the complexity of meaning itself), successively put its own elements in order, and reproduce them continuously as coming and going instantaneous events. For Luhmann, such a social system with eigen time-based autonomy and closure was sociology's empirical minimum" (Tada, 2018: 7).

Luhmann's main work on environmental issues is *Ecological Communication*, a book published in the year of the Chernobyl disaster. In it, the author questions how contemporary society produces and processes information on the natural environment. In other words, he tests the resonance capability (*Resonanzfähigkeit*) of specific functional systems regarding ecological problems (Luhmann, 1986] 1989: 32, 76). For example, the economic system treats only those changes in the environment that can be translated into the language of prices and growth or falls therein as irritations. On the one hand, this restricts the resonance capability of the system significantly, while on the other, as it were, it enforces economic activity when the answer to a given problem (e.g. felling the rainforests for oil palm

[1] https://www.gov.pl/web/klimat/polityka-energetyczna-polski.

farming) can be expressed in the language of prices, e.g. in the form of more expensive ecological products or healthy food (Luhmann, 1986] 1989: 53, 62).

In general, in a functionally differentiated society there is no top of the hierarchy, unquestioned authority and privileged observer (like a family aristocracy in an estate-based society) able to effectively impose the one true picture of the world on everybody else (cf. Luhmann, 1997: 894). At the most, there is a secondary observer, such as Luhmann's systems theory, which sees that which functional systems do not see, while being aware of its own limitations that are typical of a scientific (and specifically: sociological) perspective of reality.

Science is therefore not a privileged observer and has not taken the place given to religion in a traditional, stratificationally differentiated society. Scientific truth constitutes a symbolically generalised medium of communication which motivates recognition of what alter (the scientist) has discovered or researched as correct and credible (Luhmann, 1997: 339–340). If scientists declare, for example, that sunbathing in a tanning salon is harmful for the health, as a rule it is accepted that this is the case. Scientific research, however, is not so much about solving problems as multiplying them by questioning current knowledge (Luhmann, 1986]1989: 78). Science is oriented towards gaining new knowledge based on the principle of methodical doubt. It is an "outdifferentiated", autopoietic communications system subject to increasingly specific specialisation. As a result, scientific knowledge is often perceived as theorising detached from life and personal experience. Modern society does not question the correctness of scientific claims, but at the same time it retains distance towards the scientific worldview. Science has a monopoly on acquisition and supply of certain knowledge and can also boast technological successes. And yet, as Luhmann argues, it lacks authority that might be exploited politically. Therefore, "it cannot in the name of rightness and prudence demand for its knowledge to be adopted and applied" (Luhmann, 1990: 634, translated by the authors).

2.1. Chronology and phenomenology – two conceptions of time and future

The scientific view of reality is also differentiated from the popular experience by a different concept of time. Referring to Luhmann's analyses (1976), in this context we propose distinguishing between the chronological and the phenomenological perspective of time.

In the chronological understanding, time measures movement. Measurement of time means that we can coordinate, synchronise and provide sequential order to many actions, which is especially significant in the context of division of labour and increasing specialisation. This understanding of time consitutues its unity, and the continuity between the past, present and future is preserved. The future is nothing other than a sequence of dates that will occur after the present moment. Simplifying the issue somewhat, one can say that the future begins today. This point of view characterises scientific and technological thinking, for which the future is a series of anticipated presents (Luhmann, 1976). Science reveals cause-and-effect links and calculates the probability (risk) of occurrence of specific events, in this sense "defuturising" the future by limiting the number of possible scenarios to one which is the most probable or most desired (Luhmann, 1976: 143–144).

The phenomenology of Edmund Husserl, by contrast, rejects the naturalistic picture of the world, examining what is directly given to consciousness. Following this path, phenomenological sociology studies the world as it appears to people in a subjective manner. This is the reality of the pre- and non-scientific everyday, which is called the lifeworld (*Lebenswelt*) (Schütz & Luckmann, 1979, 1984] 2003). From this point of view, the past and future are temporal horizons of the present. Luhmann, referring to Husserl, defines time as an interpretation of reality in terms of the difference between past and future (Luhmann, 1976: 134–141). The horizon is always something unattainable and impassable, something that shifts with every step and every thought. As a result, the future does not begin today – on the contrary, "the future cannot begin" (Luhmann, 1976), and in this sense it is something non-existent and fictional (Beck, 1986] 2002: 44–46). This discontinuity between present and future appears in humans' everyday experience, especially when they perceive the situation in which they find themselves to be complex and opaque.

Science is the social system that, via experts and social movements, provides rational arguments for energy transition. Ecological communication, however, if it is to shape public opinion effectively, must take into account the popular experience of time present in everyday interactions, which according to systems theory are one of the types of social systems, and which phenomenologists call the lifeworld. When speaking about future problems and threats, we situate them in an infinitely shifting temporal horizon.

Following this line, we perceive previous analyses of temporality of energy policies in terms of a chronological or a phenomenological concept of time. Chronology assumes continuation of time, adopts dates as the principle of differentiation and is based on mathematical calculations (Luhmann, 1976). An example of this kind of understanding of temporality is Benjamin Sovacool's article on the temporal dynamics of energy transition (2016). Using chronology, he understands time in the context of changes, and connects events by looking for causality that can be interpreted as a mechanism reduces the complexity of these changes. This understanding of time has also been adopted in works on the predicted speed of changes taking place or expected in energy transition (Delina & Sovacool, 2018). We additionally observe here that the relevance of time in contemporary societies suggested by Luhmann is manifested in ever greater shortening of temporal distance, which in terms of the future leads to what Delina and Sovacool called the imperative of speed (Delina & Sovacool, 2018). The phenomenological conception of time assumes the co-existence of three modes of time: past, present and future, existing simultaneously (e.g. in language) and which we can select from to create meanings (Luhmann, 1976). This understanding of temporality is offered by an article by Malakar et al. (2019) pointing to the implications of the temporal dimension for understanding the challenges of intergenerational energy justice in India. The authors draw upon a philosophical interpretation of the Hindu cultural text the Bhagavad Gita, introducing a distinction between the concepts of "consequence-sensitive" and "duty-focused" as having consequences for energy decision making. "A consequence-sensitive approach brings into question the future consequences of present deeds, as a basis for decision-making from a justice perspective. A duty focused approach, in contrast,

emphasises the responsibility to address present challenges, including inequity and poor well-being, with little concern for the future consequences of present-day actions" (Malakar et al., 2019: 17). This article shows how coexisting modalities of time affect the paradox of India's energy policy and the tensions between the ongoing needs of the present and their implications for future energy pathways. Another example of reference to the modal dimension of time is Silvast et al. (2018) analysis of the relationship between anticipation and resilience in energy policy and law.

The perspective of phenomenological analyses assuming that both the past and the future are horizons of present actions, which despite never being reached direct current actions, is also represented by the work of Skjølsvold and Ryghaug (2020). The authors introduce the metaphor of "temporal echo" to explain a situation in which policies designed at one point of time become part of a system generated at another temporal moment and are transformed in a way serving objectives different from the intended ones. Analysis of temporality here is used for discussion on the relationship of expectations, intentions and effects, but it also shows how the past and future are reconfigured in the dynamic system of the present: "We introduce the concept of 'temporal echo', which illustrates how policies, strategies and ideas produced or introduced at one point in history, designed to serve one purpose, might unexpectedly re-appear later in a transformed way, or to serve different purposes" (Skjølsvold & Ryghaug, 2020, p. 8).

Here we see the potentiality of not only the future, but also the past. Converted into actuality, they cause an increase in complexity which the system tries to reduce by assigning meaning to each reconfiguration. Luhmann (1976) notes that the present assures the integration of time and reality, while also defining a set of constraints for the integration of past and future.

These restraints, as the cited work shows, can themselves be questioned. The theoretical perspective adopted in this article also occupies a place in the spectrum of phenomenological analyses. We treat the future here as a dynamic horizon of actions and time as constructed internally by each of the functional systems. " All social systems exist in the present simultaneously, but they share neither an exactly identical past nor an exactly identical future, as long as they are closed and autonomous" (Tada, 2018: 11–12).

2.2. Politics and the paradox of decisions

Public opinion shapes the mood of the public, which resonates in the political system. This is because it forms a structural coupling of two distinct systems – politics and mass media. As a result, publicly expressed opinions, e.g. on a government's energy policy, which for the mass media solely have value as news, in the political system resonate in the context of the rivalry between government and opposition (Luhmann, 2000: 286, 311–312). An important role in this process is played by social movements and the associated third-sector organisations. According to Luhmannian systems theory, new social movements (protest movements), including the environmental movement, are not something external to the political system, but its internal peripheries. The internal division of politics into centre and peripheries corresponds to the distinction between functionality and flexibility. The state as the central organisation of the system is responsible for maintaining its functionality or capacity to make collectively binding decisions. Parties, meanwhile, as peripheral organisations and protest movements, by tackling issues overlooked in public, ensure that the system's irritability and sensitivity to the surroundings is maintained (Luhmann, 2000: 243–253, 315–318).

The function of the political system is to maintain the ability to make collectively binding decisions, also in situations when no agreement can be reached (Luhmann, 2000: 84–86). In a functionally differentiated society, however, politics is only one of the subsystems, and not the control centre (cf. Luhmann, [1986] 1989: 84–85). Political decisions can at most cause irritations in other functional systems, which then convert them into information based on their own categories.

The autonomy of other systems applies to law, for example, which otherwise seems to have the closest coupling to politics. Contemporary law is characterised by rapidly multiplying and increasingly complex regulations. The "machinery of environmental law", as Luhmann noted in the mid-1980 s, is also "already in full swing" (Luhmann, 1986] 1989: 67). Development of the law must, however, take into account the complexity of the starting position, so that the new regulations do not clash with the existing laws, e.g. in the fields of construction, fiscal or police law.

In the field of energy studies, the interrelations of the sociotechnical are often approached in terms of functional equivalency of sociotechnical elements – a structural coupling proposed by systems theory seems to be more useful as it "implies that while technology is subject of (or stimulates) social processes, it does not determine, overlie, or substitute social reality, because the types of operation are distinct" (Sumpf & Büscher, 2018: 13). It is not only the autonomy of other functional systems that makes political decisions difficult. The fact that resolutions – paradoxically speaking - always concern insoluble questions (cf. Luhmann 2011: 132, Andersen, 2012: 204) is also a factor. In general terms, a decision is a choice between alternative options and a reaction to – sometimes mutually exclusive – expectations (Luhmann 1984: 399–404). If a precise method for choosing the only correct solution existed, we would be dealing with calculations using a computer algorithm, and not a decision assigned to a specific person. Even if individuals are free in their own decision, the emphasis is on the distribution of decision rights in a network of communicative events (Blaschke, 2015). Agency in systems theory is understood as attributed in communicative events. Most decisions to be taken in the energy system are characterised by a high level of uncertainty (Conejo et al., 2010). They are marked by technological, economic (Soroudi & Amraee, 2013), or social parameters. And, as Stirling notes, referring to Giddens, energy transition is a "monumental cultural and political challenge" (Stirling 2014: 83). Stirling points out that "ideas and hopes about possible pathways for change – as well as notions of 'the transition' itself – can be deeply constituted by incumbent interests" and "understandings, intentions and discourse about change" (Stirling 2014: 84) are significant for the agency. In Luhmannian terms, we can call this system semantics – available to decision communication (Andersen, 2001). A decision is therefore a communication which involves considerations of social expectation, one of which is "temporal expectations directed at the future", but also decisions create social expectations of subsequent decisions (Andersen, 2001).

Regarding a decision concerning closure of nuclear power points or setting CO2 emissions limits, for example, a margin of

uncertainty and arbitrariness always remains, which can cause opposition. For this reason, the moment of decision is often delayed, especially in the political system. The authorities promise to make it in future, while discussing the need for discussions, consultations etc. A separate strategy involves presenting the solutions that have been adopted as having no alternative and being clearly the best. Sooner or later, however, the opposition will offer a reminder that there is an alternative, and a lack of a decision is a decision too.

In our view, therefore, the problems of energy transition result not only from various definitions of the directions of transformation, but also from differing construction of temporal structures and their consolidation with other social structures – expectations and decisions. Structures are selection schemes which condition the systems' autopoiesis (Luhmann 1984: 62, 1997: 430–431). While Luhmannian thought has already been used in the field of transition studies to analyse power (Avelino, Rotman 2009) and trust (Büscher and Sumpf 2015), in the field of energy transition, the potential of the Luhmannian concept of temporal structures remains untapped.

The decisions taken in a given frame of reference considering the internal time of a system are observed by the remaining systems from the perspective of a different time frame. This means not only a parallel, separate temporality of energy transition in each of the systems, but different construction of the horizons of past and future.

We adopt a perspective of systemic communications theory, treating time and decisions, and more specially the ways in which they are observed, as the categories leading this analysis. Consequently, we ask questions about: Decisions – how are they observed from the perspective of various systems? How do systems cope with the uncertainty in which these decisions (which in the field of energy entail serious and long-term consequences) are taken? Time – in what way do the various systems construct the horizons of future and past, making them relevant to the present? How do they perceive the speed of internal time within their boundaries, what conceptions of time influence the observations of their environments and how do they thereby construct the temporality of energy transition?

3. Research methodology

This article is based on results obtained within large-scale research on reconstructions of visions of the future in the discourse on energy policies in Poland after 1989. Visions are understood as expressions of envisioning. They bridge a gap between imaginaries and reality (Nagpal & Foltz, 1995) and, being not only private, but shared collectively, they helped society to "cope with the variety of changes and uncertainties that the future will bring" (Adesina & Oteh, 1998). Analysing the reconstructed vision allowed us to investigate how time is constructed and minded within functional systems and how it is related to the decisions which are taken within one system and observed by the other systems.

This research employed various types of data: energy strategy documents published by the government after 1989, articles in the mainstream and technical industry press, and individual in-depth interviews (IDI). The energy development strategy documents were treated as elements of the systemic description showing how politics observes energy and its production. These documents also contain elements of planning and forecasting the future, whose communication outside the system affects the structures of expectations created. In turn, these open or restrict the possibilities of future operations. Energy strategy documents should be treated as the political system's communication on the values and decisions observed by other systems. These documents provide examples of interpretation of the future visions and refer to the observed public expectations (which influence the anticipated future). The analysis presented here was driven by two key categories: time (with an emphasis on the future) and decisions.

The press articles were treated as a record of observations reconstructing the perspectives of other systems. The corpus of texts analysed was created in two stages: using the available press articles (mainstream press and industry publications from between 2005 and 2017), we selected texts containing the key phrase combination of energy (production) + strategy and energy (production) + future. After selection of the texts, the database was checked by a team of coders to eliminate the articles that did not refer to the plans, strategy or future of energy production in Poland. Additionally, using library resources, articles published in selected years of the 1989–2005 period from three leading daily newspapers[2] were included in the analysis. The periods chosen were 1990, 1995, 1997, 2000 (dictated by the time of publication of the strategy documents) and the 2003–2004 period (Poland's accession to the EU).

Collecting such extensive material made it possible to analyse how the visions of the energy future presented in the documents are interpreted in the economic, scientific technological, and socio-ecological perspectives adopted by social movements. These perspectives were reconstructed in accordance with the systemic codes (profitable/unprofitable; true/untrue; possible/impossible; friendly/harmful to the environment and community). The binary code allows us to recognise a given communication as belonging to a specific system, forms the unity of the system and directs its autopoiesis (Luhmann, 1997: 748–749).

Since the press materials in fact do not give an insight into observations of systems, but constitute their media representation, the research also included actors operating within specific subsystems (scientists, politicians etc., who were treated as gateways providing an insight into a given subsystem. In this analysis, therefore, their statements were used not as a record of subjective intentionalities, but rather we looked for what was common for actors occupying similar structural positions, shared and therefore objectivised (within a given system) and distinct (between systems) visions and meanings. These were expected to provide a picture of how politics observes the energy transition and how political decisions (observed by different systems untransparent to each other) resonate in different subsystems.

We conducted 20 interviews with representatives of politics and administration (national and regional government level), business,

[2] Mainstream press: dailies Gazeta Wyborcza, Rzeczpospolita, Dziennik Gazeta Prawna, published since 2003;Technical-industry press: Energetyka Cieplna i Zawodowa, Rynek Energii, Nowa Energia, Przegląd Energetyczny,Elektroinstalator, Energia Gigawat, Wiadomości Naftowe i Gazownicze, Elektrosystemy, Instal.

the third sector – NGOs and activists, and science. The objective of the interviews was not to determine the dominant models of thinking, but rather to confront the themes that emerged with those presented in the strategic documents and the press. A total of 203 in-depth interviews were conducted using the Microsoft Teams, Zoom or Skype platforms or in person. Two respondents did not consent to be recorded, and in these cases we relied on notes. Two interviews with young people were ultimately discounted from the analyses as this category was not appropriate for the systemic categories adopted. The method of analysis of the data acquired in this way was discourse analysis, but this was aimed at reconstructing the meaning assigned to energy and its production in different subsystemic logics and the way temporal structures, the concept of which we borrowed from Luhmann, "work" in them.

Consequently, we approached the concept of semantic analyses based on Luhmann's theory and proposed in operationalised form by Niels Åkerstrøm Andersen (2011). He defines semantics as specific structures that link communications by making forms of meaning available, which the communication systems treat as worthy of preservation (Luhmann, 1995).

In this sense, therefore, it is an exemplary analysis providing empirical illustrations of communication mechanism, and not a critical approach as understood in critical discourse analysis. We define the communication mechanisms as related to:

a. Futurisation, understood as increasing the openness of a future by considering different options and scenarios (Luhmann, 1976) and operationalised as including
   - future scenarios
   - description of recognised uncertainties and possibility of unintended consequences
   - speculations
   - wishful thinking
   - utopian thinking
b. Defuturisation – understood as decreasing the openness of a future by
   - defining priorities and choosing goals
   - strategies
   - forecasts
   - risk assessments
   - evaluations of the scenarios; choosing the best one (the most probable or desired)

   All types of materials (strategic documents, press articles and interview transcriptions) were coded according to the corresponding codebooks in QDI Miner software and subjected to qualitative analysis focused on:
   - the linguistic layer – words and phrases used to describe time (including figurative language)
   - the semantic layer – identifying storylines, assumptions, ideas, symbols, the phenomenological or chronological understanding of time, and then identifying references to the future, past or present and relations between them, modality of time (what happened, what could have happened, what can happen); identifying the decision, including informing about it, explaining it, interpretation of the decision and its impossible consequences; identifying the systems' perspective.

The coded data were analysed to find a coherence and connections between foci. This was driven by the general question "How are meaning and expectations formed (…) and how do these become condensed or generalised into concepts, which then establish certain semantic reservoirs for certain communication systems?" (Andersen, 2011).

4. The time of energy transition is not one

For each system, time is constructed around the present, while the horizons of the past and future are constructed variously (Luhmann, 1976). As Tada noticed, "The eigen time that a system has itself constructed via self-reproduction orders possibilities, and determines the quality of a current reality perception as a 'now and so'" (2018: 9). In parallel to the phenomenological perspective in self-observation, time, in chronological and phenomenological form, affects observation of the environment of the given system. Observed events (past and anticipated) create an environment of the system that irritates it (Luhmann, 2012, 66–67), leading to decisions taken in the present – a module that changes potentialities into actualities, and the possible into the irreversible.

"Eigen time" of each functional system makes them "stopped responding one-to-one to environmental events, and thereby to operate as autonomous, closed systems (Luhmann, 1997: 83–84, Tada, 2018). There the choice of the system is always defined internally. Therefore it is linked to the decisions. Eleno Esposito (2011) gives an example of such in a political system:

"What is very clear from Luhmann's analysis is that political time is not the same as economic time. The holding of elections, the passage of bills through the legislature, the maximum length of time that a government may hold office before seeking a further mandate from the people –all may affect what decisions are taken on economic issues and the timing of those decisions."

In the following sections, we present and comment on examples of how different functional systems draw the horizons of the past and future in relation to the energy transition (4.1), then how two types of thinking about time – chronological and phenomenological – imply a different meaning of the process of transition (4.2), in particular how energy transition as a phenomenon appears to different systems and "through communicative intentionality are weighted by the system's own past and future, and are thereby selectively (not randomly) actualized as meaningful units in the present" (Tada, 2018:1). In the next Section (4.3), we consequently provide examples of how decisions taken within a political system are observed by other systems and how they meet the expectations causing the "irritation of the system". Finally, in Section 4.4 we discuss how the political system seeks to cope with disappointment caused by expectations that are not met and how temporalisation of decisions is used to relax some tensions.

4.1. Horizons of the past and future

For the political system, 1989 was a unique moment in which past observed events and decisions ceased to be perceived as events on which to base anticipation of future events and decisions in the energy sector. Only the transformation of Poland's political and economic systems that took place in the late 1980 s and early 1990 s led to a complete differentiation between these two systems, thereby challenging the credibility of the memory of past events and decisions preserved in the system, meaning that not only the future, but also the past were observed as sources of uncertainty. In this situation, the introduction to the document "Premises of the energy policy of the Republic of Poland for 1990–2010″ reads:

"It should be stated clearly that all numerical data regarding the future is indicative, very uncertain, and can only be used for drawing conclusions of a qualitative, not quantitative nature. This is because of the impossibility of predicting the future while assuming continuation of past trends. The essence of Poland's new socio-economic situation is a departure from the trends observed in the conditions of transition from a centrally planned economy at the moment of transition to a market economy. There is a lack of experience in this respect on a global scale. It is therefore impossible to construct a sufficiently credible forecast of macroeconomic development of the country on which the demand for fuel and energy largely depends. Despite this, it is worth producing forecast scenario studies, as these will make it possible to determine the types of decisions concerning a given area of the economy, divided into those that should be made immediately and those to be made at a later date."

As Luhmann assumes, therefore, a division is made into "before" and "after" a decision. Decisions that are made become the point of reference for further, postponed decisions, and therefore although in a certain sense they limit the future, they do not determine it or reduce its uncertainty. They aspire, however, to reduce the contingency of the systemic operations, limiting the number of alternative potentialities through their partial actualisation.

At the same time, however, the complexity of the temporal dimension increases through introduction of modalities – decisions that are observed as decisions only from a certain temporal distance (as Luhmann notes[3]) are considered in terms not only of actual states, but also of potentially possible realities (rejected possibilities), which have not been realised.

Nonetheless, they can serve as a point of reference for evaluating the decisions taken. One example of such a reference is the category of energy efficiency, which can be used to compare the current state to the one that would exist if specific decisions had not been taken (despite increased energy use, we assume that this increase would have been greater with a lower level of energy efficiency (Authors, 2018).

Analysis of the press and interviews confirm that horizons of the past are constructed differently in self-observation of the various systems, and even within a given system are dynamic depending on the current needs of the operation. In the perspective of the third sector, the horizon of the past is therefore sometimes marked by the history of civic and pro-environmental movements, and at other times by air quality movements active in the 1980 s, or even the period of the formation of Poland's statehood after the First World War. The economy constructs the horizon of the past in the 1970 s, referring to global events (such as the oil crisis and its consequences, and in Poland also major investments in the coal energy infrastructure and stabilisation of work privileges in this sector), or in the 1990 s – the time of the origin of electrical energy networks and centralisation of energy supply. The horizon of the past for the political system stretches back to the transformation (1980 s/'90 s) or accession to the EU (2004). Science, when reflected on energy transition, established the horizon of the past on different points of time depending on the focus of its own observation. It could be recent events, such as the governmental decision on accepting energy strategies (Hasterok et al., 2021; Pietrzak et al., 2021), the moment of publishing European policy documents perceived as impactful for the Polish energy system (Skjaerseth, 2018), or on the contrary, processes that began even 200 years ago associated with coal-based culture (Żuk & Szulecki, 2020).

The dynamic horizons of the past reconstructed for the needs of the time indicate the need to reconfigure the sequences of events so that they create the meaning needed for justifying current decisions and events or extrapolate them to the future. The references created in this way construct a sense of continuity and lastingness, while also serving to provide control– illusory, according to Luhmann – over integration of time and reality, and thus as a result to reduce contingency.

Although each energy policy document sets a different future horizon (2010, 2020, 2030, 2040, and 2050), it is 2050 that was incorporated by other subsystems (science, third sector) as a horizon of transformative changes. Press articles, published in different periods reproduced usually the time horizon proposed by the policy documents published then. An Intergovernmental Panel on Climate Change IPCC (2018) cites 2050 as the approximate date by which it is possible to halt the catastrophic effects of climate change on condition of a significant reduction of greenhouse gas emissions (global CO2 emissions should reach a net effect of zero around this time). The year 2050 as a horizon of transformative actions aiming to protect the climate is reproduced in European Union regulation documents (European Green Deal 2019), NGO reports, government documents and the media discourse. By setting a common observation of the future horizon, a step seems to be taken towards defuturising the future – adopting a target point is meant to encourage adoption of paths leading to it and construction of a sequence of decisions that are necessary for achieving the anticipated future. This is communicated by EU policy as a state of climate neutrality (European Green Deal 2019) and the various systems refer to this observed state (approving or contesting it).

The temporal horizon of 2050 is a distant horizon for the political system, whose rhythm is demarcated by the four-year term of the government. A focus on satisfying current needs therefore outweighs a long-term plan that would mean impinging on the structure of current interests. The fact of difference between system is recognised by the observer, who stated:

[3] Luhmann's argument is that the decision only obtains substance as decision through the next prospective decision. Only in retrospect can it be determined whether a decision really was a decision or merely loose talk,regardless of the "original" designation of the communication.

"Time flows 10 times more slowly in energy production, changes take place very slowly, these are gigantic installations, huge investments, calculated for long years." [Economy: IDI_2].

While the above quoted respondent represents the economic system perspective and refers to energy production, other respondents comment on the difference between politics and economy reflecting the technology dimension:

"Energy is just starting to change; I am speaking about energy policy, because energy is a creature that reacts slowly to both market and political signals. Investment processes in energy take many years." [Third Sector: IDI_4].

The science recognises the urgency of necessary changes, at the same time perceiving them in long- term perspective and underlining the uncertainty associated with each strategy:

"Strategic thinking in the energy sector must be thinking in terms of 40–50 years, but it does not mean that if you start a process today, you can realise it for these 40–50 years, because so many things will be changing over this time. No one is able to predict these changes. Therefore it is not about the plan that must be implemented but rather that we need to start the process" [Science: IDI_8].

At the same time, the primacy of short-term needs over long-term planning is observed as disadvantageous by the respondent recruited from third sector:

"A sin of governance is politicians' thinking in categories of terms (four years)" [Economy: IDI_2].

It implies the expectation of recognising by politics the urgency of some issues important from the perspective of other systems. Unmet expectations can result in negative evaluation of politics, which can be observed as "politics of simulation" (Blühdorn, 2007a):

"Only strategic action of the state [is important], which our country is lacking because our state.

has no brain. It does not have the capacity for strategic action and thinking" [Science: IDI_8].

While a future horizon outlined for around 2050 (and labelled with this date) is a consistent point in observations of the various systems, the expected speed of transformation has a different dynamic.

It is worth noting that analysis of the press confirms the characteristics of temporalisation of the energy issues within systems. While the press is usually focused on the present, it reproduces past and future horizons according to the current needs of the system. The mainstream press tend to go further in the past and more often discuss the alternative scenarios for the future (futurisation), the technological-industry press follow the future horizons proposed by the political system expressing expectation on what should happen to achieve the goals defined by political goals (defuturisation). These expectations are usually present within the logic of the economic system. They define potentiality and call to transform some of them into actuality. Even if they are usually presented as "probable", "rational" and "strategic", (Stirling (2014): 89) claims "that the most likely dynamics of transformation lie in hope-inspired alternative choices, not fear driven technical constraints".

4.2. Oscillating between chronological and phenomenological time

In the political system, energy governance is closely linked to security, constructed at the level of the self-description of the system as the overriding goal. A document from 2005 encapsulates the temporality of security as follows:

"Every meaning or process in the energy sector not only has a temporal dimension. It also has appropriate reaction time of the entities responsible for security governance. The factor of time therefore significantly influences realisation of competences in assuring energy security. In keeping with this criterion, the following approach will be applied to the practice of security governance: three fundamental time horizons are adopted which determine energy security – short-term, understood as balancing the energy sector; mid-term, understood as guaranteeing security of energy supplies; and long-term, understood as guaranteeing generation and transmission capacity" [Polityka energetyczna Polski do 2025 roku, 4.01.2005] Responsibility for the third aspect is assigned to the national and regional government administration, and constitutes the basis for future possibilities of fulfilling the first and second points. The consequences of the actions involved in this point are delayed and, as the foundation of long-term planning, encompass endeavours to make the present into the past for the anticipated state of the system. Since coal is regarded as the foundation of security, this is what the Polish economy is based on. The objectives of security – as defined by Polish energy policy (dependence on national resources) and the objectives of climate action policy, envisaging decarbonisation – contradict each other. This is a conflict of disparate, albeit equally valid hierarchies of values (security vs. climate action), typical of democratic politics (Luhmann, 2000; Saward, 1996: 100–101, 358–362). The energy transition process is meant to remove this contradiction, meaning the need to make decisions that would become a reference point for the next ones taken in the transformation sequence. Yet successive strategic documents do not deliver such solutions, rather undertaking to find them in future. The last energy policy document, which countenanced a scenario entailing introduction of nuclear energy in the future, declared an increase in renewable energy investments, yet without giving a date for phasing out of coal.[4]

Moreover, such a decision in the political system would not be perceived as optimal.

"We cannot entirely abandon coal, and I would not even want that to happen. Coal gives us energy independence and security, because we have it in our country. It is about a change of proportions." [Economy: IDI_10] The political system observes energy as a problem of control. Security means exercising this control. Control of ways of producing, converting and using energy makes it possible to combine systems structurally and open up their dynamic configuration. Control over uncertainty, meanwhile, can become a source of political strength (Author 2014).

As a result, the political system reacts slowly and seeks to maintain the balance between the processes of futurising (considering

[4] After submission of this paper, Polish government and trade unions set the date of coal phase-out for 2049.

various scenarios without binding decisions) and defuturising (constructing plans and strategies). Yet plans and strategies are an extrapolation of the currently existing conditions and a reaction to the events observed in the environment of the system (geopolitical and economic situation on global markets etc.), as well as within it (balance of political powers in the country). The political system therefore perceives a transformational change in terms of slow evolutionary actions that do not disturb the existing balance of power, while minimising the risk of loss of control. The "now" of the political system is the time in which changes are made – in an evolutionary way involving joining old and new technologies. It resonates in other systems:

"The old technologies need to find new use. In the future they will stabilize the system and they will be in harmony with the new ones" [Economy: IDI_10].

"This is the compass politicians should have in their pocket – it does not mean we will do it immediately, but this is the direction to go in. Combining energy efficiency and renewables within 30 years will make the Polish home energy independent. We can achieve energy self-sufficiency through persistent policy that consistently strives to improve energy efficiency of buildings. Until recently, this was spoken about as a utopia, and now it is a sensible investment" [Third Sector IDI_9].

Thus, the political system oscillates in its observation of the environment between chronological time (the arguments of scientists and ecological activists) and phenomenological time (energy security here and now, expectations of various interest groups vs. climate change in the future perceived as an infinitely shifting temporal horizon), extending the temporal distance to the horizon of 2050. From this perspective, there is time for development of new technologies, gradual withdrawal of the old one and evolutionary change in social relations.

Hence the tendency to reproduce points of the decision without making resolutions which would be irreversible.

We find expectations of a different speed of transformation in the ecological communication representing the scientific and chronological point of view or in the perspective of the economic system. Both adopt the imperative of "urgency" (Delina & Sovacool, 2018), although the logic behind this is different in each case. For ecological activism, the year 2050 is a terminal horizon, and crossing it without fulfilling restrictive conditions of limiting greenhouse gas emissions means absolute failure and disaster. Activists regard this time as a future present defined by the "here and now". The pressure of time ebbing away fast is distinctly felt here. It is therefore crucial to remain in control of potentially existing lifelines. The continuing changes in the natural environment are radically shortening the distance to 2050. The perceived torpor of the political system is seen as a threat, and the urgency of changes and inaction are interpreted in terms of negligence with catastrophic consequences.

From the point of view of the economic system, the lack of specific plans and strategies defining not only aims, but also action is a source of uncertainty as it makes it calculation of risk difficult. The lack of investment decisions lessens the innovation that is key to certain sectors, inhibiting the development of niches generating new solutions and technologies. At the same time, however, changes occur in the systemic environment and new conditions are formed in which the local entities will be uncompetitive. Yet this requires suitable political decisions.

4.3. At a crossroads – untaken decisions

Decisions concerning investments in large-scale objects become important for further decisions. The concerns associated with them, such as their closure, can influence election results. The political system is therefore strongly oriented towards the "now", employing a strategy of delaying the moment of decision and rather constructing decision points in which things still to be resolved are perceived as still possible and not irreversible. This results in declarations on the introduction of nuclear energy and feasibility studies not entailing high costs of potential withdrawal from the decision.

The media's reconstruction of the political perspective (as second-order observation) situates energy transition in terms of an open future (futurised) and present futures in which the decision on coal phase-out has not been taken, but without openly negating the need for climate action. This is in line with what Osička et al. (2020) noted on media representation of the future of coal in Poland. The oscillation between chronological and phenomenological time, resulting in failure to adopt plans (and thus suspension of defuturising processes) allows the risk of loss of power or control over resources to be minimised. Postponing decisions on phasing out coal makes it possible to minimise the risk of dashed expectations from the environment. The political system sees the disappointments of influential social groups (as a greater risk than ecological communication pointing to the catastrophic effects of neglecting decisions on decarbonisation. The political system does not resonate strongly with the climate threat communicated from outside and does not see it as a current threat as long as it is not reflected in voters' expectations, which are crucial for the political "now. Scholars have offered additional explanations on the basis of right-wing populism with regard to Poland (Żuk & Szulecki, 2020; Bennett & Kwiatkowski 2019) and beyond (Lockwood, 2018).

Other systems regard a lack of decision about the energy system, and thus suspended defuturising of this system along with reproduction of the operations associated with the status quo, as a possible decision which causes increased uncertainty when it is not taken as anticipated. Such decisions remain in the "memory" of systems as possible, but not taken, yet a lack of decision is ultimately also perceived as a decision. The political present is thus seen as being bound by interest groups like in the following example: "For years, mining, which traditionally has strong links to governments, has a dominant voice in what happens in energy, as if it were shackling the government and they were unable to escape from this bondage" [Third Sector: IDI_9].

The structural analysis confirmed the role of linked actors (governments, industry, trade unions) in stabilising the system (Brauers & Oei, 2020; Szpor & Ziółkowska, 2018).

The daily newspapers in the analysis, which have a major impact on the shape of second-order observations (observations of observations), emphasise the economic perspective – similarly to what was noted by Osička et al. (2020). According to this view, energy is treated mainly as a commodity (Devine-Wright, 2007).

"We are looking for a solution which for many will be uncompromising, a solution in which actions, mainly for renewables – because this is the key issue – will not lead to an excessive growth in energy prices in Poland," the prime minister said" [K. Żmijewski, W energetyce polityczna deklaracja to za mało (In energy a political declaration is not enough), Dziennik Gazeta Prawna, 4.07.2013].

This is also the dominant perspective in the technological-industry press:

"Electric energy trading currently takes place in a system of continual auctions for weekly, monthly, quarterly and annual instruments" [K. Świrski, Rola IT w nowej rzeczywistości rynkowej (The role of IT in the new market reality), Rynek Energii, 1.06.2013].

Dealing in categories of cost and product, losses and profit, price and markets, means that the lack of strategic plans in energy policy is perceived as a risk factor. The economic system therefore expects a kind of balance between an open future, in which there is room for innovation and surprising opportunities, and a defuturised future – in which we expect the present to become the past of anticipated reality. Press publications reproduce these expectations by referring to the present – unresolved processes and decisions – as well as the near future (the perspective of months or a year), dominated by calculations of risk and recommendations concerning producing the desired future framed in normative categories.

"neither now nor in the foreseeable future will renewable energy sources be an alternative or substitute for large systemic sources guaranteeing the certainty and stability of work of the electroenergetic system. How will Poland cope with construction of a nuclear power station within ten years? Our programme is indeed ambitious, but the date for launching the first nuclear plant is dictated by necessity." [A. Łakoma, Rozmowa z Hanna Trojanowska, wiceminister gospodarki, Atom jest bezpieczny (Interview with Hanna Trojanowska, deputy economy minister, Nuclear power is safe), Rzeczpospolita, 6.07.2009].

There are relatively few long-term visions opening new perspectives of thinking about the energy future and alternative (also utopian) visions of development. Instead of them, there are rathe calls to thinking in long term.

"measures taken to assure energy security, long-term forecasting of demand for electric energy and associated investment plans should be published in reports prepared by European Union member states and national systems operators" [W. Dołęga, Bezpieczeństwo energetyczne w krajowych i unijnych regulacjach prawnych (Energy security in national and EU legal regulations, Energetyka cieplna i zawodowa, 1.12.2209].

A future-oriented economic system calculates risk of losses and profit, but takes past events and processes taking place at present as a reference point. According to Luhmann, this is not a stable foundation for anticipating future events and does not reduce future uncertainty. Nonetheless, plans and strategies serve to reduce contingency, because it is to them, and not only to reality as such, that economic decisions refer, as well as seeking justification in their coherence. The future constructed through the political system is observed as unclear and doubly contingent – in long-term energy investments, withdrawal of political support and changing decisions on energy policy means dramatically increased risk of loss.

Lack of political decisions means a lack of regulations and thereby makes it impossible to complete investments on time, thus cutting profits for some sectors. The energy strategy for Poland is therefore usually awaited by many entities observing the energy sector (Gawlik & Mokrzycki, 2019). The gap between expectations and decisions (not only regarding content, but also time) causes irritation of the economic system. The recently approved *Energy Policy of Poland until 2040* document failed to meet all expectations, and moreover, it caused some tension between domestic policy and European regulations (Gawlik & Mokrzycki, 2019).

The media representation of the scientific and technological system also observes a lack of resolutions in energy policy as a barrier.

"Poland's problem continues to be the lack of an energy efficiency policy" [T. Kolakowski, Rozmowy energetyki (Energy discussions), Energetyka, 1.12.2009] or ["The problem is a lack of energy policy, and therefore the minister prefers not to take too radical steps, such as withdrawing the worst quality of coal from the market would be" [A. Wieczerzak-Krusińska, Walka ze smogiem nieco później (Batttle with smog a little later), Rzeczpospolita 10.04.2018].

The energy trade press usually represents the technological and economic perspective. Energy is observed on the one hand as a resource, from the perspective of its practical application, and on the other as a chance for civilisational development. When discussing energy technologies, the trade press concentrates on the question of what is feasible, and seldom looks at the distant future. The subject matter of articles concerns resources, possibilities of extraction and generation in the existing conditions (hence the concentration on coal) or conditions of change, specifying the requirements and sequence of decisions essential for implementation. If it is to be treated as reconstructions of expectations, these would be the expectation of making a decision per se. The lack of decision entails a negative assessment of the Polish government:

"This is drifting, one might say going downhill, as actually very little has been done in recent years. What came out in Jaworzno, Kozienice and Bełchatów is all decisions from 10 years ago. […] Nuclear energy has been in this policy for 15 years, nothing is done, it is unravelling again. Similarly, these ecological goals are actually only partly being realised".

[Science: IDI_3].

4.4. Beyond the present

The present constructed within the political system is observed from outside as being spread between two possible directions of development:

"THE PRESENT is an area where two forces clash with each other: one conservative (embedded in the past) and one geared towards change (making future)." [Third Sector: IDI_11].

The belief that transformation has in fact begun and that changes are taking place, meanwhile, is shared by the various systems observing their environment.

"We are on the cusp of revolution, in the next 10 years there will be very radical further changes in Polish energy." [Third Sector: IDI_11].

"The situation has changed dramatically – Polish coal is very expensive, for geological reasons, extraction is more expensive and dangerous; on the other hand, we hear about the great problems of PGG [a mining company], which has generated huge losses." [Third Sector: IDI_09].

"The change has begun. The process of change has begun and cannot be halted. What happened is to a great extent thanks to the social side, organisations. Not only MSK, but there is a group of activists who for many years have been working for phase-out of coal and stopping the climate catastrophe." [Third Sector: IDI_11].

These changes come with a large amount of uncertainty that cannot be eliminated. They can be linked to "contradictive interests as while for some groups uncertainties may entail opportunities, the same uncertainties may pose risks for others" (Skoczkowski et al., 2020).

Strategic plans (defuturising orientation) are needed not so much to reduce this uncertainty but to create conditions for action amid uncertainty:

"Any strategic thinking in the field of energy must be thinking in terms of 30, 40, 50 years, but that is not to say that if you start a process today you will be continuing precisely this process.

for 40–50 years, because in that time so many things will change that nobody is able to foresee, so it is not about saying at this moment we have this plan and we will be putting it into place, but about triggering this process." [Science: IDI_8].

An uncertain future can become an impetus for opening up to various scenarios, also based on radical change and interrupting the operation of integration of the past and future:

"Between past and future there is no continuity, they are different worlds." [Politics: IDI_13].

Or:

"So paradoxically we are again returning to the EU to understand that we cannot return to turbo-capitalism after coronavirus […] we must understand that this is a chance to build a new system. Unfortunately, it is unclear what this system will be like. […]" [Politics: IDI_7].

But conversely too, uncertainty about the future draws attention to the existing conditions here and now, as is the case in the technological perspective reconstructed by the industry press. Climate change as a scientific fact does not resonate with the political system, but the EU's pro-climate policy does. This means that the coming climate catastrophe, contrary to EU regulations, is perceived in terms of potentiality, not actuality.

Technical sciences observe actions in the political system as expectations to which they try to respond. Thinking about energy in terms of technology therefore comes down to diagnosis and evaluation of the current state of energy production. Technology should be used above all for modernising existing equipment and adapting it to the growing demand for energy. There is therefore a concentration on increasing capacity and efficiency and reducing emissions of pollutants, and less attention on new, future technologies.

The economic perspective also seldom adopts an apocalyptic vision of the ecological movement. Forecasts and calculations refer to expected decisions and their non-distant consequences. A diagnosed problem is the increasing cost of energy and associated economic consequences as well as the aforementioned perception of the regulatory environment as having a high level of instability (paradoxically, lack of decisions and freezing of reality, despite preserving the status quo, do not guarantee stability in the face of inexorable changes).

The political system, oscillating between two concepts of time and future, resonates weakly with visions of ecological communication, which it treats more as projections of current fears and frustrations (Luhmann, 1976) than of calculated risk.

The expectation of regulatory actions is clearly articulated from the position of the ecological movement and experts publicly presenting scientific arguments, and in part also from the economy. Politics, however, keeps the impulse of change within rhetoric that, despite producing an orientation towards environmental and climate protection, does not lead to decision making. In this sense, this is impotent semantics.

Of course, the tensions within the political system are eased by exporting problems beyond the temporal horizon (e.g. clean coal technologies invented in the future will resolve the tension between decarbonisation and energy security) or the spatial one (Poland and Europe will not be able to operate on their own; other countries have a larger impact on global warming and they must act to reduce it).

5. Concluding discussion

The times constructed by various subsystems position the same problems differently in categories of potentiality and actuality. Subsystems therefore anticipate decisions from other systems to change potentiality into actuality in line with their expectations. These in turn depend on the accepted concept of time that conditions the observation of the system environment, adopting the imperative of urgency or slow evolutionary changes. When not realised, they become the next source of uncertainty.

In the Polish politics, the strongest resonance from the spectrum of problems articulated by the third sector (ecological and social, related to energy transition) at present appears to be caused by the issue of air pollution. This problem will presumably be the first to be actualised in the form of decisions that could become an impetus for genuine transformation of the energy system.

The results of the analyses presented in this article confirm Luhmann's hypothesis about the various temporalities of sub-systems and also seem to confirm our intuitive assumption that these differences shape the relations between expectations, decisions and observations of these decisions. As such, they generate irritations influencing energy transition.

Although Poland is a unique case owing to the nature of its energy economy and political/historical background, the very phenomenon of various temporalities seems to be an immanent characteristic of contemporary societies. What mechanisms have the systems developed for coping with these irritations?

In our view, the answer can be found in the concept of "social immune mechanism".

outlined by Luhmann, who referred to social movements (1995). In Andersen and Stenner's (2020) interpretation, the conflicts and paradoxes generated by systemic structures are part of the immunological mechanisms of the system. They are meant not so much to protect the structures from change as to safeguard the systemic capacity for autopoiesis – and thus to prevent the consolidation of rigid models of operation inappropriate for the environment.

Law (institutionalising conflicts), democratic politics (institutionalising the conflict between government and opposition), and social movements (contesting the existing relations and demanding change), immunise the system, so to speak, which learns to deal with its own products. It uses them to exercise learning mechanisms, its flexibility and resilience. Social movements as peripheries of the political system thereby maintain it in a state of irritability and sensitivity to the environment. According to Bluhdorn, "from the perspective of systemic self- reproduction, the internal simulation (.) of a supposedly external point of reference is fully sufficient (Bluhdorn, 2006).

"The system does not immunize itself against the no, but with help of the no: it does not protect itself against changes, but with the help of changes against rigidifying into repeated, but not environmentally adequate, patterns of behaviour. The immune system does not protect structure, but autopoiesis, the system's closed self-reproduction (Luhmann, 1995: 371–372; quoted in: Andersen & Stenner 2020).

In this context, however, "the problem of controlling autoimmunity" (Wolfe, 2017: 108) is key. One might therefore expect the political system to initiate the mechanism of controlling this discordance of temporality not so much to resolve it as to recognise it and incorporate it into the area of its action. Only then can it be subjected to control as an element of its own reality. The process of participation of stakeholders in the processes of energy governance, which has gained currency in recent years, could be such a mechanism. In the vision of transition followed by the European Union, widespread participation and dialogue with various types of stakeholders are becoming increasingly important (Schönwälder, 2020).

Moreover, the idea of participation of citizens in energy governance justified by science (Ortwin et al., 2020) is expanding its definition, adding to invited participation social conflicts on energy investments as so-called self-organised participation (Cuppen, 2018). Without questioning the benefits of participation, we note that even in situations when it does not bring consensus or contribute to optimalisation of decisions, it makes confrontation of various temporalities possible, making expectations visible externally and thereby increasing the systems' reflexivity and "compensating for their lack of a strategic centre" (Bluhdorn, 2007b).

The above analyses constitute also an element of sociological reflection of the system of science on how scientific arguments are perceived in society (in everyday interactions) and in other functional systems, especially politics, and what are their different futures. In the scientific and chronological perspective, the future is observed as series of anticipated (predicted) presents, but in the phenomenological perspective, close to the popular experience of time, it seems to be an infinitely shifting horizon. With this in mind, ecological communication oriented towards "generating" a specific future should definitely underline the actuality of problems in the horizon of anticipated changes.

Systems theory, by showing the determinants and limits of the influence of both politics and science, as well as the autonomy of other systems, presents the modern, functionally differentiated society in all its complexity. Luhmann said that "everything could be different – but I can hardly change anything" (Esposito, 2013: 142). To take a positive approach, this is a good starting point to consider what "I can change". Better understanding of the sub-system temporalities will contribute to a more efficient society's communicative reaction to environmental disturbances (which Luhmann called resonance).

Acknowledgments

This article was written with the support of the Polish National Science Centre decision number 2016/21/B/HS6/03706 The authors express their gratitude to the project team members – Marian Niezgoda, Katarzyna- Rabiej-Sienicka and Maria Świątkiewicz-Mośny – for inspiring discussions during completion of the project.

They thank Ben Koschalka for his help in translation and language edition of this work.

References

Abbot, A. (2001). *Time matters: On theory and method.* University of Chicago Press.
Adam, B. (1998). *Timescapes of modernity: The environment and invisible hazards.* Routledge.
Adam, B. (2004). *Time*. Polity Press.
Adesina, O., & Oteh, A. (1998). Envisioning the future of nigeria, futures (Vol. 30,(6), 569–572.
Andersen, Aᵽ N., & Stenner, P. (2020). Social immune mechanisms: luhmann and potentialization technologies. *Theory, Culture & Society, 37*(2), 79–103.
Andersen A.N., 2001. The Undecidability of Decision WP 12/2001.
Andersen A.N., 2011. Conceptual history and the diagnostics of the present, Management &Organisational History Vol 6(3): 248–267.
Andersen A.N., 2012. Organisation und Entscheidung (2000), in: Luhmann Handbuch. Leben - Werk - Wirkung, Stuttgart-Weimar, 202–210.
Avelino F., Rotmans J., Power in Transition. An Interdisciplinary Framework to Study Power in Relation to Structural Change European Journal of Social Theory 12 (4): 543–569.
Beck U., [1986] 2002. Społeczeństwo ryzyka. W drodze do innej nowoczesności, SCHOLAR,Warszawa.
Bennett, S., & Kwiatkowski, C. (2019). *The environment as an emerging discourse in polish far-right politics*. Routledge.
Blaschke, S. (2015). It's all in the network: A luhmannian perspective on agency. *Management Communication Quarterly* (Vol. 29,(3), 463–468.
Bluhdorn, I. (2006). Self-experience in the theme park of radical action?social movements and political articulation in the late-modern condition. *European Journal of Social Theory, 9*(1), 23–42.
Bluhdorn, I. (2007aaa). Sustaining the unsustainable: Symbolic politics and the politics of simulation. *Environmental Politics, 16*, 2.
Bluhdorn, I. (2007bbb). Self-description, self-deception, simulation: a systems-theoretical perspective on contemporary discourses of radical change. *Social Movement Studies, 6*, 2007.

Brauers, H., & Oei, P.-H. (2020). The political economy of coal in Poland: Drivers and barriers for a shift away from fossil fuels. *Energy Policy, 144*(2020), Article 111621.
Brugger, H., Eichhammer, W., Mikova, N., & Dönitz, E. (2021). Energy efficiency vision 2050: How will new societal trends influence future energy demand in the European countries? *Energy Policy,Vo, 152*, 2021. https://doi.org/10.1016/j.enpol.2021.112216
Büscher, C., & Sumpf, P. (2015). "Trust" and "confidence" as socio-technical problems in the transformation of energy systems. *Energ Sustain Soc, 5*, 34. https://doi.org/10.1186/s13705-015-0063-7
CBOS 2018, (Polish Public Opinion] Attitude to climate change, 2018 ⟨https://www.cbos.pl/SPISKOM.POL/2018/K15818.PDF⟩.
Communication from The Commission To The European Parliament, The European Council, The Council, The European Economic And Social Committee and The Committee of The Regions The European Green Deal Com/2019/640 Final.
Conejo, A. J., Carrion, M., & Morales, J. M. (2010). *Decision making under uncertainty in electricity markets*. New York: Springer.
Cuppen, E. (2018). The value of social conflicts. *Critiquing invited participation in Energy projects, Energy Research & Social Science, 38*, 28. https://doi.org/10.1016/j.erss.2018.01.016
Delina, L. L. (2018). Whose and what futures? Navigating the contested coproduction of Thailand's energy sociotechnical imaginaries. *Energy Research and Social Science, 35*, 48–56.
Delina, L. L., & Sovacool, B. (2018). On temporality and plurality: an epistemic and governance agenda for accelerating just transitions for energy access and sustainable development. *Current Opinion in Environmental Sustainability, 34*, 1–6.
Devine-Wright, P. (2007). Energy citizenship: psychological aspects of evolution in sustainable energy technologies. In J. Murphy (Ed.), *Framing the present, shaping the future: Contemporary governance of sustainable technologies, 2007* pp. 88–122). London: Earthscan.
Esposito, E. (2011). The future of futures. *The time of money in financing and society*. Cheltenham: Edward Elgar Publishing,.
Esposito, E. (2013). Die Ontologie des Finanzwesens. In w: R. John, J. Rückert-John, & E. Esposito (Eds.), *Ontologien der Moderne* (pp. 137–152). Springer VS, Wiesbaden (s.).
Eurobarometr 2019, Europeans' attitudes on EU energy policy rpeort nr 492, Septemebr 2019, online:⟨https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/survey/getsurveydetail/instruments/special/surveyky/2238⟩; access on 1.02.2021.
Gadowska K., 2002. Zjawisko klientelizmu polityczno- ekonomicznego, WUJ: Krakow.
Gawlik, L., & Mokrzycki, E. (2019). Changes in the structure of electricity generation in Poland in view of the EU climate package. *Energies, 12*(17), 3323.
Geels, F., & Schot, J. W. (2010). 'The dynamics of transitions: a socio-technical perspective'. In J. Grin, J. Rotmans, & J. Schot (Eds.), *Transitions to sustainable development: new directions in the study of long term transformative change* (pp. 9–87). Routledge (in collaboration with Geels F.W. and Loorbach D).
Hassard J.1990. The Sociology of Time, Springer Link.
Hasterok, D.; Castro, R.;Landrat, M.; Piko ´n,K.; Doepfert, M.;Morais, H. Polish Energy Transition 2040: Energy Mix Optimization Using GreyWolf Optimizer. Energies 2021,14, 501. ⟨https://doi.org/10.3390/en14020501⟩.
Henning K., 2018. Krajowa własność technologii wytwarzania energii jako czynnik składowy bezpieczeństwa energetycznego Polski, Przegląd Bezpieczeństwa Wewnętrznego, 2018.10.19,150–165.
IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)].
Jasanoff, S., & Kim, S.-H. (2015). Future imperfect: science, technology, and the imaginations of modernity. In S. Jasanoff, & S.-H. Kim (Eds.), *Dreamscapes of modernity: sociotechnical imaginaries and the fabrication of power* (pp. 1–33). Chicago: University of Chicago Press (pp.).
Larsson, R. L., 2006, Russia's Energy Policy: Security Dimensions and Russia's Reliability as an Energy Supplier, Swedish Defense Research Agency.
Lewis, J. D., & Weigert, A. J. (1981). The structures and meanings of social time. *Social Forces, 60*, 432–462.
Lockwood, Matthew (2018). Right wing populism and the climate change agenda: Exploring the linkages. *Environmental Politics, 27*(4), 712–732. ISSN 0964-4016.
J. Lough, 2011, Russia's Energy Diplomacy, Chatham House (the Royal Institute of International Affairs).
Luhmann, N. (1976). The future cannot begin: Temporal structures in modern society. *Social Research 43:1, States*, 130–152.
Luhmann, N. (1986). 1989. *Ecological communication*. Chicago: The University of Chicago Press.
Luhmann, N. (1990). *Die Wissenschaft der Gesellschaft*. Frankfurt am Main: Suhrkamp.
Luhmann, N. (1995). *Social Systems. Stanford*. CA: Stanford University Press.
Luhmann, N. (1997). *Die Gesellschaft der Gesellschaft*. Frankfurt am Main: Suhrkamp.
Luhmann, N. (2000). *Die Politik der Gesellschaft*. Frankfurt am Main: Suhrkamp.
Luhmann, N. (2012). *Theory of Society* (vol.1). Stanford University Press.
Maines, D. R. (1987). The significance of temporality for the development of sociological theory. *The Sociological Quarterly* (Vol.28)(3)).
Malakar Y., Herington M.J., Sharmaa V., 2019. The temporalities of energy justice: Examining India's energy policy paradox using non-western philosophy Energy Research & Social Science 49 (2019) 16–25.
Marquardt, J., & Delina, L. L. (2019). Reimagining energy futures: Contributions from community sustainable energy initiatives in the Philippines and Thailand. *Energy Research and Social Science, 49*, 91–102.
Nagpal, T., & Foltz, C. (1995). *Choosing our future: visions of a sustainable world*. World Resources Institute.
Nowotny, H. (1992). Time and social theory. *Time & Society, 1*(13), 421–454.
Ortwin, R., Ulmer, F., & Deckert, A. (2020). *The role of public participation in energy transitions*. Academic Press.
Osička, J., Kemmerzell, J., Zoll, M., Lehotský, L., Černoch, F., & Knodt, M. (2020). What's next for the European coal heartland? Exploring the future of coal as presented in German. In *Energy Research & Social Science, 61*. Polish and Czech press.
Pantzar, Mika, & Shove, E. (2010). Time in practice - Discussing rhythms of practice complexes. Ethnologia Europaea. *Journal of European Ethnology, 40*(1), 19–29.
Pietrzak, M. B., Igliński, B., Kujawski, W., & Iwański, P. (2021). Energy transition in Poland—assessment of the renewable energy sector. *Energies, 14*, 2046. https://doi.org/10.3390/en14082046
PSE 2020, Data form PSE [Polskie Sieci Energetyczne], grudzień 2020, on-line: ⟨https://www.pse.pl/dane-systemowe/funkcjonowanie-kse/raporty-miesieczne-zfunkcjonowania-rb/raporty-miesieczne⟩; acess on 1.02.2021.
Ruzzenenti, F., & Wagner, A. (2018). Efficiency and the rebound effect in the hegemonic discourse on energy. *Nature and Culture, 13*(3), 356–377.
Saward, M. (1996). Democracy and competing values, government and opposition. *AUTUMN* (Vol. 31,(No. 4), 467–486. AUTUMN 1996.
Schönwälder, G. (2020). Engaging citizens to boost climate neutrality and greater circularity: Opportunities and challenges for research and innovation. *Clean Technologies and Environmental Policy*. https://doi.org/10.1007/s10098-020-01902-2
Schütz A., Luckmann T., 1979, 1984] 2003, Strukturen der Lebenswelt, UVK Verlagsgesellschaft, Konstanz.
Silvast, A., Jalas, M., & Rinkinen, J. (2018). Energy governance, risk and temporality.The construction of energy time through law and regulation. In S. Beynon-Jones, & E. Grabham (Eds.), *Law and Time*. Routlage.
Skjærseth, J. B. (2018). Implementing EU climate and energypolicies in Poland: Policy feedback and reform. *Environmental Politics* (Vol.27,(3), 498–518, 2018.
Skjølsvold, T., & Ryghaug, M. (2020). Temporal echoes and cross-geography policy effects: Multiple levels of transition governance and the electric vehicle breakthrough. *Environmental Innovation and Societal Transitions* (Volume 35,, 232–240.
Skoczkowski, T., Bielecki, S., Kochański, M., & Korczak, K. (2020). Climate-change induced uncertainties, risks and opportunities for the coal-based region of Silesia: Stakeholders' perspectives. *Environmental Innovation and Societal Transitions, 35*, 460–481.
Smith, J. M., & Tidwell, A. S. (2016). The everyday lives of energy transitions: Contested sociotechnical imaginaries in the American West. *Soc Stud Sci, 46*, 327–350.
Soroudi, A., & Amraee, T. (2013). Decision making under uncertainty in energy systems: State of the art. *Renewable and Sustainable Energy Reviews, 28*, 376–384.
Sovacool, B. K. (2016). How long will it take? *Conceptualizing the temporal Dynamics of Energy transitions Energy Research & Social Science, 13*(2016), 202–215.

Sovacool, B. K. (2019). Visions of energy. *Futures: Imagining and innovating low-carbon transitions*. Routledge,.
Sovacool, B. K., & Geels, F. (2016). Further reflections on the temporality of energy transitions: A response to critics. *Energy Research & Social Science, 22*, 232–237.
Sovacool, B. K., Kester, J., Noel, L., & de Rubens, G. Z. (2020). Contested visions and sociotechnical expectations of electric mobility and vehicle-to-grid innovation in five Nordic countries. *Environmental Innovation and Societal Transitions, 31*, 170–183.
Sumpf, P. and Büscher, C. eds., 2018. SHAPE ENERGY Research Design Challenge: Control, change and capacity-building in energy systems. Cambridge: SHAPE ENERGY.
Szpor A., Ziółkowska K. 2018, The Transformation of the Polish Coal Sector International Institute for Sustainable Development.
Tada, M. (2018). Time as sociology's basic concept: A perspective from Alfred Schutz's phenomenological sociology and Niklas Luhmann's social systems theory. *Time & Society*. https://doi.org/10.1177/0961463×18754458, 29 January 2018.
Tidwell J.H.,Tidwell A.S.D., 2018. Energy ideals, visions, narratives, and rhetoric: Examining sociotechnical imaginaries theory and methodology in energy research Energy Research & Social Science 39, 103–107.
Wolfe, C. (2017). (Auto)immunity, social theory, and the "political". *Parallax, 23*(1), 108–122.
Zientara, P. (2009). Restructuring the coal mining industry: Unionism, conflict, and cooperation: evidence from Poland. *Eastern European Economics* (Vol. 47,(No. 1), 41–59. Jan. - Feb., 2009), pp.
Żuk, P., & Szulecki, K. (2020). Unpacking the right-populist threat to climate action: Poland's pro-governmental media on energy transition and climate change. *Energy Research and Social Science, 66*, 2020.