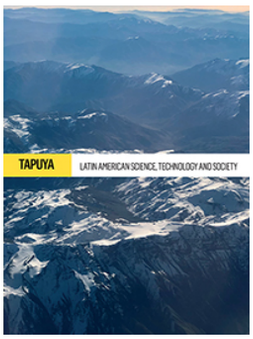

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Tapuya: Latin American Science, Technology and Society

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ttap20

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To cite this article: Matthieu Hubert (2023) Imagining futures within the constraints of the present. The coproduction of anticipatory knowledge in an energy scenarios platform in Argentina, Tapuya: Latin American Science, Technology and Society, 6:1, 2184295, DOI: 10.1080/25729861.2023.2184295

To link to this article: https://doi.org/10.1080/25729861.2023.2184295

Published online: 12 Apr 2023.

TAPUYA: LATIN AMERICAN SCIENCE, TECHNOLOGY AND SOCIETY
2023, VOL. 6, 2184295
https://doi.org/10.1080/25729861.2023.2184295

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THEMATIC CLUSTER: INTERACTION TURNS IN KNOWLEDGE PRODUCTION

Imagining futures within the constraints of the present. The coproduction of anticipatory knowledge in an energy scenarios platform in Argentina

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ABSTRACT

In this article, we study the coproduction of anticipatory knowledge and its political sensemaking during a set of participatory scenarios-building exercises. Based on interviews with organizers and participants, and analysis of reports produced by an energy scenarios platform in Argentina (the *Plataforma Escenarios Energéticos*), our investigation shows that the scenarios produced, as well as the calculations and models on which they are based, build anticipatory knowledge that denies contingency and translates the vision of the future of the energy sector of each scenarist into a straight and well-drawn path. Bringing these scenarios together in a single exercise that legitimizes and builds consensus through the participatory process and the use of technical expertise is a way of locking in the future – that is, a way of ensuring that the future can be known and controlled, setting aside other possible futures. In this sense, the objective of the scenario-building exercise is to simplify the complex process of transforming the energy matrix into predictable trajectories, thus convincing investors and the public administration.

Imaginar o futuro dentro das restrições do presente. A co-produção de conhecimento antecipado em uma plataforma de cenários energéticos na Argentina

RESUMO

Neste artigo estudamos a co-produção do conhecimento antecipado e seu significado político durante um conjunto de exercícios participativos de construção de cenários. Com base em entrevistas com organizadores e participantes e a análise dos relatórios produzidos por uma plataforma de cenários energéticos na Argentina (a *Plataforma Escenarios Energéticos*), nossa pesquisa mostra que os cenários produzidos, assim como os cálculos e modelos nos quais eles se baseiam, constroem um conhecimento antecipado que nega a contingência e traduz a visão de cada construtor de cenários sobre o futuro do setor energético em um

ARTICLE HISTORY
Received 16 June 2022
Accepted 16 February 2023

KEYWORDS
Anticipatory knowledge; energy; future; participatory instrument; scenario-building

PALAVRAS-CHAVE
Conhecimento antecipado; energia; futuro; ferramenta participativa; construção de cenários

PALABRAS CLAVE
Conocimiento anticipatorio; energía; futuro; instrumento participativo; construcción de escenarios

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caminho reto e bem traçado. Reunir estes cenários em um único exercício que legitime e construa consenso através do processo participativo e do uso de conhecimentos técnicos especializados é uma forma de fixar o futuro – ou seja, uma forma de garantir que o futuro possa ser conhecido e controlado, deixando de lado outros futuros possíveis. Neste sentido, o objetivo do exercício de construção de cenários participativos é simplificar o complexo processo de transformação da matriz energética em trajetórias previsíveis, convencendo assim os investidores e a administração pública.

Imaginando futuros dentro de las limitaciones del presente. La coproducción de conocimiento anticipatorio en una plataforma de escenarios energéticos en Argentina

RESUMEN

En este artículo, estudiamos la coproducción de conocimiento anticipatorio y de su significación política durante un conjunto de ejercicios participativos de construcción de escenarios. A partir de entrevistas con organizadores y participantes, y del análisis de los informes producidos por una plataforma de escenarios energéticos en Argentina (*la Plataforma Escenarios Energéticos*), nuestra investigación muestra que los escenarios producidos, así como los cálculos y modelos en los que se basan, construyen un conocimiento anticipatorio que niega la contingencia y traduce la visión del futuro del sector energético de cada escenarista en un camino recto y bien trazado. Reunir estos escenarios en un único ejercicio que legitima y construye el consenso a través del proceso participativo y el uso de la experticia técnica es una forma de fijar el futuro – es decir, una forma de asegurar que el futuro puede ser conocido y controlado, dejando de lado otros futuros posibles. En este sentido, el objetivo del ejercicio participativo de construcción de escenarios es simplificar el complejo proceso de transformación de la matriz energética en trayectorias predecibles, convenciendo así a los inversores y a la administración pública.

Introduction

Whether it is to call for improved access to electricity or to respect international commitments on climate change, discourses calling for energy transition are multiplying. While they inevitably refer to a critique of the existing energy system, they are also part of a change that is not only desired but already underway, which would make it all the more inevitable (Aykut and Evrard 2017). In the Argentine context, the notion of transition refers to different sociotechnical imaginaries (Jasanoff and Kim 2009) and, consequently, takes different meanings depending on the political cultures that mobilize it. While they converge on the need for profound changes in the energy system, these imaginaries are in conflict over the main actors who should lead them (in particular the respective place of the state and the market), the role of public policies, and the "right" way to manage the social, economic, and environmental risks associated with energy production (Hubert and Spivak L'Hoste 2021).

Nevertheless, these calls for energy transition do not describe precisely its content, scope, and pace.[1] In order to discuss the forms that energy transition should take and, consequently, the desirable future of the energy sector, experts and actors in charge of energy policies are seeking to develop knowledge and instruments that allow them to envisage the possible futures of energy. In Argentina, this is the case, in particular, of the *Plataforma Escenarios Energéticos*.[2] Its objective is to bring together actors representing diverse interests (NGOs, industry representatives, academics, administrative and political actors) around the same sociotechnical device of future projection and prospective; it aims to facilitate the dialogue on energy issues and, if possible, to influence the national energy policy.

Based on interviews with organizers and participants, and analysis of reports produced by the platform, our investigation shows that these scenarios, as well as the calculations and models on which they are based, can be considered as both technology of government and technology of proof (Jasanoff 2004). They reflect not only the coproduction of anticipatory knowledge (Aykut, Demortain, and Benbouzid 2019) by heterogeneous actors, but also new modalities for the constitution of expertise, in particular through the role given to experts in deliberations. In this respect, the *Plataforma Escenarios Energéticos* provides tools for reflection, argumentation, and evaluation to enable the production of visions that combine the desirable (each scenarist proposes a vision of the future of energy) and the possible (the modeling tools provide the limitations of the existing Argentinean energy system and the investments needed to transform it). The main objective of the article is to analyze the processes of anticipatory knowledge production on the *Plataforma Escenarios Energéticos*, without evaluating the concrete effects of this knowledge on the energy policies carried out in Argentina.[3]

In the continuation of the article, we examine successively: the conceptions and uses of the future in Science and Technology Studies (STS); the process of selection of the scenarists who participate in the platform; the methodological options to associate expert knowledge and interest representations; the process of coproduction of anticipatory knowledge that is formalized in the energy scenarios; and, finally, the comparison of scenarios and the formulation of recommendations that give a political sense to the anticipatory knowledge produced.

The future(s) in STS

Anticipations (forecasts, expectations, future projections, etc.) have been studied by STS because they enable and constrain a whole series of activities central to research and innovation (Brown and Michael 2003; Aykut, Demortain, and Benbouzid 2019). In particular, they are mobilized in the evaluation of the socio-economic benefits and risks likely to accompany the development of new industrial or technological projects. Whether to

[1] In fact, historians of technology show that these energy transitions (in the sense of the replacement of one technology with another) have never really existed; there is always an addition of technologies that accumulate over time (Fressoz 2013).

[2] See, for instance: https://www.vidasilvestre.org.ar/?13620/Plataforma-Escenarios-Energticos-2035#.

[3] I will come back to this point in the conclusion of the article.

compare technological alternatives, to evaluate the probability (or the level of uncertainty) concerning the success or failure of technological innovations, or to legitimize public or private investments that will have a lasting impact on the development trajectories of the organizations concerned, the process of anticipation makes it possible to base decisions on a (supposedly) reasonable level of predictability. This process has been questioned because of its temporal ambiguity, the epistemic uncertainties associated with its reliability, as well as the entanglement of its descriptive and performative dimensions (Nelson, Geltzer, and Hilgartner 2008).

STS has examined, in particular, how anticipations affect or shape social reality – that is, the *performative* dimension of expectations, forecasts, or future projections. Van Lente and Rip (1998) have been pioneers in the study of the performativity of technological promises. In particular, they have studied the different stages of the sociotechnical process by which a simple technical option formulated from the results of laboratory experiments becomes a promise, then is translated into institutional objectives to be reached and, finally, into an opportunity for investors who decide to finance the technological developments necessary to build a prototype and industrialize it. By doing so, they highlight the role of technological promises in legitimizing innovation projects, mobilizing resources, and stabilizing their socio-institutional environment. After more than two decades of work on this issue, the performative dimension of expectations and anticipations has been analyzed by STS in different ways, which Aykut (2019) summarizes in three main research avenues.

The first line of research focuses on the *discursive* dimension of anticipations. It investigates how the decision-making of intentionally rational actors is anchored in a set of expectations and beliefs that shape the discursive context of policy formulation, reducing an a priori indeterminate future to a set of plausible trajectories. Following such an approach, we can mention, on the one hand, studies using the concept of "sociotechnical imaginary" (Jasanoff and Kim 2009) and, on the other, works analyzing the "regime of promises" that characterizes contemporary technosciences (Joly 2010). In the definition initially proposed by Jasanoff and Kim (2009), the notion of sociotechnical imaginary refers to the collectively imagined forms of social life that are inscribed in the design and implementation of techno-scientific projects on a national scale. The notion reflects the collective vision of a desirable society – what would be a "good society" (Tidwell 2015, 687) – as achievable through a scientific and/or technological program. In contrast to imaginaries, in which national political cultures prevail, the notion of techno-scientific promise implies the creation of a horizon of expectations in which the relational dimension is central, because it underpins the credible commitment of one party to another (Audétat 2015).

A second approach identified by Aykut (2019) emphasizes the *social* dimension of performativity. In particular, it stresses that the existence of some specific organizations (networks of experts, committees within public administrations, etc.) depends on the elaboration of anticipations that coincide with the – possibly implicit – objectives of these organizations. The concept of *vision* has been developed by focusing on this social dimension. Hedgecoe and Martin (2003) define visions as a specific type of anticipation that forms a strategic framework for actors linked to this vision in order to build new sociotechnical networks. In that sense, coalitions of actors are constituted around such visions – or "technovisions," according to Eriksson, Fischer and Ulfbecker (2020) –

to promote a technological solution to address one or more social problems, and several coalitions of actors compete to promote alternative visions. The "social performativity" (Schubert 2015) of such visions highlights, rather than discourses or beliefs, how expectations and anticipations shape and are shaped by social order.

A third axis of research shifts the analytical focus from discourses and social organization to *practice*. It focuses on how the use of some technical devices (simulation models, foresight and planning techniques, roadmaps, etc.) shapes social practice. Mackenzie (2008), for example, shows how a mathematical model of option pricing has altered the functioning of financial markets, since investors and financial actors using such a model tend to act very differently from those who do not use it. In this case, it is argued that the forecasting models themselves shape social reality, because they are part of the shared practices of the actors involved (see also: Li Vigni 2020). The concept of "predictive policy assemblage" has been developed to apprehend this set of social practices and material artifacts, in which different coalitions of actors use models and forecasts in pursuit of public attention or political influence (Aykut 2019). It emphasizes both the central role and the "performative" effects of anticipatory practices in shaping dominant networks and ideas.

Borrowing from these three lines of research, with a particular focus on the third, the rest of the article analyzes the conceptions and uses of the future in the development of the energy sector in Argentina. Through the case study of the *Plataforma Escenarios Energéticos*, it examines how various anticipations are collectively produced in this context, taking seriously the anticipatory knowledge needed to imagine and design future energy matrixes and trajectories.

The selection of the participants: bringing together actors in a participatory process

> We chose the scenarists in order to have a balanced table, to be able to have all the views present, to have a debate that represents all the voices that could exist in society regarding the energy issue. (Executive Committee member)

Since its creation in 2011, the *Plataforma Escenarios Energéticos* has been conceived as a participatory mechanism. In this sense, it is part of a global trend in public policies – especially in central countries – that reflects the ambition of governments, civil associations, and international organizations to transform the content and way of elaborating public policy. This approach is based both on the increase in the number of places where debates are organized (national, territorial, internet), on the diversification of the actors involved (local authorities, economic actors, trade unions, and associations, etc.), as well as on the recognition of the principle of contradictory expertise (including experiential knowledge). In this context, the objective of the *Plataforma Escenarios Energéticos* is to bring together actors representing different interests around the same forward-looking mechanism, with the aim of facilitating dialogue on energy issues and, if possible, of influencing public policy. The dialogue is based on the production, by each of the actors involved (the so-called scenarists), of a scenario that combines the vision of a desirable energy future, the limitations of the existing national energy system, and the investments needed to transform it. The participatory process consists of several steps, which are summarized schematically in Figure 1.

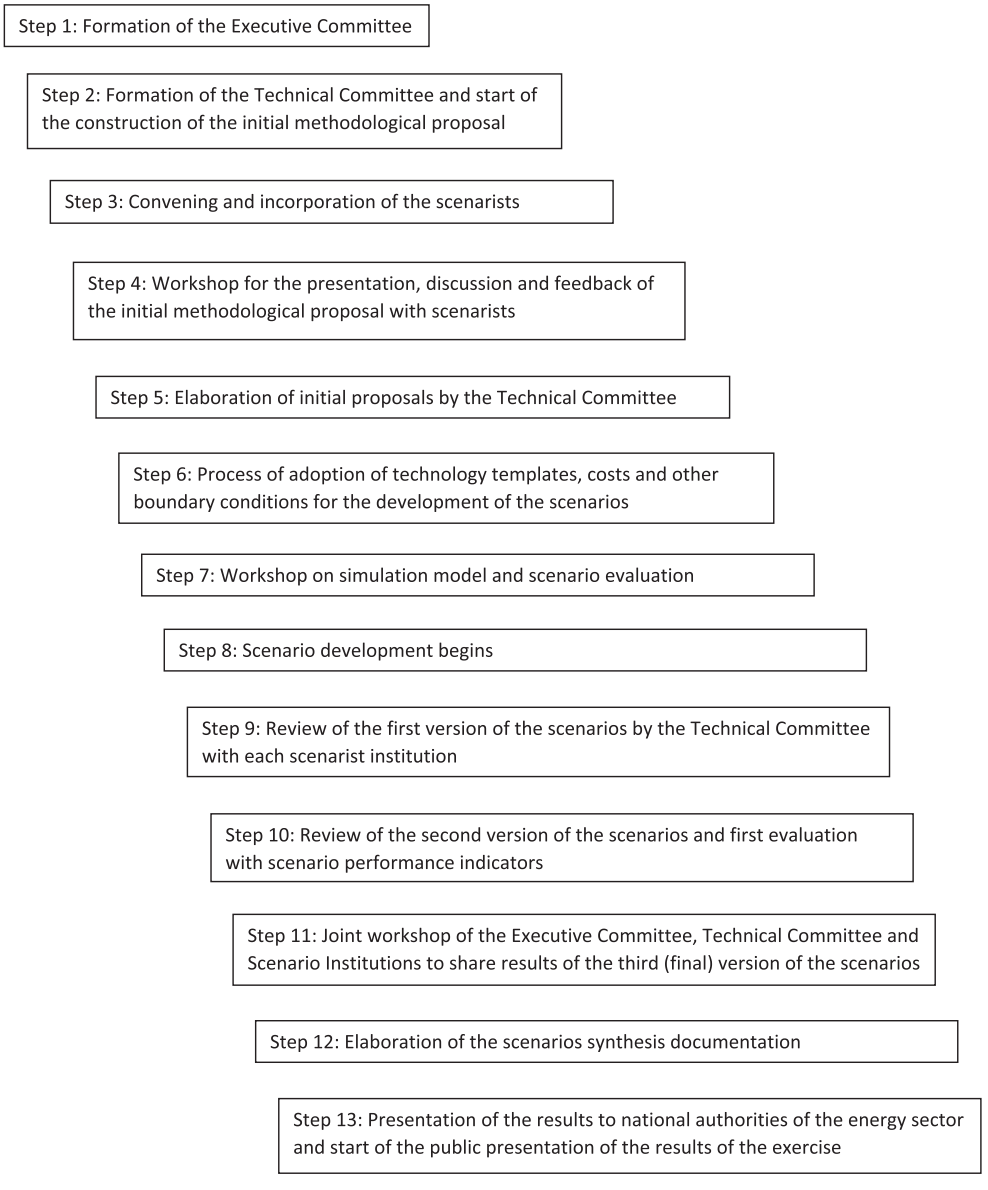

Figure 1. Diagram of the participatory process.

The platform was launched by the Avina Foundation,[4] after a first similar experience in Chile, and three "rounds" were held in 2012, 2015, and 2018, each with a different time horizon (respectively 2030, 2035, and 2040). An Executive Committee was formed by four university and non-governmental organizations in the first two "rounds," who were joined, in the third and last round, by the Ministry of Energy and Mining (MINEM)

[4]Avina is a Latin American NGO created in 1994 by a Swiss entrepreneur to contribute to sustainable development in the region.

and the United Nations Development Programme (UNDP).[5] This new scheme incorporated for the first time the participation of the national State, an actor considered as key in an exercise that aims to generate "non-binding inputs" for the elaboration of long-term policies, as explained by a member of the Executive Committee:

> The agreement [with the Government] was always that they were non-binding inputs. This takes the voices and experience of society, but the one ultimately responsible for writing the policies is the State, it is the government. (Executive Committee member)

In this sense, and as in many participatory experiences, the recommendations produced by the platform are not intended to be taken up in extenso by the representative political actors; rather, they feed the reflections and decision-making processes. The notion of "non-binding input" expresses the commitment that participation should contribute to strengthen political representation, but not replace it.

The selection of the scenarists: in search of "representativeness"

A central prerogative of the Executive Committee is the selection of the scenarists –that is, to choose the legitimate actors to formulate a future vision of the evolution of the national energy matrix. In each round, the Executive Committee invited institutions and organizations from civil society, academia, and the business world to play this role. A list of the relevant scenario makers was drawn up for the deliberations, which allowed, in the last round, the production of nine scenarios.[6] The criteria for the inclusion of the scenarists in the list are rather vague and imprecise – "of the highest technical and academic level, highly representative of the interests of the different sectors of energy supply and demand," says one of the final reports (Beljansky, Katz, and Barbarán 2018) – and the continuity from one round to the next is favored, since it constitutes the possibility of collective learning.

Despite this vagueness and the priority given to continuity, participants emphasize the importance of one particular selection criterion: "representativeness" – that is, in this case, the search for a "fair" balance between organizations favoring an environmental viewpoint and organizations favoring an economic one. In other words, this axis of polarization (economic logic versus socio-environmental logic) is the most important criterion when evaluating the candidates:

> Generally, the organizations that participated in the previous round are called and some other organizations that expressed their interest are called, but always maintaining a balance: when one that is very green enters, we try to let one that is not so green enter. So that the views are diverse, but with a more or less even relative participation. Because, if not, it would not be fair in the discussions. (Technical Committee member)

[5]The Executive Committee of the third round was formed, in addition to MINEM and UNDP, by the Center for Energy Regulatory Activity Studies (CEARE) of the University of Buenos Aires, the Technological Institute of Buenos Aires (ITBA) and the Avina Foundation. The *Fundación Ambiente y Recursos Naturales* (FARN), which was part of the Committee in the first two rounds, withdrew from the Executive Committee in the last round, since it participated as a scenarist.

[6]There were 6 scenarios in the first round and 9 in the second and third rounds. In the last round, the scenarists were: the Association of Electric Power Generators of the Argentine Republic (AGEERA); the Association of Large Electric Power Users of the Argentine Republic (AGUEERA) in conjunction with the Argentine Industrial Union (UIA); the Argentine Committee of the World Energy Council (CACME); the Argentine Chamber of Renewable Energies (CADER); the *Foro de Ecología Política* (FEP); the *Fundación Vida Silvestre* (FVS); the *Fundación Ambiente y Recursos Naturales* (FARN) in conjunction with the *Universidad Nacional del Centro de la Provincia de Buenos Aires* (UNICEN); the NOA Group (Salta and Jujuy); the *Consejo Asesor de Política Energética de la Provincia de Córdoba* (CAPEC).

In this sense, the list of participants is updated mainly following a balance between actors in favor of environmentally friendly energy policies (the *Foro de Ecología Política* or the *Fundación Vida Silvestre*, for example) and actors that privilege the costs of energy production and consumption (the *Unión Industrial Argentina*, for instance). This is also explained by a member of the Executive Committee:

> We [the Executive Committee] do not get involved in being scenarists, but we are very careful when we select the scenarists to guarantee that all the voices are represented (…) If you analyze who are the scenarists, you are going to find organizations of electricity generators, you are going to find big energy consumers, the industrialists who are the big consumers, you are also going to find environmentalists, you are going to find rather academic organizations. (Executive Committee member)

This diversity of viewpoints among stakeholders is carefully maintained by the Executive Committee. As explained by the Executive and Technical Committees members, this diversity has to do not only with the "representativeness" that should offer the production device of diverse scenarios, but also with a need for the device to become an instance of *contradictory* debate among the participants. This concern is particularly evident when a member of the Executive Committee is renewed. For instance:

> When FARN [*Fundación Ambiente y Recursos Naturales*] decided to leave, we thought it would be good to have another actor who would also come with a more environmental perspective [to replace FARN]. We always try to ensure that our spaces are diverse and that there is a balanced view. So we already had academic institutions with ITBA and CREA. The AVINA Foundation was focusing on sustainability. With the departure of FARN, a more environmental perspective was missing. Hence, the incorporation of the UNDP-environment department was really good for us. And then obviously with the involvement of the Ministry of Energy, much better, with the public view of the State. (Executive Committee member)

Of course, this attention to maintaining a diversity of views depends heavily on the interests of potential participants. Some actors prefer not to participate, which limits the desired "representativeness." This was particularly the case in the oil and gas sector:

> One sector that we had a hard time involving was the oil sector. What we have of organizations linked to energy production are more from the electricity sector. And when we invited the IAPG, which is the Argentine Institute of Oil and Gas, to the first round, they rejected the proposal. They were not interested in participating. In the second round we did not invite them. And in the third round, when we made the agreement with the Ministry of Energy, the IAPG came and offered to participate as scenarist. Finally, they had a discontinuous participation, and what they did was rather to focus on offering tools when dealing with the oil and gas issue (…) They did not do a complete scenario, but only made contributions in that part of the process, providing information for modeling calibration. (Executive Committee member)

Finally, the "representativeness" of the participants is evolving from one round to another, and the achievement of this objective is complicated by the strategies and the importance of the actors involved. Achieving this goal also depends on the perception that these same actors have of the importance of the anticipation exercise and its possible consequences on the decisions of key actors (such as the Ministry of Energy, in the above interview extract).[7]

[7]As mentionned by a Technical Committee member:

Methodology: associating expert knowledge and representation of interests to have an "educated and technically supported dialogue"

One of the most outstanding organizational characteristics of the platform, in addition to the presence of an Executive Committee that does not participate directly in the production of scenarios, is its openness to a diversity of anticipatory knowledge and future projections formulated by heterogeneous actors. However, the limits of this principle of openness and diversity have been reached sometimes, and the public expression of important disagreements had some consequences on the process of collective scenario-building.[8] These disagreements run the risk, as we will see in the next sections, of hindering the smooth running of the scenario-building exercises, leading to concerns of a sterile debate around incommensurable positions. As the resolution of these disagreements –even a partial agreement- constitutes an important moment of political clarification, it is necessary for the participatory platform to develop some conflict resolution mechanisms. That is why the platform stakeholders underline the need to organize mediation between the sponsor of the debate (the Executive Committee) and the scenarists. In practice, this mediation is carried out by the Technical Committee. Let's introduce it briefly.

The Technical Committee defines the methodological and technical aspects of the scenario-building exercise. It is composed of four experts appointed by consensus by the Executive Committee. During the scenarization exercise, it meets regularly (twice a month, on average) with the scenarists to define the common preliminary criteria and to accompany the scenarists in the formalization of their "vision" of the national energy future. At the end of the round, the same Committee drafts the final report, which constitutes the main output of the scenarization exercise.

The composition of the Technical Committee reflects a certain complementarity of experience and skills among the four experts chosen.[9] It responds to a joint demand of the Executive Committee and the scenarists who want to keep the debate as open as possible, without prematurely closing some technical options due to lack of previous experience and knowledge. Although the composition of the group was initially based on a set of experts chosen from the AVINA Foundation's previous contacts, this initial core was rapidly expanded in the following rounds to achieve greater representativeness. In the division of roles between the Executive Committee and the Technical Committee, the former represents the interests of the main actors (civil society, State, companies, academia), while the Technical Committee brings together professionals "as disinterested as possible": "We do not have a stance that responds to an interest. We have a technical

strategically, it is very important to participate for many sectors: they are telling the education sector what things they should have in their careers, in their postgraduate programs; they are telling the innovation sector if this is going to come, try to do something in Argentina. Many things come out of that, out of the whole process. For example, energy efficiency measures had to be incorporated in undergraduate curricula, engineering, architecture, but also economics, etc.

[8]This was the case, in particular, when strong disagreements occurred concerning the definition of the so-called preliminary criteria –that is, criteria that are defined in common for all the scenarists and that are used as a basis for the calculation of the modeling of each scenario. For instance, these disagreements occurred, in the third round, with "preliminary criteria" such as the evolution of local natural gas production prices and the cost of greenhouse gas emissions. See next sections for more details.

[9]For example, in the last Technical Committee, there was a general coordinator (head of the technical committee), an oil and gas specialist (the most important sector in the current energy matrix), an energy modeling expert, and someone in charge of the integration and communication of the results (an "integrator").

criterion, which is not the case with the Executive Committee" (member of the Technical Committee).

If this division of roles seems simple, the methodology implemented to associate expert knowledge and representation of the interests of all the sectors involved is complicated by the game of contradictory logics faced by the organizers. On the one hand, following a logic of anticipation, it is assumed that anticipatory knowledge is built through a reasoned and argued dialogue among participants (an "educated and technically supported dialogue," as one member of the Technical Committee affirms). However, on the other hand, this rational logic, which assumes a greater role for technical knowledge, is confronted with the participatory logic, which implies that specialized knowledge is at the service of deliberation among the actors involved. This double bind between rational and participatory logics – and the tensions it generates – is embodied in the exchanges (meetings, e-mails, etc.) between the scenarists and the Committees (and within each Committee), which produces several uncertainties: how are these exchanges structured? What is the role of specialized (expert) knowledge in the debates? What is the way to combine this knowledge with the experience of each scenarist and the interests it represents?

These questions do not have general answers, but at least two characteristic features of the way expert knowledge is used during scenario-building exercises can be raised. First, knowledge is not validated only by the status (expert or not) of the protagonist who uses it. The data, arguments, and knowledge mobilized must be based on reliable sources (academic articles, institutional reports, etc.), as stated by a member of the technical committee:

> Each of the scenarists contributed information because what had been agreed upon was that it was not valid for someone to say: "I know that such and such technology has that performance or costs so much in Argentina." Everything had to have technical support, all claims must be supported by recognized sources. (Technical Committee member)

This process of collective validation of the knowledge apt to be mobilized in the debate (and which, as we will see, eventually serves as input in the modeling) allows for the combination of the logic of participation with a logic of anticipation that aims to maintain a certain level of techno-scientific rationality.

Second, the participatory mechanism must contribute to the reduction of knowledge asymmetries among the participants, as stated by a member of the Executive Committee:

> We ensure that the debate has technical rigor and that at the same time it is an informed debate, without the asymmetries of information that could exist between the different actors. Asymmetries not only of information, but also of training because there are actors who are suddenly more environmental and discuss certain positions, but sometimes they do not have the technical knowledge to discuss the energy matrix. Therefore, we strengthen the capacity of these actors so that they can join an informed and technically rigorous discussion. (Executive Committee member)

This reduction of asymmetries has a double meaning. On the one hand, the experts of the Technical Committee must be *at the service of* the participatory process – that is to say, the starting point must always be based on the vision (projection) of the future that each stakeholder has, and the experts of the Technical Committee must maintain a certain "neutrality." This is the condition for the scenarization exercises not to be subordinated to

expert knowledge. However, on the other hand, the experts themselves must validate the technical feasibility of the scenarists' visions in order to translate them in terms of concrete energy policy – for instance, they must give the vision a value in terms of investments or a meaning in terms of regulations. These back and forth between the visions of the scenarists and energy policies are mediated by some expert knowledge that is, in principle, handled by the members of the Technical Committee. And, as we will see in the next section, it is in these back and forth that the coproduction of anticipatory knowledge takes shape.

Coproducing anticipatory knowledge

As operational manager of the scenario-building exercise, the Technical Committee deals with the Long-range Energy Alternative Planning (LEAP) software, a tool created by the Stockholm Environment Institute, which is one of the most widely used in the world to evaluate energy scenarios that incorporate environmental variables in its analysis. This type of tool is part of a long history of techno-scientific developments by various actors who, in many countries around the world, have developed their own instruments for calculating and modeling future scenarios (Cornilleau 2016). They are resources not only for dominant actors in the energy field (companies, national administrations), but also, increasingly, for non-governmental organizations and transnational networks of activists – in particular, environmental organizations – who thus develop alternative and quantified visions of the future of energy systems, at the local, national or regional level (see, for instance, Aykut and Nadaï 2019).

In the LEAP model, each scenarist conceptually configures its scenario in an Excel spreadsheet, which can be processed by the software. This interaction between the LEAP model and the Excel spreadsheet allows scenario designers unfamiliar with the model to take advantage of it without having to learn how to use the software in depth:

> It should be noted that the scenario designer builds everything on Excel. Some do download LEAP and do it themselves. At this point, several of the organizations already work in Excel and then import the LEAP to see the results. But there was always the possibility that if they don't know anything about LEAP, they send the Excel and someone from the Technical Committee does the run in LEAP. At that point, in round 3, most, if not all, of the institutions were already using LEAP, in order to make the iterations [between trial and results] easier. (Technical Committee member)

Thus, each scenarist focuses on the decisions that will guide its energy scenario by translating its vision into an Excel file. This leads each one to reformulate its hypotheses according to identical (technical, economic, and social) dimensions and criteria – that is, it leads each one to reformulate its vision in a shareable frame of reference and a calculation space where the visions become comparable to each other (Aykut and Nadaï 2019). In that sense, the spreadsheet acts as a device that allows converting heterogeneous socio-political and economic visions into (partially) quantified energy scenarios and, therefore, comparable among them. Of course, this comparability is forced by simplifications inherent to the modeling – simplifications that the scenarists and members of the Committees recognize as a necessity (a "necessary evil," says one scenarist) to carry out the scenarization exercise.

Anticipatory knowledge and its controversies

With those limitations in mind, what can we say about the anticipatory knowledge produced by this kind of scenarization exercise? To answer that question, it is necessary to go to a singular case to see what kind of discussions and controversies are generated. As a preliminary point, it is worth mentioning that the scenarios produced through the modeling program are not predictive, since the divergence between each scenario produced (divergences to which we will return in the following section) is a characteristic – and a sought-after characteristic – of the scenario exercise, given that each scenario designer enters his or her own hypotheses in the model. However, the scenarists do not have absolute freedom in the parameterization of their simulations. In particular, they have to agree on what the Technical Committee calls "common assumptions, parameters and input variables" (Beljansky, Katz, and Barbarán 2018, 17), which are agreed assumptions on the future evolution of some key parameters such as: energy demand, energy efficiency, natural gas prices and volumes, cost of greenhouse gas emissions, etc. The value attributed to each of these parameters is constantly being revised from one round to the next, and reaching a consensus is a central part of the preliminary deliberative process carried out by the scenarists and members of the Committees (especially the Technical Committee), since the results of each modeling are strongly dependent on these common assumptions and preliminary agreements.

Thus, for example, in the last round, while a consensus was reached on the vast majority of these parameters, it proved difficult to reach a consensus on the future evolution of two key parameters: the evolution of local natural gas production prices and the cost of greenhouse gas emissions. Therefore, and for the first time in the history of the platform, the intervention of the Executive Committee was requested to determine the future value of these two parameters. According to the Technical Committee, these divergences were caused by "the great heterogeneity of values established in the sources consulted, the highly political character that these definitions have, and by their influence on the medium- and long-term development of different technologies" (Beljansky, Katz, and Barbarán 2018, 18). In particular, the disagreement had to do with the appreciation of the potential and sustainability of non-conventional gas exploitation in the *Vaca Muerta* area, as stated by a member of the Technical Committee:

> With respect to *Vaca Muerta* there was a very strong discussion regarding the forward price. Because we set up a model that was linked to international reference prices. Taking as a reference the international price plus an additional cost. And the people of the *Unión Industrial Argentina*, who were very involved in the development of *Vaca Muerta* and the possibility of having a low gas price for the industry, made a very strong statement saying: we are not going to validate it that way. That discussion had to be settled by the Executive Committee. It was very tough. (Technical Committee member)

Thereafter, despite the intervention of the Executive Committee to define the future value of gas and to go ahead with the modeling and participative process, the *Unión Industrial Argentina* (UIA) "was still not satisfied" with the decision of the Executive Committee and decided to dissociate itself from the results of the scenarization exercise. This disagreement was reflected in the final report of the exercise, as explained by a member of the Executive Committee:

> We came to an agreement. There was an organization, the *Unión Industrial Argentina*, which at the end was not so happy with that agreement, and went back with the intention that we should change some parameters when we had already been working for almost a year and we could not change it at that moment. We were going to lose all credibility and the platform's track record. So, in that case, what we allowed them to do was in the annexes, at the end, where each scenarist describes what assumption they used for the long term and for their scenario, where each scenarist justifies in some way why it chooses to do this or that scenario. In the case of *Asociación de Grandes Usuarios de Energía Eléctrica de la República Argentina* (AGUEERA) and *Unión Industrial Argentina* (UIA), they used this annex to make a whole disclaimer regarding what should be, in their opinion, the future gas price. As if they did not agree with that part of the common assumptions. (Executive Committee member)

Finally, beyond the divergences inherent to each scenario, the anticipatory knowledge produced by this type of scenario-building exercise is highly dependent on controversial hypotheses that are discussed in the framework of the exercise and have a "highly political nature" (Beljansky, Katz, and Barbarán 2018, 18). This "highly political nature" is evident in the aforementioned case of non-conventional gas, where definitions and future trends are based on a consensus forced by the Executive Committee. More generally, it can be noted that these controversies, which are included and summarized in the final report, constitute (paradoxically) one of the important results of the scenario-building exercise. They underline that divergences and disagreements are central parts of this kind of anticipation process – and, in this sense, the *Plataforma Escenarios Energéticos* adds a participatory component that profoundly modifies the modeling exercise.

Comparing scenarios, formulating recommendations, and giving a political meaning to anticipatory knowledge

The scenarization exercises of the *Plataforma Escenarios Energéticos* produce three types of results: visions, quantitative indicators, and a series of coincidences and divergences. These qualitative and quantitative results publicly reveal the political positions inscribed in the scenarios – positions that are already active but not made explicit in the previous phases of the scenario-building exercise.

The visions

The first result of the scenarization exercise is qualitative: each scenarist writes, in the form of a short text of three pages (on average), the "vision" guiding its own scenario. This vision allows each one to express different aspects of its experience during the participation and scenarization process. In these pages, the scenarists justify their decisions and choices in terms of energy trajectory. Some take advantage of this space for expression to criticize the limitations of the participatory process and the LEAP model. For example, *Fundación Vida Silvestre* criticizes the constraints imposed by the model, considering that its own scenario "does not reflect" its "true intention" in terms of energy production and use: "our scenario proposal represents the best adaptation of our vision to the model and to the parameters agreed upon for planning, but it does not reflect our true intention" (Beljansky, Katz, and Barbarán 2018, 94). In that sense, the software as well as the decisions made by the Technical and Executive Committees frame the possibilities and partially limit the options of the scenarists.

The written formulation of these "visions" makes it possible to identify and make explicit the general principles and underlying assumptions that guided the definition of the energy matrix trajectory adopted by the scenarists. This explicitness is made, according to the scenarists, by looking for what differentiates the scenario under consideration from the other scenarios. It is based not only on an (expert) discourse of justification of the technical-economic choices made (in relation to the modeling process), but also on a (political) discourse of legitimization of the position defended with respect to the energy issue (in relation to the participation process itself and in relation to the communication of the results to other audiences). In this sense, the "vision" formulated by each scenarist makes it possible to give a political meaning to the technical choices inscribed in the computer models and their calculations (Aykut and Nadaï 2019).

Quantitative indicators

The second set of results of the scenario exercise is quantitative. In particular, the scenarios are quantified on the basis of a series of 16 indicators of 3 types: economic (electricity energy diversity, primary energy diversity, average cost, total cost, energy efficiency, external independence, trade balance), environmental (greenhouse gas emissions, primary energy emissions intensity, electricity generation emissions, electricity sector emissions intensity, sulfur and nitrogen oxide emissions, land use, environmental aspects of hydrocarbons), and social (conflict and employment generation).

These indicators would merit a more in-depth analysis that we cannot carry out in this article. However, it is worth mentioning that they play an important role in the evaluation of the trajectory of the energy system proposed in each scenario. Not only do they provide a synthesized picture of the characteristics of each one, but also – and above all – to make comparative calculations (between scenarios) using criteria that a wider audience (beyond the platform participants) could understand. Developed collectively by the platform's Technical and Executive Committees, the 16 criteria selected assess the feasibility and attractiveness or rejection of each option in relation to its economic, social, and environmental performance.

Their interpretations are the subject of discussion among platform participants on the "right" way to translate irreconcilable differences (each scenario) into calculable (and therefore commensurable) differences. This translation operation constitutes an important moment of inversion of the relationship between expertise and politics, since, at this point, *expertise is no longer at the service of politics* – as it was in the previous stage of translating the vision of the scenarist into data to fill the Excel spreadsheet that feeds the computer model (see previous sections). On the contrary, at this point, the political voice of each scenarist (its "vision" of an energy future) is placed at the service of the expert work of calculating the indicators. This back-and-forth between expertise and politics is one of the most significant characteristics of the coproduction process (Jasanoff 2004) that enables the scenario-building exercise.

Coincidences and divergences

Finally, the scenarization exercises produce a third type of output: a list of "coincidences" and "divergences" between the proposed scenarios. That list constitutes much of the

"executive summary" of the final report –that is, the most publicly disseminated and visible part of the scenarization exercise. To establish this list, the scenarios are reviewed in a comparative manner. The conjunction of these coincidences and divergences enables the formulation of a set of recommendations in which various ideas are conveyed about what should happen (the coincidences) and what follows open to further debate (the divergences). For example, the growth of renewable technologies (in particular, wind and solar generation) in the energy matrix projected for 2040 is widely accepted and promoted: "The strong growth of renewables in relation to the current installed capacity situation occurs in all scenarios, being in some of them the most relevant variable of the final matrix" (Beljansky, Katz, and Barbarán 2018). In contrast, the production of unconventional gas and oil generates opposite positions: while some scenarists strongly recommend that the local production level exceeds the local demand in order to export gas (by pipelines or liquefaction), other scenarists, on the contrary, do not support the development of *Vaca Muerta* with high production levels, because they consider that the environmental risks and/or the levels of investment and infrastructure requirements are far too high.

Another characteristic of this exercise of anticipation and future projections is the coexistence of scenarios of incremental diversification (continuity) with scenarios of strong reorientation of the energy matrix (discontinuity). For example, the matrix proposed by the *Asociación de Grandes Usuarios de Energía Eléctrica de la República Argentina* (AGUEERA) in conjunction with the *Argentine Industrial Unión* (UIA), which aims at "competitive costs that favor industrial development," coexists with the matrix proposed by the *Fundación Ambiente y Recursos Naturales* (FARN) in conjunction with the *Universidad Nacional del Centro de la Provincia de Buenos Aires* (UNICEN), which strongly aims at wind energy without "investing in new developments in nuclear energy, in large hydroelectric dams, or in hydrocarbon exploitation" (Beljansky, Katz, and Barbarán 2018) –that is, a conservative scenario coexists with a breakthrough scenario in the same anticipation exercise. In that way, the results can jointly inspire the confidence of realistic expectations and the ambition of a profound transformation of the energy matrix.

Conclusion

In this article, we study the coproduction of anticipatory knowledge and its political translation (into arguments and indicators intended to feed the public debate, and into recommendations for decision-making) during a set of participatory scenarios-building exercises. It examines how various anticipations are collectively produced in this context, taking seriously the anticipatory knowledge needed to imagine and design future energy matrixes and trajectories. Based on interviews with organizers and participants, and analysis of reports produced by the platform, our investigation shows that these scenarios, as well as the calculations and models on which they are based, reflect not only the coproduction of anticipatory knowledge (Aykut, Demortain, and Benbouzid 2019) by heterogeneous actors, but also new modalities for the constitution of expertise. In this respect, the *Plataforma Escenarios Energéticos* is part of a global trend in public policy that reflects the ambition of governments, academics, civil associations, and international organizations to transform not only the content of public policy but also the way in which it is elaborated. Its objective is to provide tools for reflection, argumentation, and

evaluation to enable the production of visions that combine the scenarist vision (what should be) and the limitations provided by the modeling tools and its preliminary criteria (what is possible).

It is difficult to evaluate the concrete effects of the *Plataforma Escenarios Energéticos* on the energy policies carried out in Argentina. The most rigorous approach would be to start from the anticipatory knowledge produced by the scenario-building exercise and to try to account for its translation into decision-making instances, which exceeds the ambition of this article. Moreover, in the present case, this anticipatory knowledge takes the form, as we have seen, of a final report mainly written by the Technical Committee (including the quantitative indicators and the list of "convergences and divergences"), but completed and amended by the "visions" written by each of the scenarists. The possibility of dissent is thus integrated into the system and, as a result, it is difficult to know which scenario(s) (or, more specifically, which recommendation(s)) is (are) taken up by the decision-makers. Furthermore, like other participatory exercises (see, for example, Aykut and Nadaï 2019), and despite the participation of the Ministry of Energy in the Executive Committee, the *Plataforma Escenarios Energéticos* is characterized by a significant dissociation between the platform's discussion spaces and the decision-making bodies, which complicates, for the analyst, the possibility of accounting for what actually circulates between the two social spaces. Finally, the platform's contributions are not limited to the direct translation of the results of the anticipation exercises into public policy. In the analytical perspective developed here, but also from the point of view of the platform's designers, the interest of this type of exercise lies much more in the multiple relationships that are gradually established between the participatory anticipation mechanism and more global transformations of public policies – transformations which, moreover, are not the product of a single anticipation exercise. We can therefore assume that, beyond the recommendations produced sporadically, it is rather the accumulation of participatory experiences of this type that produces various forms of learning, whether in the institutions directly concerned or in the public debate.

The participatory scenarization method that has been studied in this article builds anticipatory knowledge that selects a diversity of scenarios and excludes other possible ones. Bringing these scenarios together in a single exercise that legitimizes and builds consensus through the participatory process and the use of technical expertise is a way of locking-in the future (Cardon 2020) – that is, a way of ensuring that the future can be known and controlled, setting aside other possible futures. In this sense, whatever the privileged scenario, what is important is the affirmation of the confidence that can be attributed to this anticipatory knowledge – a confidence which is transmitted, on the one hand, by the naturalization of the simulation model used (and, especially, in the present case, its "common assumptions, parameters and input variables") and, on the other hand, through the identification of technological options, public policies, and favorable investment opportunities (according to the economic, environmental, or social priorities of each scenarist).

Thus, the set of scenarios that concludes each exercise transmits the idea of a solid and reliable anticipatory knowledge of the future energy matrix. Despite the uncertainties about economic evolutions and innovations that can possibly modify the range of technical options, this anticipatory knowledge is likely to present the future as dependent on the decisions taken by the scenarists at each moment of the chosen trajectory. In this

sense, the objective of the scenario-building exercise is to simplify the complex process of transforming the energy matrix into predictable trajectories, thus convincing investors and the public administration. By basing anticipatory knowledge on the decisions made by the scenarists and on anticipation instruments (model, indicators, etc.) opening some technological options and closing others, the scenario-building exercise denies contingency and translates the vision of the future of the energy sector of each scenarist into a straight and well-drawn path.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Agencia Nacional de Promoción de la Investigación, el Desarrollo Tecnológico y la Innovación [grant number PICT-2020-SERIEA-01520]; CONICET [grant number PIP-1177].

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