

Article

Negotiating Water and Technology—Competing Expectations and Confronting Knowledges in the Case of the Coca Codo Sinclair in Ecuador

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Abstract: Recent and on-going mega-hydraulic development in the global South implies profound socio-technical, ecological, territorial and cultural transformations at different levels and spaces of society. The transformations often involve conflicts and also new governance arrangements between different knowledge regimes, local practices and national and global frameworks of climate mitigation, water resources management and the green economy. Significantly, they also entail varying expectations concerning the meaning of water and the political promises of technology in advancing more sustainable futures. Drawing on sociological science and technology studies, particularly the sociology of expectations, this article analyses competing, parallel and confronting expectations regarding water and technology that different actors produce, negotiate and contest in the context of the recently launched 1500 MW hydropower megaproject Coca Codo Sinclair in Ecuador. It takes expectations as performative as they may shape and challenge policies, discourses, social interactions, institutions and power relations. By analysing and comparing these expectations, the article scrutinises the socio-technical imaginaries and related knowledge regimes they represent, derive from and support, and what kinds of repercussions these have in terms of water resources management in particular and sustainability governance in general.

Keywords: expectations; hydroelectric megaprojects; socio-technical imaginaries; Ecuador; energy policy

1. Background

Recently, academic scholars, national governments and international organisations such as the OECD and the UN have increasingly called for system-level sustainable transitions driven by new policy concepts like green growth and the green economy [1–6]. These concepts have highlighted the urgency of climate change while seeking to simultaneously ensure sustained economic growth and responsible environmental governance. National responses to these challenges have entailed new policy visions accompanied by increased investment in clean technologies and renewable energy sources in order to enable and accelerate substantial changes in national energy matrices [3,4,6–8]. This article addresses such efforts in the context of the Andean country Ecuador, which exemplifies recent developmental challenges and the ways in which a new hydroelectricity-driven energy policy approach has been negotiated, contested and legitimised. In this context, the role of expectations is crucial: the ways in which the new hydraulic megaprojects such as the 1500 MW Coca Codo Sinclair (CCS) are motivated and imagined have important repercussions for how energy futures, values, industrial transformations, social organization and governance are understood, rationalised and managed [9–13].

Hydropower can be understood not only as a form of electricity production but also as a socio-technical, cultural-symbolic, discursive and political phenomenon. This article focuses on

expectations and confronting knowledge regimes (see the introduction in this volume) concerning water and technology, understood as hydropower infrastructure, in the CCS as it exemplifies current challenges in sustainability governance and green transitions. Drawing on sociological science and technology studies, in particular the sociology of expectations [10,12–14] and transitions studies literature [1,2,9,12], the article takes an actor-oriented approach and examines recent expectations and future visions regarding the CCS among various actors at different levels and spheres of Ecuadorian society. We show how the project is understood by diverse actors, ranging from instrumental and functionalist-pragmatic interpretations to addressing an intrinsic value of water and technology or generating symbolic understandings. Thus, the meanings of water and technology vary from resource-based views to energy supply and security-oriented interpretations, and further to drawing on esthetical and cultural values or seeing them as mediators of techno-economic advancement and systemic transitions. These meanings have important repercussions not only in terms of understanding the CCS and the Ecuadorian context but also, more broadly, in planning and governing pathways to more sustainable energy futures. Moreover, they show how hydro-social realities (see the introduction in this volume) are formed and negotiated by confronting knowledge regimes based on different grounds for claiming the truth.

The sociology of expectations has been applied, for example, to biomedical research [10,15] but less often in relation to natural resources governance or hydropower (see, however, [9,12]). This article emphasises the performativity of expectations [10,13], i.e., how expectations shape politics, the future, technology, stakeholder interactions and concrete policies. Examining socio-political and cultural-symbolic dimensions of hydropower infrastructures opens up insights into understanding how perceptions concerning water and technology shape levels and forms of knowledge and governance. This highlights how expectations shape and are shaped by both the everyday lives in riverside communities and national energy policy visions. The article also generates knowledge about the challenges of new hydropower in the global South by examining the degree to which different understandings and knowledge regimes resemble or depart from each other. It does not take the benefits or problems often associated with hydraulic mega-projects as a given, but instead considers them as social constructs and as subjects of continuous political (re)negotiation (see also [16] in this volume).

The analysis is based on interview data and written material collected in Ecuador in 2016–2017. The interview data consists of 39 open-ended, semi-structured interviews with representatives from relevant ministries (two), regulatory authorities (five), regional administration (two) and Coca Codo Sinclair S.A. (three) as well as non-governmental organizations (NGOs) (four), project workers (three) and local inhabitants (twenty) in the riverside villages of the Rio Coca. All interviews were conducted with and transcribed by a local research assistant (we would like to thank Ricardo Andrade and Paolo Aranda for their valuable contribution in the data collection and the transcriptions of the interview data). The interview data was collected using snowball sampling for the expert and authority interviews to allow finding key actors relating to the CCS. In the riverside villages, snowball sampling was complemented by purposeful sampling [17] to illustrate what kinds of perspectives are shared by not only the politically active or knowledgeable actors but also among local residents in the CCS's impact area. The purposeful sampling strategy was based on identifying and interviewing informants who lived in the impact area and collecting data until the point of theoretical saturation, i.e., the point at which the collected data did not provide additional major insights. The data also includes participatory observation in the project site and surrounding areas (2016–2017). This part of the data was used as background and contextual information in the analyses. The interviews and notes from the participatory observation were complemented by written material, especially regarding the official views and the NGO perspectives. This material consists of official documents, strategies, evaluation reports, project documents and other written communications produced by the Ecuadorian government, key ministries, national and regional regulatory authorities and provincial actors as well as NGOs and the Coca Codo S.A. (2005–2018).

The main method employed is data-driven qualitative content analysis [18] which allows a data-oriented and inductive approach. Rather than using pre-selected categories or theory-driven themes, the thematic codes, categories and broader themes were identified and elaborated directly from the data through several readings of the material. The analysis was then conducted on the basis of the identified categories and themes.

The first two sections discuss the theoretical framework and context of the study including a brief introduction to Ecuadorian energy policy in general and the case of the CCS in particular. The following section entails an analysis of expectations that various actors have in relation to the CCS and what kinds of socio-technical imaginaries and knowledge regimes they draw on, shape and represent. The concluding section summarises the key findings and discusses them in relation to how the different imaginaries are reflected in the dynamics of various levels and forums of negotiation and contestation.

2. Expectations Shaping Energy Futures, Technological Choices and Policy

The meanings and roles given to water and technology shape the ways in which water rights and futures are constructed, negotiated and contested. Parallel, competing and confronting expectations play a crucial role in imagining energy futures and making technological and political choices—and in turning policy visions into concrete policies and practices [13]. The sociology of expectations literature suggests that an important aspect of expectations is their future orientation [10,13]. National and supranational policy documents [3,4,19,20] imply that increasing electricity demand, together with climate mitigation and the ideas of the green economy, necessitate a particular set of politico-economic, technological and institutional changes. In this way, new hydropower projects contain a promise of providing solutions to broad societal challenges and can be seen as a kind of an ‘imagined world’ ([14], Anderson’s term *imagined community* [21]), wherein hydraulic technology serves to prevent human and ecological disasters in a sustainable and profitable way (cf. [12,13,15]). Hydropower is, therefore, not only an economic or techno-scientific project but, importantly, a political one.

This article analyses the expectations different actors from the state to grassroots level regarding water and technology. It approaches expectations and visions concerning hydropower as historically and culturally constituted socio-technical imaginaries. This concept refers to nationally or locally produced expectations and visions related to techno-economic and socio-political possibilities [14,21,22]. They are constitutive because they generate expectations, but at the same time, they are based on local practices, history and public reasoning [14]. This interpretative flexibility [23] implies that water and technology are subject to varying forms of reasoning in particular contexts, which necessitates going beyond technical aspects and focusing on their social and political dimensions [12–14].

Another key aspect is that expectations and socio-technical imaginaries are actively produced [13,23] and performative [10] because they create actions, define roles and responsibilities and shape political agendas [2,12,13]. This ties the sociology of expectations to transition studies [1,2,9,10,12–14] wherein socio-technical transitions are seen as enabled and/or hindered by prevalent or changing politico-economic conditions and political activities at different levels of a society. As Sovacool and Brossman [12] (p. 839) have summarised, literature on technology and future visions, or “fantasies” (e.g., [22,24]) suggests that successful socio-technical imaginaries often entail four common characteristics; they (1) are concrete enough to be applied in the real world, (2) are critical towards the present situation, (3) provide convincing arguments for socio-technical transition, and (4) suggest that the socio-technical vision in question is powerful enough to make previous changes irrelevant. This implies that expectations are important not only in generating policy visions but also in accelerating or hindering sustainability transitions.

Expectations are also crucial in defining cooperation and common goals and brokering relationships between different actors and stakeholders who often draw on different knowledges and modes of social interaction [9,10,12–15]. They are thus important in understanding how and to what extent different rhetorical strategies and rationales resemble or depart from each other, how

they take shape in politics, and how they represent and shape different knowledge regimes [9,11–13]. Rather than neutral or universally agreed-upon entities, this points to hydropower infrastructures as negotiated and co-produced constructs [14] that have contextually embedded meanings and manifestations. Socio-technical imaginaries, with expectations and counter-expectations concerning water and technology as delivering progress, modernity, hope and prosperity, thus shape the ways in which society perceives new hydropower and its potential or challenges (see also [25] in this volume).

As will be discussed below, expectations concerning the CCS reflect divergent socio-technical imaginaries (Table 1). They tend to frame the Coca River not only *instrumentally*, as a resource for electricity or a service for the nation, but also *functionalist-pragmatically*, as an ecosystem with rich biodiversity, a source of local income and regional development, and as having an important recreational value; or by *addressing an intrinsic value of water*, as an historically and culturally situated place with esthetical and cultural value. In addition, *symbolic understandings* have also attached new meanings to water. The river has been understood as a mediator of techno-economic advancement and a key element in enabling and accelerating socio-technical transitions. These four ways of constructing meanings for water imply divergent knowledge regimes, resulting in rather different socio-technical, cultural and environmental imaginaries and policy alternatives.

Table 1. Expectations towards water and technology in the context of the Coca Codo Sinclair.

	Instrumental	Functionalist-Pragmatic	Intrinsic Value	Symbolic
WATER	<ul style="list-style-type: none"> • resource for electricity • service for the nation 	<ul style="list-style-type: none"> • ecosystem with rich biodiversity • a source of local income and regional development • recreational value 	<ul style="list-style-type: none"> • historically and culturally situated place • esthetical and cultural value 	<ul style="list-style-type: none"> • mediator in techno-economic advancement • enabling and accelerating sociotechnical transitions
TECHNOLOGY	<ul style="list-style-type: none"> • contribution to national economy • potential for regional development • a means for social and environmental compensations 	<ul style="list-style-type: none"> • improved access to and supply of electricity • provision of lightning in households • control and regulatory infrastructures 	<ul style="list-style-type: none"> • development of the national knowledge base and technological know-how • modernization and progress 	<ul style="list-style-type: none"> • future hopes and national pride • mediator in environmental, social and economic policy goals • symbolizing techno-economic and industrial competence with contributions to <i>buen vivir</i>

The four ways of reasoning also imply different understandings concerning technology that draw on divergent knowledge regimes. Instrumental constructions tend to emphasise the contribution of hydraulic technology to the national economic and regional development and consider it a means through which various social and environmental compensations can be attained. The functionalist-pragmatic perspectives focus on expectations regarding enhanced direct influences such as improved access to and supply of electricity and more secure provision of lighting in households. Since both the technology and know-how used by the CCS are largely imported, these perceptions highlight national competence and technological infrastructures particularly within the systems of control and regulation. Constructions that provide technology an intrinsic value are closely related to imaginaries of the importance of technological advancement as such and for the broader development of the national knowledge base. These conceptualisations tend to value technological advancement as signifying modernisation and progress. Finally, symbolic views attach future hopes and national pride to hydraulic technology. In these perceptions, technology is viewed as mediating environmental, social and economic policy goals and as symbolising techno-economic and industrial competence with contributions to good living (*Buen vivir*, see below). Moreover, hydraulic technology is represented in the symbolic understandings as a means to control natural resources and as an enabler of system-level sustainable transitions. These conceptualisations highlight the performativity of expectations as they may have important political repercussions and shape broader understandings regarding sustainability and technology.

3. Ecuadorian Energy Policy and the Case of the Coca Codo Sinclair (CCS)

3.1. 'Buen Vivir' and the Grand Energy Transition

The CCS was constructed in the context of former (2007–2017) President Rafael Correa's political program of 'Citizen Revolution' (*Revolución Ciudadana*) adopted in 2006 as a response to the previous market-based regime, or, as Correa put it, the 30-year 'long and dark night of neo-liberalism' [26]. The program has been based on the notion of 'good living' (*Buen Vivir*), a concept borrowed from the Kitcha term *Sumak Kawsay*. It has to be noted, however, that somewhat similar ideas have been visible for instance in Bolivia as well. Under the presidency of Evo Morales (2006–), the ideas of "vivir bien" have included an attempt to defend 'Mother Earth' (*Pachamama*) through sustainable use of natural resources [27]. Correa's program has been characterised as a mixture of a statist and neoliberal models [28] due to its strong, state-led orientation in governing the 'strategic sectors' defined by the 2008 Constitution, i.e., energy, telecommunications, non-renewable natural resources and water, combined with neoliberal and market-based mechanisms. The National Plan for Good Living 2013–2017 (*Plan Nacional de Buen Vivir*) [8] outlines key aspects of *Buen vivir* and suggests a shift towards long-term planning and a holistic view of (state-led) governance. It entails several ambitious objectives to improve education, health care and infrastructure while protecting nature and managing natural resources in a sustainable way. A focal aspect in this effort has been strengthening the state's role in resource management and re-nationalising natural resources as well as re-enforcing state power in the strategic sectors and increasing public expenditure in fields such as transport infrastructure, public health care and hydropower [26,29–31].

A key element in the new policy programme is an ambitious energy transition aimed at diversifying the energy matrix, contributing to climate change mitigation and improving national energy security and sovereignty [26,31,32]. The Electricity Master Plan 2007–2016 [20] emphasises generating a substantial change in the national energy matrix largely by accelerating greater use of renewable energy sources. The CCS is one of the eight new hydropower projects included in the energy transition that seeks to increase the share of hydropower from 58% of electricity generation in 2015 to 90% in upcoming years (see also [25] in this volume, [29]). The policy priorities also include accelerating sustained economic growth, e.g., via electricity export and reducing the public deficit that has resulted from the recent oil price fall [33].

Generally, the Ecuadorian economy has grown steadily over past few decades (excluding the recessions in 1999–2000 and 2015–2016) and especially since the early 2000s, while the growth in population has been moderate (Table 2). The gross domestic product (GDP) grew from 74,111 billion USD in 1990 to 160,097 billion USD in 2015, while the total population increased from 10.22 million to 16.14 million during the same period with average annual growth of 1.4% [33–35]. The rise in total greenhouse gas (GHG) emissions has been explained by the growing energy sector, increasing demand and transportation [30]. However, this development has been relatively moderate in relation to the GDP or per capita (Table 2).

Table 2. Ecuador's GDP, population growth, GHG emissions * and oil production and consumption in 1990–2015.

	1990	2000	2005	2010	2015
Real GDP (constant prices, million USD 2011)	74,111	93,842	118,922	140,492	160,097 **
Real GDP per capita (constant prices, USD 2010)	3721	3679	4287	4657	5353
Population (million)	10.22	12.63	13.74	14.93	16.14
Total GHG emissions (kton CO _{2eq})	45,300	42,210	53,240	65,970	67,940 **
GHG emissions (kton CO _{2eq}) per GDP	0.59	0.45	0.45	0.47	0.43 **
GHG emissions (kton CO _{2eq}) per capita	4.44	3.34	3.87	4.42	4.41 **
Oil consumption (t of barrels/day)	97	134	159	243	251
Oil production (t of barrels/day)	285	395	532	486	504

* Excluding the land-use, land-use change and forestry sector ** 2012. Sources: [33,35–37].

In 2012, Ecuador's total GHG emissions amounted to 67,940 kton CO_{2eq}, which accounted for a 0.15% share of the world's GHG emissions [36]. The country's energy sector is still highly reliant on fossil fuels. For instance in 2014, oil accounted for 88.50% of the total production of primary energy. Ecuador is a member of OPEC and a net exporter of oil; nonetheless, its dependency on price fluctuations in the world market has had significant implications for the country's economy, and current plans entail exporting the oil surplus or refining it to a higher value. In terms of GHG emissions, the energy sector is responsible for almost half (44.63% in 2012) of national emissions [38]. While the new policy approach has been driven by development, climate mitigation, conservation and resource nationalism, the rhetoric concerning the sustainable transition in the national energy matrix has been somewhat inconsistent with recent policy actions such as new oil fields concessions [30]. The large Chinese loans and investments, e.g., to finance the CCS, have also limited resource nationalism, and the recent economic situation has partly subjected conservation demands to developmental imperatives [30,39]. It can thus be questioned to what extent these policies are in line with the 2008 Constitution, which gives nature rights of its own and seeks to preserve the environment. Related to this point, concerns have also emerged regarding stakeholder engagement, integrative environmental planning and transparency and accountability in the new mega-projects (interview data, [40]).

3.2. The Coca Codo Sinclair

The CCS is located in the Napo and Sucumbios provinces, approximately 100 km east of Ecuador's capital Quito, in an area where the River Coca is formed by the waters of the Quijos and Salado Rivers (Figure 1). The CCS diverts water just below the confluence, piping flows to a power plant about 25 km downstream of the diversion dam. The total drop at the powerhouse is 620 m [41].

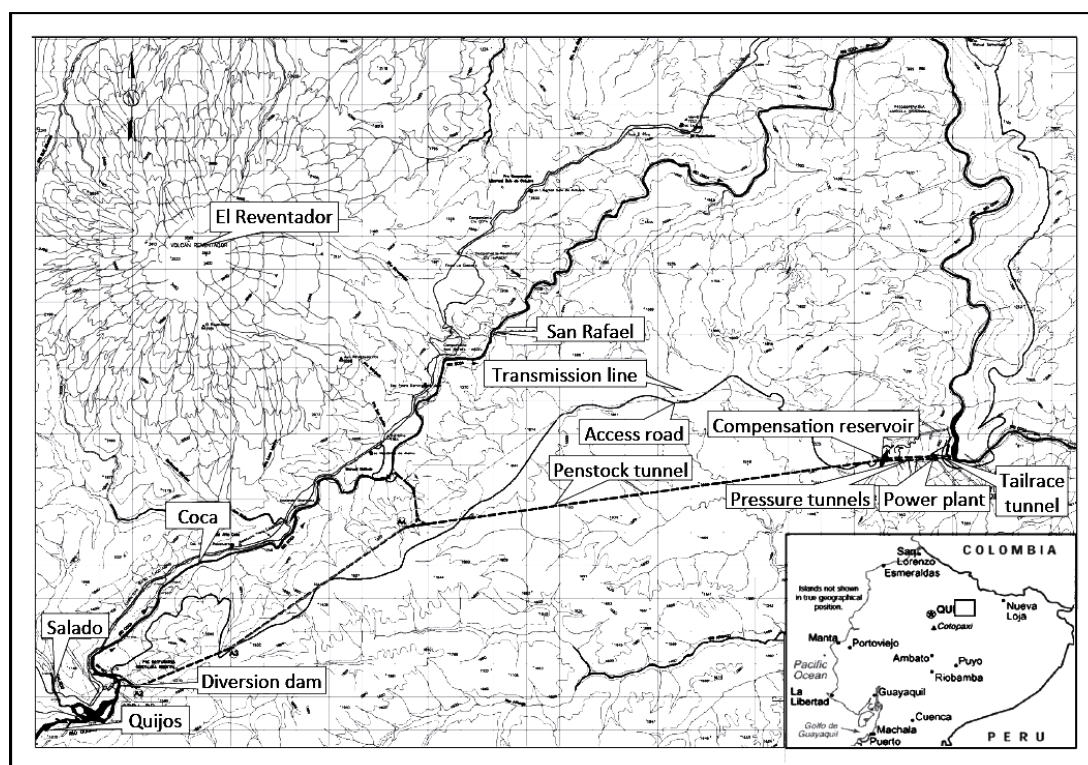


Figure 1. The Coca Codo Sinclair project and the surrounding area. Source: modified from [42].

Initial studies concerning the project began in the 1970s. A pre-feasibility study in 1976 and a feasibility study in 1992 were conducted on the basis of registered flow calculations from 1972–1990. It suggested an 859 MW project with two units (432 MW and 427 MW) using a total flow of 127 m³/s. Because of financial constraints and the eruption of the Reventador volcano close to the project area in

1987, the plans were halted for almost two decades. The 1992 plan was updated in 2007 to include a potential of up to 1500 MW and a maximum usage of 222 m³/s flow out of the estimated average annual flow of 287 m³/s. However, the new feasibility studies were, according to a representative of the Ecuadorian Rivers Institute (interview data), based on historical hydrological data of questionable validity, which led to overestimations concerning water availability [43,44]. The average annual flow figures also are not very informative because of large differences in wet and dry season flows [43,45,46].

The preliminary Environmental Impact Assessment (EIA) studies were conducted quite rapidly, between September 2007 and March 2008, by the consultant Entrix, a contractor of the Ecuadorian generator Termopichincha [46]. The national electricity coordinator, Coordinador Eléctrico Nacional (CONELC), approved these in record time, within one week, in the beginning of April 2008. At the time, the project had already been included in the 2007 Electrification Master Plan, and the Ministry of Environment had given the project a certificate concerning protected areas in February 2008. These did not, however, include official environmental permissions or licenses for the project [46].

In April 2008, Rafael Correa and former Argentine head of state Cristina Fernández de Kirchner broke ground on the project by establishing a joint venture between Termopichincha and the Argentinean state energy company Enarsa. At the same time, the Ministry of Electricity and Renewable Energy (Ministerio de Electricidad y Energía Renovable, MEER) promoted the project locally and sought to reduce opposition through special agreements with municipal governments entailing aims to educate local residents, build a health center and improve inter-institutional cooperation. Entrix was hired again to conduct public consultations, together with Coca Codo Sinclair S.A., in the area in May and June 2008. These entailed informing local residents about the project through a public hearing and an advertising campaign in local newspapers as well as establishing two public information centers in the impact area. However, little detailed information is available regarding the community consultations, environmental audits or the EIA processes (see also [40,45]).

In 2009, Argentina sold its share to Ecuador's state power generation holding company, CELEC EP (*La Corporación Eléctrica del Ecuador*), and in 2010, the state-owned special-purpose company Coca Codo Sinclair EP was established for the project's development. The project was constructed by a Chinese company, Sinohydro, which won the engineering, construction and procurement contract for the project in 2009. Initially, the Sinohydro-Andes JV consortium consisted of the Chinese Sinohydro (89%); an Ecuadorian company, Coandes (8%); and the Chinese Yellow River and Italian Geodato consultant companies (3%). In September 2009, however, Coandes withdrew from the consortium, and the contract was awarded to Sinohydro alone. The project is highly dependent on foreign debt: the Export-Import Bank of China financed 85% of it with a 1.68 billion USD loan, while the Ecuadorian government was responsible for the rest of the funding. The total costs of the project rose to 2.25 billion USD.

The water intake consists of a concrete-face rockfill dam, a concrete spillway and an intake between them (Figure 2). The water diverted from the intake runs via the sedimentation basin through the 24.85 km tunnel into the compensating reservoir (with 800,000 m³ usable volume), and via the almost 2 km-long penstocks to the eight Pelton-type turbines, each with a capacity of 187.5 MW. The CCS's run-of-river intake has a maximum capacity of 7500 m³/s. The project has been in operation since 2016; the first commercial phase entailed taking four units to operation in August 2016, and the second included the remaining units in December 2016. According to the MEER [40], the project contributed to the National Interconnected System (NIS) by 11,603.76 GWh by May 2018. Nevertheless, the project has also suffered from technical difficulties. In 2012, a tunnel collapse during the construction caused the deaths of 13 people. In October 2018, CELEC EP announced that three out of eight generation units were not operating because of major disconnections in the system. The power cuts in the transmission lines affected many Ecuadorian cities, and two newly launched hydroelectric projects (Minas San Francisco and Delsitanisagua) were used to replace the energy shortage [47].

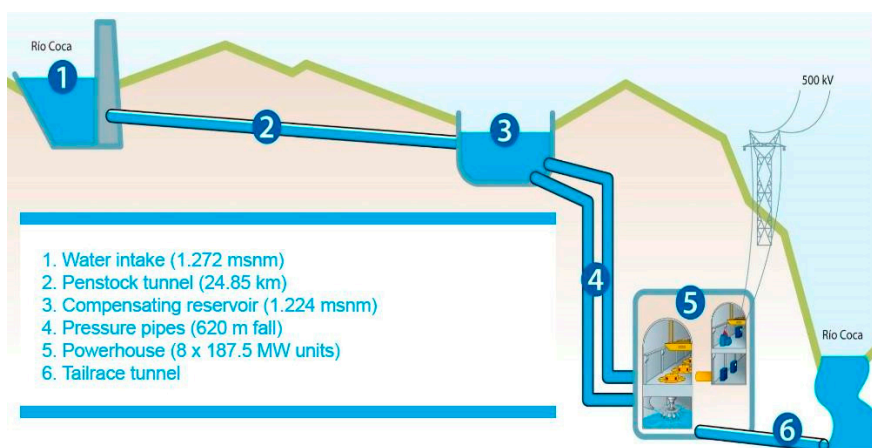


Figure 2. The structure of the Coca Codo Sinclair. Source: modified from [41].

The CCS's impact area covers almost 40,000 hectares, and it has been estimated to directly influence about 2000 people [46,48]. The population in the area mostly consists of small-scale farmers and entrepreneurs. As a run-of-river project situated in a highly active seismic area, the CCS does not include a massive compensation reservoir and thus it is not comparable with typical mega-dams in terms of carbon emissions. Nor has it entailed displacement of people or violations of indigenous rights as has been the case in many other mega-dams. Concerns have emerged, however, concerning the project's other impacts, including increased sedimentation upstream and significant lowering of the water flow below the dam, affecting fish supplies. It also is claimed to practically dewater Ecuador's tallest (146 m) waterfall, San Rafael [49], which is a major attraction of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Sumaco Biosphere and is located about 20 km downstream of the water diversion dam (see Figure 1).

The available water flows vary considerably in the dry and wet seasons, which makes the CCS's commitment to the minimum flow requirement of 20 m³/s (originally 56 m³/s)—the amount of water being left in the river to maintain the waterfall—challenging [48–50]. In particular during dry seasons, the prioritisation of different water uses (e.g., power generation vs. recreational use) thus is an important question. Yet, this matter is difficult to accurately estimate beyond observations, given the problems of accessing hydrologic and operational data of the CCS (see also [45]). Other concerns entail the CCS's impacts on the flora and fauna of the Sumaco Reserve and the Cayambe-Coca National Park, the high seismic risk, as well as deforestation caused by the construction of the transmission lines. Social concerns relate to employment opportunities and working conditions in the construction sites, infrastructural transformations, healthcare and sanitation as well as broader regional development and the living conditions of the local residents (interview data, [40,45]). One criticism also concerns the partiality of the EIAs, which were conducted separately for the dam and the transmission lines and, thus, allegedly lacked a comprehensive view of the impact of the project as a whole.

At the same time, high expectations are visible at the national level regarding the ability of the project to deliver a pathway to a more sustainable and economically viable energy future. Described as an 'emblematic' project of the national government, the government expects the CCS to provide approximately 30–44% of the supply of national energy demand, contribute to 3.45 tons of CO₂ emission reductions annually, generate annual savings worth 617 million USD by reducing the import and consumption of fossil fuels, create 7739 new jobs (mostly in the construction work) and directly benefit over 16,000 inhabitants through its compensation programs such as public infrastructure and improved access to electricity. Whether and to what extent these estimations are met remains yet to be seen because of the lack of accurate, updated hydrologic and operational data and pending compensation activities [45,46]. In any case, the CCS can work at full capacity only about five or six months per year because of the changes in the availability of water. The following section discusses in

more detail the different expectations stakeholders have expressed concerning the project and some of the key rationalities and diverging knowledge regimes that shape them.

4. Competing, Parallel and Confronting Expectations around the CCS

4.1. The Government's Logic: Economic Growth, Energy Security and Buen Vivir

Hydropower has been an attractive electricity generation option in Ecuador not because the technology as such is superior to other renewable energy technologies but rather because it significantly contributes to national policy priorities such as energy security, self-sufficiency and the reduction of CO₂ emissions (interview data, [19,20,31,32,41]). The official rhetoric has emphasised how the CCS is a crucial part of the transition of the national energy matrix towards more reliable, self-sufficient, cost-efficient and cleaner energy production [38,41]. Thus, it is portrayed as a kind of a systemic innovation and an important part of a society-wide transformation that also provides export opportunities. As a representative of the CELEC EP stated,

"We, rather than being suppliers of infrastructure, say that to produce electricity, the intention is to be an exporter of energy. A vision of 20 years from now is for Ecuador to be a regional supplier of electricity, that is, not to develop infrastructure or equipment technologies but selling energy."

Behind these arguments is also the international climate debate vis-à-vis national concerns concerning the reliance on fossil fuels and the increasing need for electricity related to economic development. Moreover, the Ecuadorian government's hype around hydraulic mega-projects aligns with the broader rhetoric of modernity and progress (see also [26,29,30,41]), which has partly justified the official energy policy. Ecuador is thus presented in the government's arguments as a kind of energy policy pioneer with advanced policy visions, enabling the modernisation of the national energy system while boosting economic growth and social well-being (interview data).

The official rhetoric also resembles the notions of green growth and the green economy. Advocated by the Organization for Economic Cooperation and Development (OECD) [3] and the United Nations Environment Program (UNEP) [4] in the 2000s, these concepts build on previous eco-modernist ideas of decoupling economic growth from environmental depletion and emphasise the economic potential of a system-level transition [1,2,9,12] to cleaner energy production, green technologies and resource efficiency. This has entailed considerations concerning energy security and climate change. The OECD [3] (p. 9) defines green growth as "fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies." This formulation calls for synchronising economic and environmental policy goals into a coherent, cross-sectoral policy approach in which the role of public policies is crucial.

The Ecuadorian government's rhetoric similarly emphasises clean electricity production and a change in the national energy matrix towards a greater use of renewable energy sources while enabling improvements in the country's economic performance and climate action [19,31,38,41]. Here, water is constructed instrumentally as a resource for development and a service for the nation (Table 1, interview data).

"Advantageously, for the size of our country, we have sufficient and extensive resources that logically allow us to make a strong investment to transform the energy matrix. [. . .] We consider that the [local] impact is quite low compared to the benefits that Coca Sinclair brings" (a representative of MEER).

The relatively strong role attributed to the state in the vision of *buen vivir* also highlights the importance of public policies in achieving sustainable transitions and infrastructure improvements to enable long-term economic growth and societal well-being [8]. In this context, technology is viewed in a functionalist-pragmatic way as contributing to infrastructural development and energy

supply. Unlike in other countries where energy policy objectives are largely motivated and rationalised by climate policy arguments, Ecuadorian energy policy rhetoric particularly emphasises national prosperity and energy security and conditions climate change concern in terms of energy sovereignty and self-sufficiency (interview data). The strong focus on hydropower also raises a question concerning the future potential of new green technologies (e.g., solar, wind, new biomass applications) that have received increasing global emphasis. The technological choices the government makes today have important repercussions for the country's energy future, and the potential technological lock-ins and path dependencies [1,2] also crucially shape longer-term socio-technical transformations and the country's innovative potential.

So far, there has been relatively little discussion concerning the potential of other renewable energy sources because the government's high expectations of hydropower (interview data) have dominated the discussion. As Sovacool and Brossman [12] (p. 839) have noted, "Those who advance a rhetorical vision naturally shape and limit the scope of how the vision is discussed." In the Ecuadorian case, the public debate on energy policy has indeed been quite limited. The Correa regime had a high level of control over national media and non-state actors such as NGOs, and the terms, conditions and content of all kinds of public debates were, thus, strongly determined by official authorities (interview data). Representatives of NGOs and inhabitants saw that one reason for the lack of public resistance and protests against the CCS has been the Correa government's repressive policy towards political action and organisation (interview data). In addition, the government policy has been secretive, and little information concerning public consultations, project implementation details, China–Ecuador relations or alternative energy policy choices has been publicly available. Currently, with the new government, the situation may change in this respect, and according to many interviewees, one welcome change under the new president Lenín Moreno (2017–) is at least some degree of liberalisation in terms of the freedom of speech. Yet, it needs to be noted that Moreno also was actively involved with the CCS negotiations and acted as a mediator between the Chinese Eximbank and the Ecuadorian government in the preparatory phases of the project. Despite new hopes and expectations towards enhanced possibilities for a more open political dialogue, few thus consider broader political changes attainable in the near future (interview data).

4.2. Technological Optimism Underpinning Regulatory Practices and Regional Development

Whereas the government's official rhetoric demonstrates a broader strategic policy approach and reflects high expectations of economic development and prosperity through cleaner electricity production, energy security and self-sufficiency, the expectations of regulatory authorities and national energy policy agencies highlight infrastructural innovations and technology within the regulatory systems (interview data).

These exemplify how the CCS is perceived symbolically in this rhetoric, not only as an electricity generation project but also as a showpiece of national competence and pride (Table 1). This, together with the government's rhetoric of the CCS as an 'emblematic' project, implies its construction as a kind of a monument, a signifier of how the government transforms and modernises the whole society through its massive infrastructural and energy projects [26,30,32,41]. While the technology utilised by the CCS is not new per se, the advanced technology used within the infrastructure for the regulation and control of its operations is interpreted as representing modernity and technological know-how, thus symbolising hopes for national technological advancement (interview data, [51]).

"It is important to continuously enhance the knowledge of technology and professional development that will be even more relevant in the future. [. . .] There is a very clear policy of the government's electricity system." (representative of CENACE).

In this context, water is perceived instrumentally as a resource for increased electricity demand without any (explicit) socio-political or culturally embedded value. This apoliticisation of water frames electricity generation in general and the CCS in particular not only as a necessity but also a possibility

for the nation because it seems to offer a potential for the development and utilisation of technologies especially within the established structures of regulatory infrastructure (interview data).

“Here, within Ecuador, the opportunities for technological development entail all the maintenance that we have to take care of. [...] We have to be technically sustainable to be able to repair all components. [...] All this is our responsibility that we are going to develop, and it also is an opportunity to understand the latest-generation hydrodynamic profiles” (a representative of ARCONEL).

While the politics of water and questions concerning the social and environmental impacts and public and political acceptability of the CCS are largely hidden by in this rhetoric, infrastructural innovations and supportive technologies is a source of national competence. The pride over technological advancement is exemplified by the regulatory authorities’ references to the project’s technology-driven and allegedly well-functioning systems of regulation and control (interview data, [51]), in a way demonstrating a faith in national technological expertise within the regulatory systems. These expectations are thus largely shaped by hopes and future visions for technological and economic modernisation, a mastery over natural resources and an enhanced techno-scientific knowledge base. This kind of technological optimism, or legitimisation, has also been visible in other contexts such as the early 20th-century hydropower projects in the U.S. [11], nuclear new-build in Finland, France and the UK in the 2010s [52], and in Peruvian water resources management [53–55]. At the same time, regulatory authorities and energy policy agencies perceive their role as more or less politically neutral (interview data). This rhetoric thus implies a pragmatic, apoliticised and techno-economic rationalism fueled by a sense of national pride and a technology-driven imaginary of the future energy system (cf. [6,16] in this volume).

A certain type of technological optimism is also visible among regional authorities. Here future expectations are related to the compensation schemes and the potential of introducing new solutions for water treatment because one major problem in the area is the contamination of water by municipal waste (interview data). The project’s presence in the area symbolises future potential in the form of techno-economic cooperation and investment in innovation, and expectations favour its ability to contribute to regional development through technological upgrading (interview data). In a sense, these expectations reflect technocratic visions of modernisation (see also [53–55]) with imaginaries concerning the exploitation of clean technology solutions that would improve the overall living conditions within the area. In this rhetoric, water is also perceived instrumentally as a resource, not only for electricity production for national needs or economic purposes, but also as a source of local income and well-being for inhabitants (Table 1). In general, the regional authorities’ expectations centre on balanced regional development, sustainable socio-technical transitions, environmental protection and improvements in the everyday living conditions of the local residents. While many CCS-related initiatives have remained at the level of political promises (interview data), strong expectations prevail concerning the future developments and local support that the project might offer. The lack of resources, unequal distribution of benefits and inadequate attention from the project’s side towards local developmental needs are considered a major hindrance to technological and social improvements (interview data).

4.3. Expertise Outside and Beyond the State: The Value of the Multiple Uses of Water

In contrast to economically or technologically oriented argumentation or symbolic framings (Table 1), many NGOs emphasize the multiple uses of water in the case of the CCS. Instead of appealing to culturally embedded or historically constructed understandings, however, their argumentation tends to draw primarily from research and statistical data. This professionalisation of political activism is increasingly used by NGOs in many other countries as well to gain a voice in political debates and legitimise knowledge claims that partly emerge outside and beyond the state structures, as in the case of nuclear power opposition in Europe [52]. It is a kind of activism-expertise that draws its legitimacy

from evidence and sophisticated techno-economic calculations rather than from arguments appealing to normative or emotional rationalities (as visible for instance in the government's politically appealing promises of *buen vivir*).

In the case of the CCS, environmental organisations have been concerned about the local effects the project may have on the flow of the river, its biodiversity, deforestation and the impacts of the transmission lines on the vulnerable Amazonian area, especially the UNESCO Sumaco Biosphere Reserve (interview data, [43,44,48]). They also have criticised the environmental and social impact assessments and consultations for their inadequate implementation, hurried schedule, insufficient local participation, and flawed or outdated background data (interview data). According to some interviewees, however, many NGOs have considered the project's overall impacts relatively limited in comparison to some other mega-dams (interview data). Another factor in this respect has been the lack of indigenous population in the area, and as, for instance, a representative of Acción Ecológica Ecuador mentioned, many NGOs have focused on other hydraulic projects with more direct and excessive impacts on local livelihoods in areas with more indigenous population. In these cases, the influence of the NGOs has been seen as potentially more concrete and effective (interview data).

Currently prevailing concerns relate to the operational capacity of the CCS. NGO leaders criticise the government for overestimating the availability of water especially in the dry season, and the flow estimations are claimed to have been made with inaccurate and historical data (interview data, [43–45,48]). Related to this matter, the future of the San Rafael watershed has raised severe concerns among environmentalists, perhaps most visibly in the calculations of the International Rivers and Save America's Forests (interview data, see also [43,44]). Another issue the NGOs emphasise is the recreational value of the river Coca, which in many official communications has gained little attention.

The characteristics of the environmentalist rhetoric, however, are not only a focus on concrete questions and impacts of the project, but also on the processes of governance, policy negotiations and democracy at a more general level. The government's oppressive policies and the lack of freedom of speech are referred to as delimiting the possibilities for open public dialogue and political influence [interview data]. Many interviewees mentioned that multiple voices and understandings concerning water and technology are often not sufficiently heard because the official communication practices have remained closed, and public consultations have been organised with short notice (interview data). Moreover, the environmentalists criticise the established evaluation practices for their lack of case-sensitivity and sufficient contextual understanding. They highlight the local contexts and the need to develop and refine the assessment procedures in a more detailed, case-sensitive and contextually embedded direction (interview data). Representatives of NGOs have also mentioned the insufficient monitoring practices and the lack of transparency and accountability of the CCS operations as key problems of its governance. Recent studies regarding the impacts of the CCS also support these claims (e.g., [40,45]).

An interesting finding in the case of the CCS is that the visibility of NGOs in the project's area of influence is nearly non-existent. This raises a question concerning the modes, levels and forums in which expectations and policy visions are articulated, interpreted and contested. Indeed, it seems that many environmental NGOs' operations are largely nationally or internationally oriented, and the debates take place in forums such as informal policy networks, internet-based forums, blogs and other official or unofficial communications. In this sense, the different levels and forums of policy negotiation do not necessarily meet and, therefore, the policy-making and governance processes lack mutual dialogue and multi-level stakeholder interaction. Arguably, the Ecuadorian state-centrist political context is also behind this (see also [28,56]); there has been only limited participatory processes, public debates and political inclusion. This has also been visible in the minimal critical discussion concerning energy policy issues or the CCS in the national media. An important exception is the studies and debates steered by an international science-activist network, Foro Recursos Humanos (RRHH) (see [57]).

4.4. Mundane Expectations and Hopes for Enhanced Local Development

At the local level, expectations concerning water and technology are largely framed by the mundane concerns of everyday life. These perspectives highlight the concrete implications that the CCS may have in the riverside villages and the lives of the local inhabitants (Table 1). In general, the local inhabitants perceive the direct environmental and socio-political impacts on their livelihoods as relatively small (interview data). Most agricultural activities focus on products that are not highly dependent on the river and, thus, the impact of the CCS in this respect is commonly seen as limited (interview data). In terms of environmental impacts, the local residents expect the government and the CCS to take care of necessary environmental protection measures such as reforestation programs and preventing the contamination of the available water resources (interview data).

Perhaps partly affected by the government's strong policy rhetoric and the promises of the 2008 Constitution, many local residents also believe that the level of environmental protection is sufficient, and the CCS causes no major harm. One issue, however, is the project's impact on the biodiversity and species in the river, particularly in terms of substantially reduced possibilities for fisheries. The residents perceive this as having a direct negative effect on fishermen's income opportunities and the recreational value of Coca (interview data), which confirms the concerns some NGOs have anticipated. The impact on the river's natural flow has in turn raised local concerns about the watershed San Rafael and its implications for eco-tourism in the area. According to a guide of the San Rafael, the dewatering (estimated to amount to about 60% of its flow) is further accompanied by the deforestation of some parts of the UNESCO natural reserve, and uncertainty regarding the project's degree of commitment remains in terms of mitigating these impacts (interview data). At the same time, however, some interviewees saw the project itself as a potential tourist attraction, thereby indirectly benefitting the whole area because of its promotional value and the expected international visibility as a flagship project of the new national energy policy.

Some degree of change has taken place since the inauguration of the project in 2016. While, in the beginning, the hegemony of the government's promising rhetoric was locally quite visible, more recently (as of October 2017), the perceptions among the residents have also entailed more critical aspects. The expectations they had towards the benefits of the project faded to some extent, especially in terms of the distribution of benefits and compensation between different parts of the area (interview data). Some communities are seen to have benefitted from the project more than others, and in some areas improvements in schooling and health care in particular are still pending (interview data, [45]). A representative of local administration in Gonzalo Pizarro also shared this viewpoint (interview data). Another issue is the CCS's local employment effects. According to a recent study, the high expectations generated during the public consultation process were not fulfilled because the project hired approximately only 40% instead of the promised 70% of its labour force from the area of impact, mainly including jobs for unskilled labour (45). Yet, there have been varying estimations on this matter and, thus, it remains somewhat unclear who, and to what extent, has benefitted from the added employment.

However, many local residents and administrative staff have regarded the increased availability of potable water, which had previously been a substantial problem in some parts of the area, as a major improvement. In addition, an enhanced system of and access to the electricity supply are generally seen as positive developmental impacts of the CCS in the area (interview data). Some local inhabitants, however, argue that a more secure supply of electricity has been accompanied by increased electricity prices and, therefore, their expectations concerning the benefits of the CCS have not been fully met. The government's dominant rhetoric and the state-led governing rationale have also been experienced as delimiting opportunities for political influence. In this respect, the historically and culturally constituted skepticism and lack of trust towards public authorities still seems to prevail in local contexts.

At the same time, the major concerns at the local level have remained largely unchanged; they include everyday matters such as sustained income, the availability of jobs, the functioning of the

electricity system and overall living conditions (interview data). One issue has been the loss of jobs after the completion of the construction work, which has directly impacted the lives of many local villagers (interview data). Related to this matter is that a majority of the Chinese and Ecuadorian project workers have left the area, which has had multiple direct and indirect impacts on the local economy and society. A socio-cultural impact has also been the intercultural interactions and cultural diffusion of the Chinese and Ecuadorians; many new multicultural families have formed in the area (interview data).

Unlike some other more confrontational projects (see [7,58–63] in this volume) that may have substantial, direct impacts on local livelihoods, however, municipal authorities and local residents have claimed that the CCS has not generated organised opposition or major criticism in the area (interview data). There seems to be neither major interest in nor substantial concerns regarding the project beyond mundane expectations related to practical matters (interview data). One reason for this might be that the project has only limited direct influence on everyday lives in the surrounding villages as their livelihoods are typically not directly dependent on the river. Another issue is that the government's rhetoric has been largely hegemonised through mechanisms of necessitation and naturalisation, i.e., de-politicising arguments visible in several government documents claiming that the project is 'emblematic', 'neutral' and a 'necessity' for national economic development and energy policy. Moreover, symbolic actions, such as Correa's personal visit to the area and the municipalities during the construction phase, may have contributed to local acceptance of the project (interview data).

5. Conclusions: Expectations Embedded in Diverging Socio-Technical Imaginaries

Socio-technical imaginaries are related to the notion of imagined communities [21], which, in this case, are largely defined by sustainable energy futures and hopes for technology's ability to generate economic prosperity and social well-being. Official imaginaries of national energy policy in general and the CCS in particular are constructed around the rhetoric of progress, economic development and national competence. In this context of state paternalism combined with elements of neo-liberal rationality, the official rhetoric constructs a particular national imagined community wherein the context and rules of policy negotiation are strongly defined by the state. As the findings indicate, this form of public reasoning implies that the modes and spheres of political participation and influence are essentially conditioned by the dominant policy vision, which determines not only the desired energy future of the country but also the rationales for citizenship, identity and participation.

The rather hopeful political visions evident in the government's rhetoric concerning water and technology have indeed been influential in legitimising the CCS. Expectations emerging around substantial national economic benefits accompanied by visions of enhanced energy security and self-sufficiency, climate-friendliness and improved local well-being have been appealing arguments also at the local level. In this way, the dominant rhetoric has been strategically used to provide political acceptability and public legitimacy for the government's policy program. At some points, however, the dominant socio-technical imaginaries have been confronted by local perceptions of failed political promises, NGOs' views regarding misleading information and secretive policymaking practices, as well as regional authorities' and residents' concerns over future regional development.

The four ways of constructing meanings for water and technology (instrumental, functionalist-pragmatic, with intrinsic value and symbolic) discussed in this article illustrate how various expectations and counter-expectations generate competing, and at some points confronting, visions concerning energy futures. They also entail varying understandings concerning *buen vivir* and good society. The instrumental views emphasise economic growth, GDP development and electricity export as key elements of *buen vivir* as they are seen to not only contribute to economic goals but also enable and support national well-being and prosperity. The functionalist-pragmatic perceptions highlight climate benefits, biodiversity and social progress through enhanced employment and energy supply as well as technological regulation and multiple uses of water, thereby pointing to social and environmental aspects and control over technology. The expectations addressing an intrinsic value

to water and technology instead highlight the importance of recognising cultural aspects and local knowledge on the one hand, and including ideas of modernisation and progress into the core of *buen vivir* on the other hand. Finally, the symbolic understandings point to *buen vivir* as inherently mediated by technology. They emphasise the importance of techno-economic and industrial competence in boosting system-level transitions, controlling natural resources and integrating various policy goals.

At a more general level, the findings illustrate the performativity and the contextual embeddedness of expectations. The results show how the current political climate emphasising the urgency of climate policy actions, the replacement of fossil fuels by renewable energy sources, and concerns over energy supply and security have provided strong justifications for the national policy approach. Moreover, the rhetoric of sustainable transitions and green growth has provided further legitimisation for these arguments, as socio-technical transitions and renewable energy production are seen as needed in order to achieve more sustainable futures and economic prosperity. The official rhetoric has also presented the CCS as a matter of national security and sovereignty, a ‘necessity’ for broader developmental and economic objectives, in this way de-politicising and neutralising the national policy approach. The generation of economic abundance, environmental protection and social well-being have been politically appealing promises in an age of uncertainty, politico-economic turbulence and new global fears [64,65]. This shows how the official rhetoric has strategically employed elements from both, national (and local) policy concerns and international climate policy, in justifying the government’s policy program. It also has been nearly hegemonised, given the lack of opposition and the very limited opportunities for counter-arguments and alternative rationalities to gain credibility or recognition.

At some point, however, locally embedded concerns have raised critical questions with repercussions at various levels and across sectoral policies. These include, for instance, the connections between hydraulic development and extractive industries in relation to regional socio-economic development and impacts; the reliance of Ecuador on foreign (Chinese) investment and its relation to new governance arrangements; and the potential of sustainable socio-technical transitions in a context in which some people’s basic needs are yet not fulfilled. These concerns highlight policy challenges that have so far continued to gain somewhat little attention but might provide important entries for future research, also in other countries. In addition, it can be questioned how and to what extent divergent expectations, knowledges and future imaginaries could be effectively integrated into national decision-making, and what kinds of policymaking structures and forums would allow the generation of democratic innovations for more transparent policy-making and governance that might emerge from more open public debates and co-construction of knowledge. These findings provide a basis for reflection for further analyses concerning the politics, legitimacy and acceptability of energy transitions in other contexts as well. Theoretically, they illustrate the importance of expectations not only in constructing meanings but also in shaping politics and energy futures.

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