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The role of metrics in the governance of the water-energy-food nexus within the European Commission

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ABSTRACT

Recent years have witnessed a growing interest in the water-energy-food (WEF) nexus in both academia and policy. This concept draws attention to the link between different environmental and societal domains, and potentially entails substantive shifts in governance processes. As a consequence, policy-makers and scientists have started to develop metrics to make these interactions and 'trade-offs' visible. However, it is unknown if current framings of the nexus and relevant quantified metrics either reinforce or challenge existing governance structures.

This paper explores relationships between framings of the nexus, metrics and models of governance based on discussions with staff within the European Commission. Although narratives around the need for new metrics are situated in a conventional script about the use of evidence to change policy, our data indicate processes of co-production, by which the use (or non-use) of any new metrics is dependent on existing institutional practices; and will reflect dominant political orderings. In doing so we provide a critical analysis of the role of metrics in environmental governance, and direct attention to the discursive, institutional and political arrangements in which they are embedded and with which they are co-constitutive. Focusing on the cultural and institutional settings in which they are established and used, our study suggests that the question of metrics in the water-energy-food nexus needs to be explored as a problem of establishing a legitimate policy objective in the European Commission and EU policy-making more broadly.

1. Introduction: nexus as a governance problem

In recent years we have witnessed a growing interest in the water-energy-food (WEF) nexus in both academia and policy. The term gained prominence in the World Economic Forum in 2008 as a link between environmental concerns and economic growth and has been further developed in the Bonn 2011 Nexus conference "The Water, Energy and Food Security Nexus – Solutions for the Green Economy". Subsequently the WEF nexus also gained traction within European policy making and is addressed in European policy documents, such as the Blueprint to Safeguard Europe's Water Resources (European Commission, 2012) and in an ongoing flagship project of the European Commission's Joint Research Centre which addresses the so-called 'water-energy-food-ecosystem nexus'.[1] 'Nexus thinking' or a 'nexus perspective' acknowledges planetary boundaries and calls for a more sustainable use of the Earth's resources. To that end, highlighting the water-energy-food nexus means directing attention to the interrelated pressures created by agricultural production, water use, and energy production and consumption practices. Thus, policy-makers and scientists have started to develop metrics to make these interactions and 'trade-offs' visible and measurable.

Whilst much discussion on 'the nexus' focuses on quantifying nexus relations (Shannak et al., 2018; Endo et al., 2017; Cabello et al., 2019), a smaller body of literature has highlighted the need to address the institutional, political and cultural dimensions of nexus policy-making (Cairns and Krzywoszynska. 2016; Stirling, 2015). In this understanding, the epistemic challenges of understanding these complex and non-linear interactions need to be addressed together with the policy

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[1] https://setis.ec.europa.eu/setis-reports/setis-magazine/relevance-of-water-energy-nexus-eu-policies/water-energy-food. Accessed November 14, 2018.

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problems of governing a transition to more sustainable modes of production and consumption (Giampietro et al., 2017). Such analysts have pointed out that one reason for the prominence of the term is that its interpretation by governing communities can reinforce a managerial view on environmental issues (Leese and Meisch, 2015) that focuses on motifs of 'efficiency' and 'win-win' logics thereby "obscuring the political and economic drivers of unsustainable outcomes" (Cairns and Krzywoszynska, 2016, 166). In the words of Stirling: "(…) a framing of 'the Nexus' as if it were a single discrete self-evident problem susceptible to primarily science-based solutions, is itself a clear indication of essentially political values. Ideas that there exist single technological 'solutions' to such massive, complex, pervasive and intensively-interlinked societal challenges, are highly instrumental simplifications." (Stirling, 2015, 3). As such there is a clear need to better understand the nexus as a governance problem.

In this paper we explore nexus framings and their implications within European policy-making, by examining how European Commission staff frame the nexus and relevant metrics. While most studies highlight epistemological problems or conceptual challenges, our data indicate that there are institutional logics and mechanisms that might hinder an implementation of nexus thinking and governance. These can make it difficult to establish the water-energy-food nexus as a legitimate policy problem. Therefore, we argue that it is necessary to explore institutionally established narratives about making environmental concerns such as the nexus visible and relevant.

The paper proceeds as follows: in the first section of the paper we situate the nexus debate within a broader conceptual frame that allows us to understand the call for nexus metrics in the context of a broader debate about the role of quantification in governance. We then highlight the role of metrics in attempts to build and maintain governance legitimacy. After describing the methodological approach, in the empirical part of this paper we summarise how the participants described existing quantification processes; their understandings of the nexus concept; the discussion of nexus metrics as part of a script regarding use of evidence for policy and the counter storyline of the difficulties of using evidence to reframe policy perspectives. This leads into a discussion of the warning parables about the issues involved with new metrics and finally a discussion about how nexus metrics might fit, or disrupt, existing quantification processes. We argue that the water-energy-food nexus needs to be explored as a problem of establishing a legitimate policy objective in the particular institutional culture of the European Commission and EU policy-making more broadly. Therefore, we contribute to debates that illustrate that the nexus is not just a technical issue, and to debates on the politics of quantification that are interested in how metrics are used to stabilise or disrupt institutions.

2. Literature review: perspectives on the role of quantification in governance

The idea of the nexus can direct attention to various types of interlinkages, including between political areas: additionally, institutional arrangements may shape understandings of the nexus itself and the metrics considered relevant for making it visible and governable. To understand potential relationships between metrics and governance, we draw on existing literature on quantification in governance. We briefly summarise this below and we then highlight a tension in ideas of quantification and governance: metrics can play a dual role of stabilizing existing institutional arrangements yet may also become instrumental in challenging these.

There is a long history of debate on the role of quantified information in governance. The widespread use and general popularity of quantification in governance processes is usually attributed to the ability of numbers to travel and thus to function as a technology that allows for governing and knowing at a distance (Scott, 1998). Achieving this ability, however, is not a trivial task. Quantification requires considerable work and relies on previously established infrastructures of knowing. This includes actual technical and administrative infrastructures that allow for data collection and processing, but also refers to the development of methods and the training of a skilled work-force. However, once such 'machineries' (Edwards, 2010) are put in place, they become not only quite stable and 'sticky' (Waylen et al., 2015), but also reactive and start intervening in societal orderings: e.g. setting up national surveys became consequential for how we think about and act as nations (Porter, 1995). In a similar manner, environmental metrics constitute particular natures and modes of environmental governance (Turnhout et al., 2007). This means that metrics such as rankings, quantified targets or indicators can be regarded not only as epistemic mechanisms for generating knowledge about the world, but also as a particular mode of governance (Rottenburg et al., 2015). They are thus a tool of 'disciplining' (Foucault, 1981 [1969]) in the sense that they enable bureaucracies to 'see' and thus create governable objects. Importantly, numbers as quantified evidence give a sense of authority and legitimacy as they correspond to an ideal of 'mechanized objectivity' (Daston, 1995; Daston and Galison, 1992; Galison, 1998; Porter, 1995). Historians of science have long pointed to the importance of trust in the establishment and maintenance of societal order (Shapin and Schaffer, 1985). Starting with trust in gentlemen-scientists, this trust has now shifted to standardized methods and automated data gathering and processing through what is currently discussed as 'big data' (Rieder and Simon, 2016, 2017). The use of quantification and governance is thus closely entwined with questions of trust and legitimacy. In a climate of mistrust (Fairbrother, 2017) it is thus no surprise that numbers – such as quantified indicators – may take on the role of a mechanism to defend the legitimacy of governance actors and arrangements.

Understanding quantification as a mode of nexus governance through the lens of a sociology of quantification thus emphasises "how quantitative authority is accomplished and mobilized, how it gets built into institutions, circulates, and creates enduring structures that shape and constrain cognition and behaviour." (Espeland and Stevens, 2008, 419). This idea of mutual shaping of the institutional, epistemic and social orders is contained within the idiom of 'co-production' (Jasanoff, 2004), in which "co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it." (Jasanoff, 2004, 2) This highlights the need to understand how governing bodies are able to 'see' their objects (Scott, 1998; Law, 2009; Asdal, 2008) and to question how quantitative evidence is interwoven with the particular institutional sites in which these discussions take place. As Jasanoff stresses, what and how we know about the world is closely tied "to our sense of what we can do about it, as well as to the felt legitimacy of specific actors, instruments and courses of action." (Jasanoff, 2004: 14). In other words, quantification practices such as the development of indicators or metrics, as particular ways of knowing, are intimately entwined with institutional arrangements and social orders. Once established, they can thus become instrumental in sustaining the legitimacy of current modes of governance.

Questions of legitimacy are also highlighted by the neo-institutionalist literature. This builds on the insight that organizations depend on legitimacy to acquire the resources necessary to become more resilient, and so focuses on how legitimacy is acquired and maintained in organizations and governance settings (Suchman, 1995, Wolf and Gosh, 2019 forthcoming, Kraft and Wolf, 2016). For example (Kraft and Wolf, 2016) argue that particular governance arrangements shape and re-shape organizations' identities and legitimacy strategies, strategies that were also affected by the biophysical characteristics of specific socioecological domains. From this perspective, change can be promoted by creating new accountability relations. This might be achieved by introducing new metrics that go beyond managerial values focused on cost-effectiveness and efficiency. Such metrics, according to the neo-institutionalist literature, might help create new accountability relations and legitimacy for changes in governance arrangements.

(Turnhout et al., 2015).

While there is a wide literature on quantification practices critiquing simplistic understanding of the policy process as linear, rational and evidence based (e.g. Davoudi, 2006; Head, 2010; Waylen and Young, 2014), there is considerably less work exploring how actors' models of the relation of metrics, quantification and governance relate to particular institutional arrangements and scripts of knowledge transfer and evidence-based policy (and why they persist). Bringing together literatures on co-production and neo-institutionalism highlights an urgent need to question how particular ideas of quantification become inscribed in and stabilized through institutional arrangements, and how they contribute to stabilizing these arrangements – or are conversely used in attempts to disrupt them. Different metrics tend to "reflect the social and cultural worlds of the actors and organizations that create them and the regimes of power within which they are formed" (Merry, 2016, 4f.). They incorporate assumptions, visions and interests of those involved in their production and use. In this paper we are thus not primarily interested in the particular metrics and processes of quantification themselves, but in the institutional settings and shared cultural understandings on the basis of which they are established and used; and in how they might become instrumental either in stabilizing currently dominant institutional scripts or in challenging them. Even though 'the nexus' is currently of great interest (Cairns and Krzywoszynska 2016, Endo et al., 2017; Shannak et al., 2018) and potentially entails substantial shifts in understanding and governance (Howarth and Monasterolo, 2016; Leese and Meisch, 2015; Stirling, 2015) these issues have not been explored yet. In this paper we address this gap by exploring the narratives of staff in the European Commission and other EU bodies.

3. Research questions

We focus on understanding the relationship between framings of nexus governance and the role of metrics in policy-making. Given that metrics can play a role in either stabilizing or challenging how policy makers represent the world, we consider how a 'nexus' perspective may require new metrics and whether such metrics will provide a paradigm shift or perpetuate managerialist approaches. By eliciting and analysing the narratives of European policy-makers, we ask the following questions:

- What are the understandings of nexus and its relation to governance?
- How is quantified evidence and metrics referred to in relation to nexus governance?
- What is the role of quantification in either stabilizing existing siloed governance arrangements or in the process of opening up spaces for nexus governance?

We will now briefly describe our methodological approach before presenting the empirical findings, a discussion of what they might mean for the overall themes of this paper and a final conclusion.

4. Material and methods: analysing quantification through 'narrative'

Our study explores the role of metrics in nexus governance within the European Commission. The Commission is the administration for the European Parliament and Council of Europe, and is responsible for making, implementing, evaluating and enforcing cross-European policies that are mandatory for the 28 member states in the current European Union. The Commission is organised into 33 Directorate-Generals (DGs -departments), each with a separate, specific and self-contained policy area, giving rise to the idea of 'policy silos' (Atkinson, 2002; Jordan and Halpin, 2006; Turnpenny et al., 2008), a concept to which we will return later in the paper. Our primary focus was on the views and experiences of the staff within the Commission although we are aware that there are many other actors (Parliamentarians, Lobby groups, environmental NGOs) that will influence discourse coalitions around the WEF nexus.

Our empirical data is based on conversations in interviews and focus group discussions. Such an explorative discursive approach is appropriate for exploring a poorly understood and complex subject, and to exploring narrative processes of legitimation and justification that may not be accessible in formal statements and public documents.

The analysis presented in the empirical part of this paper builds on 28 interviews with 32 actors from different European Commission DGs, members of European Parliament and its Science and Technology Options Assessment (STOA) as well as from the European Environment Agency (EEA). Additionally a focus group discussion was organised, in which a subset of the interviewees were invited to discuss preliminary outcomes of the interviews. The data collected for this paper was designed to support a 'Quantitative Story Telling (QST)' process.[2] For this paper, however, we focus only on participants' accounts that relate to nexus governance and the role of metrics.

The selection of interviewees followed a rough stakeholder analysis to identify the policy DGs working on the above policies that were relevant for the water-energy-food nexus and the departments working on these issues within these DGs. We then searched for individual staff and/or contacted of the relevant 'Heads of Unit' to request meetings. Additionally we followed a snowballing approach, by asking for further relevant contacts from those we contacted, and during interviews themselves. Although we took a purposive approach to our contacts, our interviewees were self-selecting so may not represent the full spectrum of views on, interests in and knowledge of the WEF nexus in these DGs.

The interviews were semi-structured and sought to elicit the main aspects of nexus-related policy areas within the European Commission. We used an interview guide that addressed the main issues we wanted to discuss with our interviewees: first, we talked about the historical development and recent changes of particular policy documents. Then we moved to current issues and challenges. This usually initiated conversations about both policy development and institutional challenges. Finally we explored the notion of the nexus and if and how this relates to interviewees' work. The interview guide was constructed based on a prior analysis of the relevant policy documents and, when it came to challenges and nexus-related questions, on the literature on the politics of quantification. It should be acknowledged that our interviewees understood we were seeking narratives about nexus in policy making so the data produced from these interviews will be influenced by this framing; bringing some aspects to the fore and potentially excluding others.

The data were organised using the NVIVO software and team coded by the authors. The data were analysed using a coding structure that was developed on the basis of the interview guide, but focused on understandings of the nexus concept, the use of metrics and narrations about different kinds of evidence needed at the science-policy interface especially in regard to so-called nexus challenges. A framework matrix (Srivastava and Thomson, 2009) was then used to compare and contrast the findings between individuals and their relevant policy domains or settings within the DG. This framework was further developed in an iterative process. Although our analysis focussed on actors' accounts and roles, the presentation of the data remains at a more abstract level to ensure individuals remain anonymous. Our research design was

[2] This process was conducted for five policy areas considered central to the governance of the WEF nexus within Europe: Common Agricultural Policy, Circular Economy, Energy, Natura 2000 and Water Framework Directive. QST is an iterative participatory modelling approach that quantifies narratives using a social metabolism approach: it is not the focus of this paper but is further described by Kovacic (2018) or Matthews et al. (2017).

approved by the Research Ethics Committee of the James Hutton Institute, and all data collection and processing was carried out in accordance with European GDPR and related national laws.

The analysis of the interview data is guided by the concept of 'narratives': in its basic understanding narratives describe a (mostly retrospective) sequential ordering of events constituting particular temporal and spatial structures and establishing a set of subject positions with particular rationales, often together with a causal relationship between a problem and a solution. This links to the insight that the relationship between scientific evidence and policy-making is "neither straightforward nor guaranteed" (Gluckman, 2016, 969), but rather a 'messy' process in which scientific evidence is only one of many inputs (Porter, 1995; Stirling, 2015). Working with narratives thus is a way to analyse the informal side of governance (Hajer, 2006; Turnhout et al., 2015) as well as for moving beyond the individual actors and their 'opinions' and to instead explore institutionally established and grounded ways of sense-making. Analysing narratives through interview and focus group data for us is a way to explore the "cultural frameworks they had available to think about a problem" (Lamont and Swidler, 2014, 161). This approach sensitizes us to our interviewees' perception of their own position in relation to institutional entities within the European Commission (and beyond). This is especially useful since our focus is not so much on the intricacies of particular metrics themselves, but on the cultural and institutional settings in which they are established and used.

For our analysis we draw inspiration from a distinction made in Leith et al. (2014) between scripts, parables and story lines. A script is "a culturally shared expression, story or common line of argument, or an expected unfolding of events, that is deemed to be appropriate or to be expected in a particular socially defined context and that provide a rationale or justification for a particular issue or course of action" (Vanclay and Enticott, 2011, 260, cit. in Leith et al., 2014). Parables are normative stories that often appear in the form of cautionary tales about potential consequences of inappropriate action. And finally, story lines are narratives that describe contrasting positions on particular issues. These can be counter narratives as they are sometimes expressed in opposition to currently stabilized scripts or parables. These concepts are a useful way to distinguish established and stabilized narratives (scripts) from what can be called counter narratives (story lines). In that sense this can be a useful conceptual frame to understand how narratives are used in governance and to illustrate the tension we outlined in the literature review, between how metrics can stabilise existing institutional orders (scripts and parables) or open up alternative arrangements (storylines).

5. Results

The empirical results begin by briefly explaining the institutional spaces in which quantified evidence or metrics are employed within the Commission, illustrating the co-production perspective on quantification in governance. The second section considers how nexus metrics challenge dominant scripts regarding single issue policy making within the Commission, illustrating that if the WEF nexus is a policy problem in need of governing, there is insufficient evidence at present (neo-institutionalist perspective). The parables employed in illustrating particular epistemic challenges involved are then discussed before turning to look at how these issues might come together in within impact assessment processes. Finally, we turn to explore how one institutional arena, recommended as a potential home for nexus metrics, and consider what was said about how these institutional arrangements could help to open up new spaces for governance. Throughout the findings is the thread that illustrates how metrics provide an insight into the negotiation of scientific and organizational orders of actors involved in nexus policy-making.

5.1. Quantification in the European Commission

This section describes the existing institutional structure and the role of quantification within this institutional order. Our findings can be located within the wider discussions of how modern bureaucracies portray policy making as rational, logic, transparent and based on best available evidence. We would argue that this evidence-based-policy narrative is a dominant script within the European Commission, with many interviewees describing the importance of using science to better understand nexus-type interactions to make or amend policy. However, discussions about the issues with methodology can be seen as parables or cautionary tales, which highlight the difficulties involved in trying to use quantified evidence in policy making.

Discussions on evidence and targets appeared to be of particular importance in the context of WEF nexus policy making. Interviewees and focus group participants directed our attention to the role of quantification in policy making processes and confirmed that it is considered essential for the policy-making processes of the Commission:

> "[T]he Commission has a vision on how evidence, good evidence, should look like, and this is quantitative"

In addition to stories about target-setting, monitoring and control we encountered a number of less prominent accounts in regard to the purpose of this kind of evidence. Some interviewees talked about the need for quantification as a motivating driver for change. In particular, quantified targets, if accepted as appropriate for the context, were seen as useful motivations for member states to take action – particularly in the case of renewable energy or the circular economy.

> "[N]ow it had one element that caught everyone's attention which was the overall resource efficiency target"

This is clearly a top-down idea of change initiated by the European Commission and implemented at Member State level. Naturally, there were also references to resistance to such targets when they challenged vested interests (e.g. mining in the case of renewables) or when they were poorly adapted to local conditions (e.g. good ecological status of water in south-east member states). Furthermore, some believed that a lack of targets or quantified metrics can be a deliberate institutional arrangement – for positive reasons (e.g. to encourage innovative approaches) or more negative (e.g. to obscure the effects of a policy). Finally, some participants pointed out existing metrics that they perceive as unhelpful such as gross domestic product, the dominance of which obscures many wider aspects of societal wellbeing.

These findings confirm that quantification is not an objective process or passive by-product of policy making. Instead, different metrics are actively enrolled in building stable coalitions of interests and outcomes. It is important to note that accounts such as these build on an implicit understanding of metrics, quantified targets and indicators in these accounts, as a particular mode of governance.

Within such framings of metrics we identify at least two different narratives about the WEF nexus in our data: First and very much in line with the idiom of evidence-based governance, the nexus is described as set of physical interlinkages that need to be researched and made visible.

> "When you work on nexus, when you work on policy that/ where you have to tackle food production in one way, food safety but also environment, delivery of ecosystem services for the society, there are clearly some trade-offs and there are some contradictions in what do you want to do and where do you want to go?"

> "That's why I say/ I mentioned, the nexus is really important to/ I would link it with the system approach and to understand the complexity, the global complexity."

Accounts of this type would describe the nexus as a way to address a set of problems that are currently not properly measured. It is described e.g. as a 'powerful concept' that can 'reveal' 'unintended consequences or trade-offs' over different levels of a system. Such accounts would include for example approaches like Integrated Water Resource Management (IWRM) and life cycle analysis, or concepts such as systems thinking or trade-offs. Second, the nexus was framed as a governance issue, requiring far greater interaction between different policy making communities who are used to working within their own policy 'silos'. In these accounts, the approach is less focussed on what interlinkages need to be quantified and measured, but how these metrics are used to open up the policy debates in order to ensure more attention is paid to human-environmental interactions.

Different framings of the nexus thus relate to corresponding conceptions of the role of quantification: when the nexus is framed as an epistemic problem, this corresponds to a perspective that takes current institutional arrangements and an ethos of evidence-based policy as granted (echoing a co-productionist perspective that stresses the interdependence of scientific, institutional and natural orders); however, when the nexus is described as a governance problem, this usually resonates with a focus on challenging current institutional orders (what we summarized as neo-institutionalist perspective). The next sections we will dive more deeply into this part of the tension.

5.2. Challenging scripts and the need for 'eye-opening' evidence

Our data also showed understandings of quantification as a means for opening-up or challenge existing institutional arrangements. Interviewees who wanted to advance the concept believed evidence is needed for arguments about challenging the status quo or stabilized narratives in the form of scripts. Interviewees would talk about their need for input that shows how 'business as usual' is no longer possible, and 'more' needs to be done.

> "I think what, what it would be important is to contribute to the, to the, to the evidence that we cannot continue business as usual, because if you look at the, the prospects of the evolution of societies of demands of climate change in all this complex world that we are living in, if we continue business as usual with silo approaches to our objectives, we will, we will lock unsustainable practices more and more, and we will/ in the long term, it will be counter-productive. So anything that contributes to the reflection that we need to operate in these areas with a change of, of mind and attitude upstream, attitude also towards other/ these other legitimate objectives, I think this will, this will be very helpful."

These arguments are not easy to be made; they can be understood as storylines in the sense of that they are counter-narratives that necessitate particular grounding and enforcement. Interviewees often appreciated the difficulties in opening up a space to challenge the consensus and start to ask new questions.

Interviewees would stress how they need 'eye-opening evidence' that is needed so institutions can face the realities in terms of environmental and economic pressure that is currently masked by existing scripts in common use in their policy domains.

Such scripts would include e.g. narratives and justifications for keeping beef production local while it's seemingly no problem to import phones or fridges.

> "I was hearing 2 days ago in a workshop in the Parliament, in relation to beef, if we stop producing beef it would be produced by someone else, it would be transported across the world, that's crazy! Yeah. But we do that with … fridges, we do that with uh … telephones"

These critiques of scripts are common when interviewees build arguments for more interlinked policies, which usually mean more environmentally sensitive policies. Hence, quotes like these come from interviewees working on environmental or certain agricultural issues. This points to the fact that nexus policy making may challenge existing, powerful, policy narratives, such as for example the need to maintain farm subsidies, that are maintained by powerful policy DGs.

This need for 'eye-opening' evidence therefore links potential solutions for environmental problems to changing ways of working, taken for granted ways of thinking and doing things within European policy making. Parables are used to explain why such changes might be difficult. One interviewee described that - using a biological metaphor - as 'neural pathways'.

> "R: I mean … ask them to ask this question because in the US, the states that are not farming states they ask the farming states what do you deliver, what do you do? What do I tell the people from Chicago why should I finance your farming in Iowa? But in Europe this discussion just doesn't take place. I'm not saying you shouldn't fund farming for farmers or whatever but you need to find ways to break these … I don't know – I: Assumptions. R: Assumptions. It's like a neural pathway, that goes like this and then you turn the corner like that because you always turn the corner like that. And nobody is like calling on you to say like 'why?'"

Another one used the analogy of 'riding a bike' for his work to stress that there is little room to think about what people are doing when one is busy and focussed on immediate priorities.

> "Because the problem that we are working like a/ riding bike, looking at this, is we don't have time to, to open the horizon. So for me, what is needed is eye, eye-opening, and eye opening means work in anticipation to identify really what are the, the potential problems. So if indeed you are identifying issues related to the nexus water, water, water, food, energy, you have, you have to get a, a series of, of question marks."

What becomes visible in these accounts is that the nexus is not framed as a cognitive issue, but rather as problem of institutional arrangements and culturally shared understandings of how things are done. For challenging this status quo, however, our interviewees ask for novel forms of quantified knowledge and in doing so reinforce this particular mode of governance. Thus, while this mode of governance itself is hardly ever challenged, our interviewees mention a number of more concrete issues with it, which we will turn to in the next section.

5.3. Metrics and the epistemic challenges of nexus governance

This section illustrates some examples where these tensions between reinforcing or contesting the institutional order are played out in discussions about epistemic challenges of quantifying nexus relations. In our conversations with EU staff they were most visible in discussions about different indicators. Interviewees for example described a problem of 'convertibility' of different indicators:

> "Our indicators read like number of hectares contributing to this and that. While their indicator is in terms of CO2 saved. They're not necessarily immediately convertible and even if you can have some further work to convert them it's not really immediately clear why don't you do the simple thing of aligning indicators so that you know what you did with this, this, and that bit of policy?"

These indicators are being developed within changing institutional arrangements drawing on different resources. There is a lot of work on indicators that focuses on interlinkages, we were told, but nothing that has "*gotten broad awareness*".

> "And then you also need to find a way to actually go beyond the indicators, because what you want to, to describe is how the policies interlink. Here we're coming back to interlinkages and explain actually the, the trends and then relate it back to the effectiveness of our action. But this is all still work in progress, and so we'll see."

'Aligning indicators' is not only a problem of methodology, but also a matter of where they come from institutionally and what they were initially intended to do. These interlinkages may lead to systematically produced ignorance that is not easy to tackle. In these attempts our interviewees are facing something of a ‘chicken-egg’ problem: there is a perceived need for additional data about physical interlinkages in the interviews. To receive the mandate to produce this data however, evidence is needed to show that the nexus is an actual problem, i.e. it must be established as a legitimate policy objective in its own right. The data show how the construction and use of metrics is not just a technical problem. Rather, this needs to be described as a problem of use of evidence and metrics in institutions and policy making. We now turn briefly to an institutional setting in which metrics could be used in eye-opening ways to help draw attention to the nexus, understood either as biophysical interlinkages or as a governance problem.

5.4. Role of metrics in moving from siloed governance to nexus governance

In this section, we focus on a European Commission procedure using quantified evidence that interviewees suggested had potential to be used to open up institutional arrangements for the WEF nexus: impact assessments. Impact assessments refer to established mechanisms that the European Commission uses during the preparation of legislative proposals, which are then assessed by the Council of Europe and the European Parliament. As such they are established evaluation procedures, which are required by the European Commission during the preparation phase of new law proposals.

Many interviewees felt the obligatory impact assessments were a potential niche to overturn scripts and advance WEF nexus storylines. However, they also talk about a number of problems with this especially with regard to the nexus, such as data availability and commensurability of different data sets. For example, interviewees discuss problems with evidence for impact assessments such as the lack of generalizable and reliable ecosystem service indicators. The data suggest that reporting on systemic nexus issues is difficult, partly as there is a lack of EU wide, long-term credible data sets that cover the full system. Whilst many data sets and indicators exist, they are not always suitable or sufficiently extensive to conform to the impact assessment procedures.

In addition to data availability some interviewees also addressed the issue of data pedigrees and a related inertia when it comes to creating new metrics. As we have described in the previous sections, a perceived shortcoming of current ways of measurement is that interlinkages are not being captured by the indicators in use. To remedy this shortcoming new metrics need to be developed or built from pre-established materials respectively. However, interviewees point out severe problems with the need to rely on already existing indicators such as the perpetuation of existing blind spots:

> “I mean, for many of the indicators, we can actually take them from things like the resource efficiency scoreboard, the raw materials scoreboard, the eco(inc.) scoreboard so I think we can pick things here and there. But one or two are simply nowhere because there were issues that came in sideways that were not there before. The example is food waste, for instance, where a methodology and/ a common methodology and a common indicator doesn't exist.”

Apart from such more technical considerations, the potential of impact assessments to open up more nexus thinking is hampered by epistemic and institutional misfits within the impact assessment process:

> “So, you discover that your colleagues in another area are doing something which is more or less compatible, then it's simply a matter of sitting down and to find a way to interact, but sometimes you discover that in terms of policy there could be a completely … complete split, or even … long term vision which are clearly opposite, so it's not a matter of technicalities. Our … are our models compatible with another area? This is not a point of being compatible, it is a point of long-term vision. And this is challenging because … you know … being part of a huge institution.”

This quote addresses a fundamental problem of misaligned visions. As the interviewee states, this is not a technicality but a clash of normative frames and premises on which metrics are built. Evidently, this is not something that can be easily resolved by new nexus metrics.

Furthermore, there are a number of temporal tensions in the production and use of quantified evidence. Interviewees describe a disconnect between doing the impact assessment and when evidence becomes available.

> “For example, on the pollination one, very good. It's also because I mean it requires work to do that because … often it's before the results come out of the project are in an article that they are actually needed for the policy. I mean the policy cycle and the science cycles are desynchronized, I mean they are unfortunately not synchronized.”

A further description of the lag effects nicely relates to the impact assessment process to questions of power and how to think about change:

> “So it's a little bit kind of hard yeah to do because of the legislative process, sometimes it will require from the research perspective more time to prove something because I'm sure sometimes things would work. But now you can only model it, you cannot just say that after 2 years we have more butterflies”

What is usually described as a cycle, a notion that implies the idea of smoothly running concerted processes, appears to be a messy process with a number of gaps and lags in the perception of our interviewees. And while accounts like these highlight a number of practical problems when it comes to the task of finding and aligning proper modes of quantifying nexus relations, they also raise broader questions about who has to carry the burden of proof and for which kinds of arguments evidence is required or requested.

However, it is notable how, even in their critique of current metrics, most interviewees still reinforce a traditional model of science policy relations in which science creates evidence which then feeds into the policy-making process to underpin decision making:

> “If you have like 5 options - one of them is status quo, another one is different, for example focused more on environmental aspects - we just want to present what would happen. What would happen with liberalisation for example, we don't have direct payments at all. Nobody wants to pick up this option but then following this Impact Assessment process then the political decisions to be taken.”

This description is one example of how boundaries between the production of evidence or *options* on the one side and the *political decisions* on the other are upheld. As we have shown, this model of evidence in policy-making is visible in stories of interviewees in which they point out a need for more evidence while almost simultaneously talking about all the challenges of using evidence in policy-making. This again questions whether and how new metrics can resolve wider political and institutional struggles about knowledge-in-use.

Thus, we seem to be stuck with the chicken-and-egg conundrum, whereby new nexus metrics are sought to open up institutional space like impact assessments, either to make systemic interactions and their bio-physical impacts more visible, or to highlight and legitimate policy making across policy silos. However, the ability to develop and use any such metrics is constrained by challenges in how evidence in impact assessments is utilized.

Such accounts require us to take a more critical stance towards the nexus and point to the potentially system affirmative effects of the concept itself. Focusing on the nexus, so the argument runs, may lead to an urge to consider everything at once instead of making decisions. To counter these problems, interviewees propose to more clearly distinguish between the scientific and policy spheres:

> "But sometimes some policy instruments will also respond to everything in once and then it becomes something very blurry and not really efficient […]the systems approach should be research level oriented to policy definitions but then the instruments that you implement at the policy levels should maybe not respond to everything at once"

This resonates with another interviewee's aim to create policies that are 'implementable':

> "No exactly, the things that …. this is also the challenge for the future, because it's easy to … it's easier to define a policy which takes into account the different aspects and the complexities … but then to make this thing happen, or implementable is … a challenge."

This is a cautionary narrative, or parable, about how particular concepts such as the nexus relate to models of governance (through evidence) that mainly maintain system stability, even when the goal of the WEF nexus champions might be to find windows of change. Erecting such neat distinctions, however, leads to a process of de-politicizing politics through the notion of the nexus. Thus our results illustrate how metrics are positioned as means to do both support existing siloed governance arrangements and instrumentalized to stimulate change in institutional arrangements.

Finally, we should acknowledge that participants expressed frustration regarding how impact assessments were sometimes side-lined. For example, they gave instances where the Council of Europe or Parliament had amended commission proposals without considering the evidence generated through the impact assessments undertaken. This illustrates that whilst metrics are a governing technology, they do not overcome political choices.

6. Discussion

As we were able to show, our approach helps to make visible the political and institutional aspects of the nexus, something that has been underdeveloped in the nexus literature to date (Wiegleb and Bruns, 2018).

There are currently few if any suitable metrics to make the nexus visible and amenable to current policy practices within the European Commission. Our data showed that, at first glance, the discussion around metrics and quantification seemed to resonate with dominant narratives about the role and use of evidence in policy making (Funtowicz and Strand 2007). In the participants' accounts we found a central tension between positions that echo co-productionist perspectives highlighting how metrics are mutually constitutive with institutional arrangements and can become instrumental in maintaining the status quo on the one side, and positions resonating neo-institutionalist views foregrounding modalities of change on the other. This was illustrated when despite the initial scripts being rehearsed in many of the interviews, in the majority of the cases a discussion on the role of evidence in policy-making and the need for better metrics quickly morphed into wider discussions about the institutional practices and challenges of policy making in practice. For example, consider the emphasis on temporalities of interventions, where it was clear to the authors that these were not issues that were resolvable through better indicators or improved metrics. In other words, the issues with developing a 'nexus' perspective and using 'nexus' metrics are not information deficit problems but speak to wider issues of institutional structures and cultures, reflecting how the 'tidy' concept of metrics quickly become 'messy' compromises (cf. Wolf and Gosh, 2019 forthcoming). The establishment of the water-energy-food nexus as a legitimate policy-objective within a given institutional setting in need for quantification and governance therefore needs to be studied as a process that is interactively shaped by actors from various institutions. Therefore, our findings support the widely observed phenomenon in the wider science and technology studies literature that metrics and evidence aren't really neutral or technical objects, but actors within a political and normative setting (Merry, 2016; Rottenburg et al., 2015; Espeland and Stevens, 2008).

Our study has uncovered how interviewees employ alternative storylines and thereby challenge dominant scripts. Most notably the actors who call for increased attention to the interlinkages between different policy areas and different kinds of evidence are usually looking for ways to challenge established narratives or scripts. The legitimacy of storylines is thus closely related to what one interviewee called 'eye-opening evidence'; which returns us to the script about the need for new metrics to contest existing quantifications, despite the fact that new evidence is unlikely to achieve traction when competing with evidence that confirms existing scripts (see Boswell, 2018 for example). Therefore, any search for new methodologies and more 'convertible' indicators needs to be set in the wider context of how these might be used (or ignored) in the institutional setting. Furthermore, deeper reflection is needed regarding the conditions under which the existing attempts at developing metrics for policy interlinkages might get first awareness and then use within the European Commission.

Our contribution is to show how both lenses on metrics as part of governance arrangements (co-production and new institutionalist) can co-exist and are negotiated. Our empirical examples show that producing and maintaining legitimacy is closely tied to particular ways of working within the Commission and to what has been described as identity or boundary work in regard to scientists' practices (Gieryn, 1999). These boundaries, often labelled 'silos', are constantly worked on in policy making processes. Epistemic challenges of working on trade-offs and interlinkages thus become organizational challenges of aligning different policy objectives. These boundaries are described e.g. in terms of 'portfolios' that people tend to be very protective about. They relate to institutional and group identities that bind together legitimate policy aims and also disciplinary and methodological preferences. As such they are likely to be premised around the struggles to create, maintain and protect legitimacy (Turnhout et al., 2015; Kraft and Wolf, 2016). The narratives about working across, or breaking down, silos within the European Commission remain a future research topic that deserves more attention in the discussion of how nexus approaches could be implemented.

More research is needed to understand the mechanisms through which negotiations about ownership relate to the stability of certain narratives (scripts or parables) at the expense of alternative ones (storylines). This relates to the broader issue of the difficulty of change, which runs as a thread to most of our empirical material; and is a common theme in policy studies (Waylen et al., 2015; Lindblom, 1979). From a narrative perspective, the question then is how to challenge dominant narratives or scripts and how to initiate change within an institution like the European Commission.

7. Conclusion

This paper has illustrated, using empirical data drawn from interviews with staff in various EU institutions, that the water-energy-food nexus is also a governance problem. Exploring the role of metrics in governance illustrated that two approaches (co-production and neo-institutional) co-exist as frames for sense-making in the accounts of EU staff and are constantly negotiated. Sometimes existing methods, indicators and metrics were not suitable to 'open the eyes' of policy-makers to the need to govern the nexus more effectively because of problems of convertibility and missing data. Such arguments for the need for new and/or better metrics was positioned in a conventional rational-linear model of evidence-based policy-making. However, our data were full of challenges in developing and using metrics that illustrate the institutional barriers that influence whether and how metrics help to open up new spaces for governance. Therefore our research contributes to debates on how quantification is used in governance by showing how both framings are valid ways to understand the situation. The juxtaposition of the search for new metrics with these age-old institutional challenges is both ironic and illustrates parallels with other scholarship on the implementation of indicators intended to transform thinking (e.g. sustainability). The use of narratives as scripts, parables and storylines has added a novel twist to these debates between co-production and neo-institutionalists.

Furthermore, this work confirms recent scholarship on the nexus that argues the nexus is a governance issue not just a technical problem, while adding a new perspective from within a complex administration working at the European scale. Therefore, we argue that the nexus governance challenges should not be understood as 'mere' information/indicator deficits, the actual challenges lie in the relationship between metrics and the political and cultural practices of the institutions themselves.

We recognise that our data set, whilst rich and drawn from a broad purposive selection, may not reflect all positions on this topic within the European Commission; and the interviews only record the individuals' thinking at that moment in time. Our analysis has focussed on a narrow selection of the available themes arising from the data; and there is much else to discover. In future work we intend to return and advance the emerging insights into 'silo working' to better understand where and by whom the nexus might be governed within the existing EU institutions. Why does this matter? These debates start to unveil the more complex and messy realities of the politics of quantification and knowledge-in-use and also illustrate the risks as well as rewards for policy makers seeking to govern the water-energy-food nexus.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrurstud.2019.08.001.

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